Track Report

The Journal of Pandrol Rail Fastenings 2009

Contents

DIRECT FIXATION ASSEMBLIES

PANDROL FASTCLIP

PROJECTS

Front Cover: PANDROL FASTCLIP installed on high speed tracks on the Hefei to Wuhan Passenger Dedicated Line in China.

Back Cover: Pandrol SFC Baseplates installed on CRTS1 Slab Track in a tunnel on the Shijiazhuang-Taiyuan Passenger Dedicated Line in China.

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Pandrol and the Railways in China

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Junxun WANG, Chief Engineer, China Railway Construction Co. No. 22, P. R. of China

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.

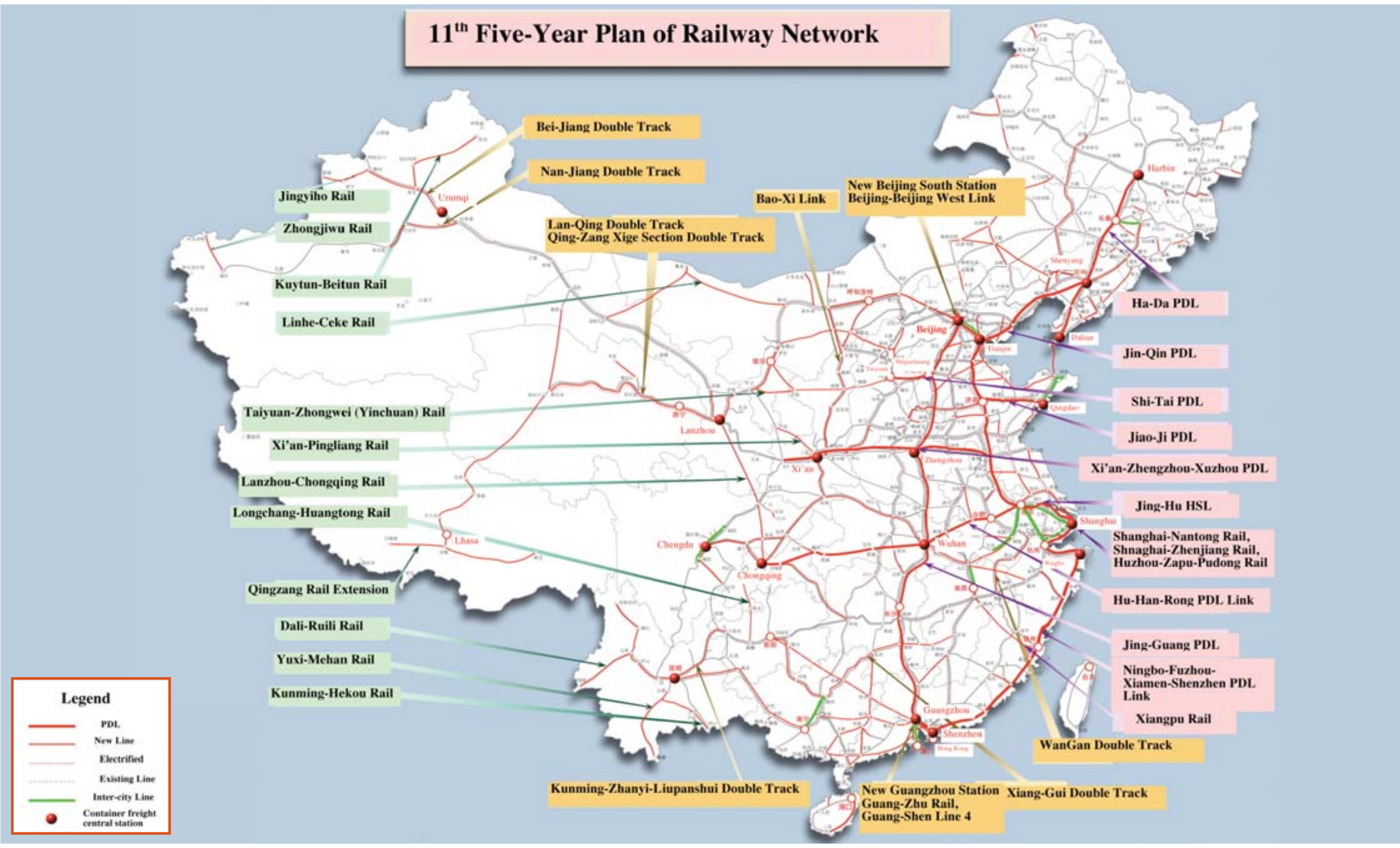
Four north-south lines: (PDL)

- 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‰ (Up Track) 18‰ (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	

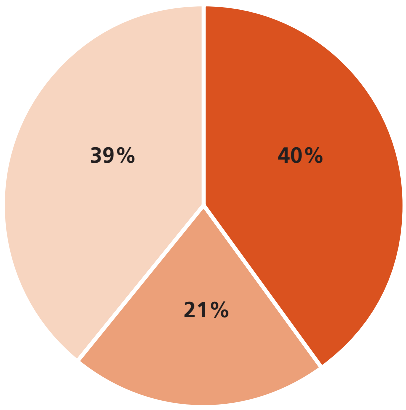
Construction of the new Passenger Dedicated Link (PDL) from Shijiazhuang to Taiyuan began in 2005. This PDL has been designed for an initial operating speed of 250km/h, which will be increased to 300km/hr after several years' operation. Unusually for a PDL, some freight traffic will also be allowed on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

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.

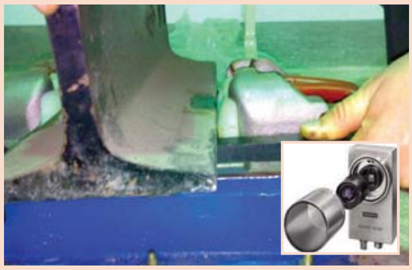
2. The baseplates were fitted to the slabs in the 'neutral' position.

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.

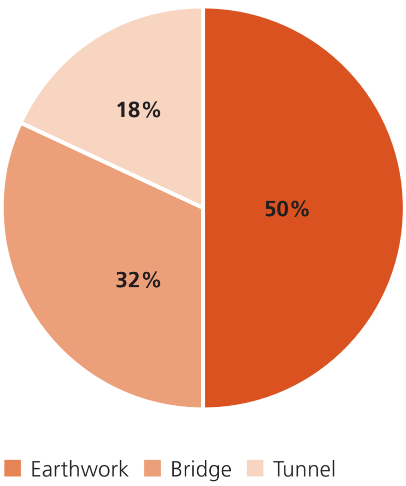
As with the S-T PDL, the initial line speed will be 250km/hr, increasing to 300km/hr, with a maximum axle load of 25 tonnes.

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%o	
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.

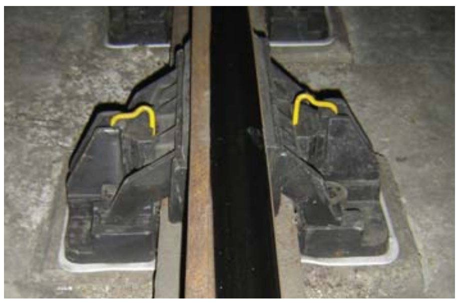
Pandrol's VANGUARD system delivers an assembly with both very low vertical stiffness and minimal rail roll and delivers exceptional vibration reduction performance at a much lower cost than floating slab.

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

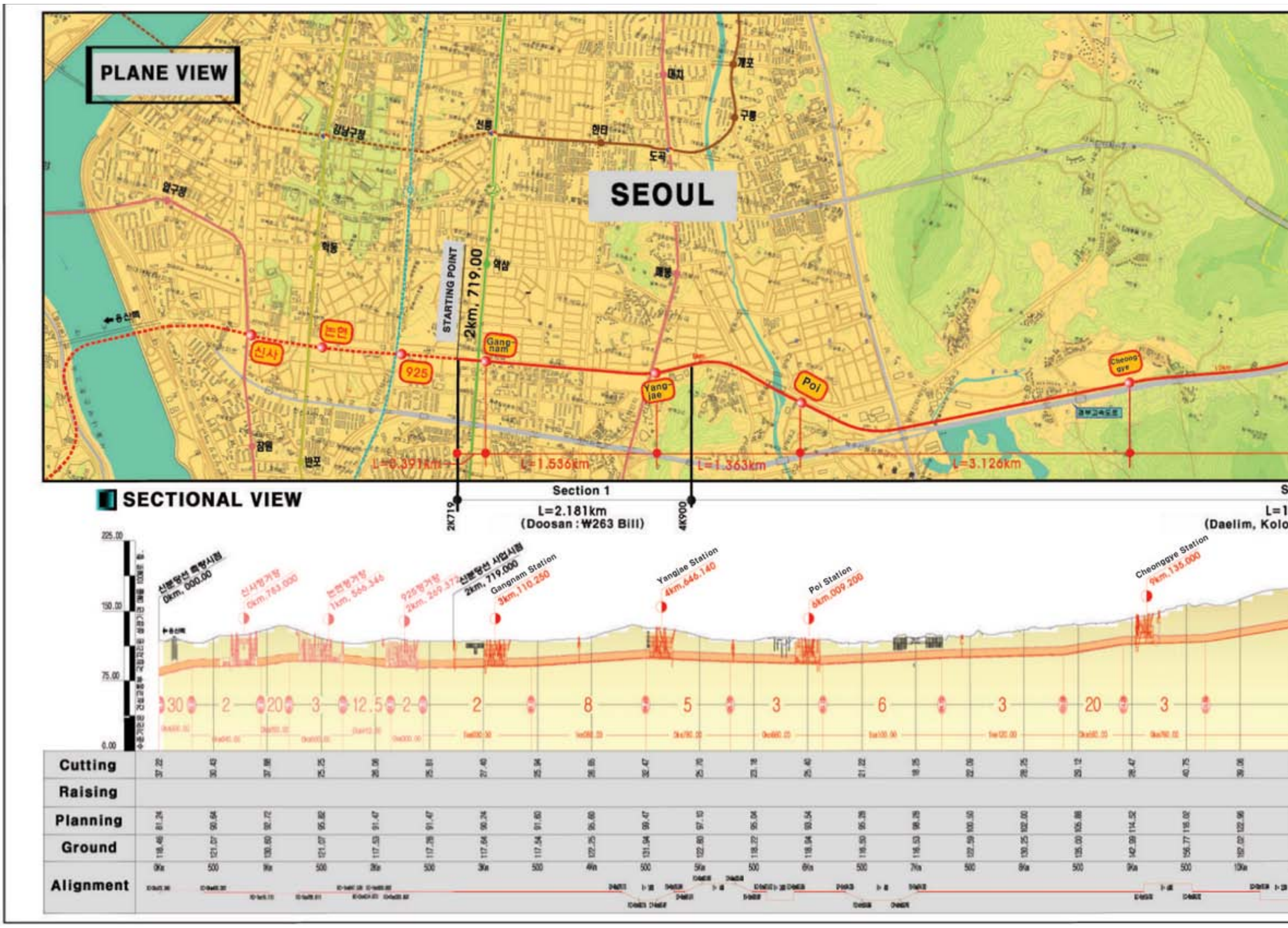
Korean Metro Shinbundang Project

The Pandrol VANGUARD system is gaining widespread recognition for its excellent performance in controlling ground vibration. The system is now being installed all over the world, and has recently been adopted by the Korean Metro Shinbundang Project.

	in	Phase I	Phase II	Total
Dual Track Construction	Km	20.721	18.491	39.212
Concrete Pour	m^2	21,993	21,192	43,185
Vanguard System	set	7,358	6,926	14,284

The Shinbundang project covers the construction and operation of a dual-track railway connecting Gangnam, Seoul and Bundang, in the south-east suburbs of the capital city. 'Bundang' is a new town that was built on the south-east outskirts of Seoul in the early 1990s, and 'shin' simply means 'new' in Korean, so combining the two gives the project its name, meaning 'New Bundang' line.

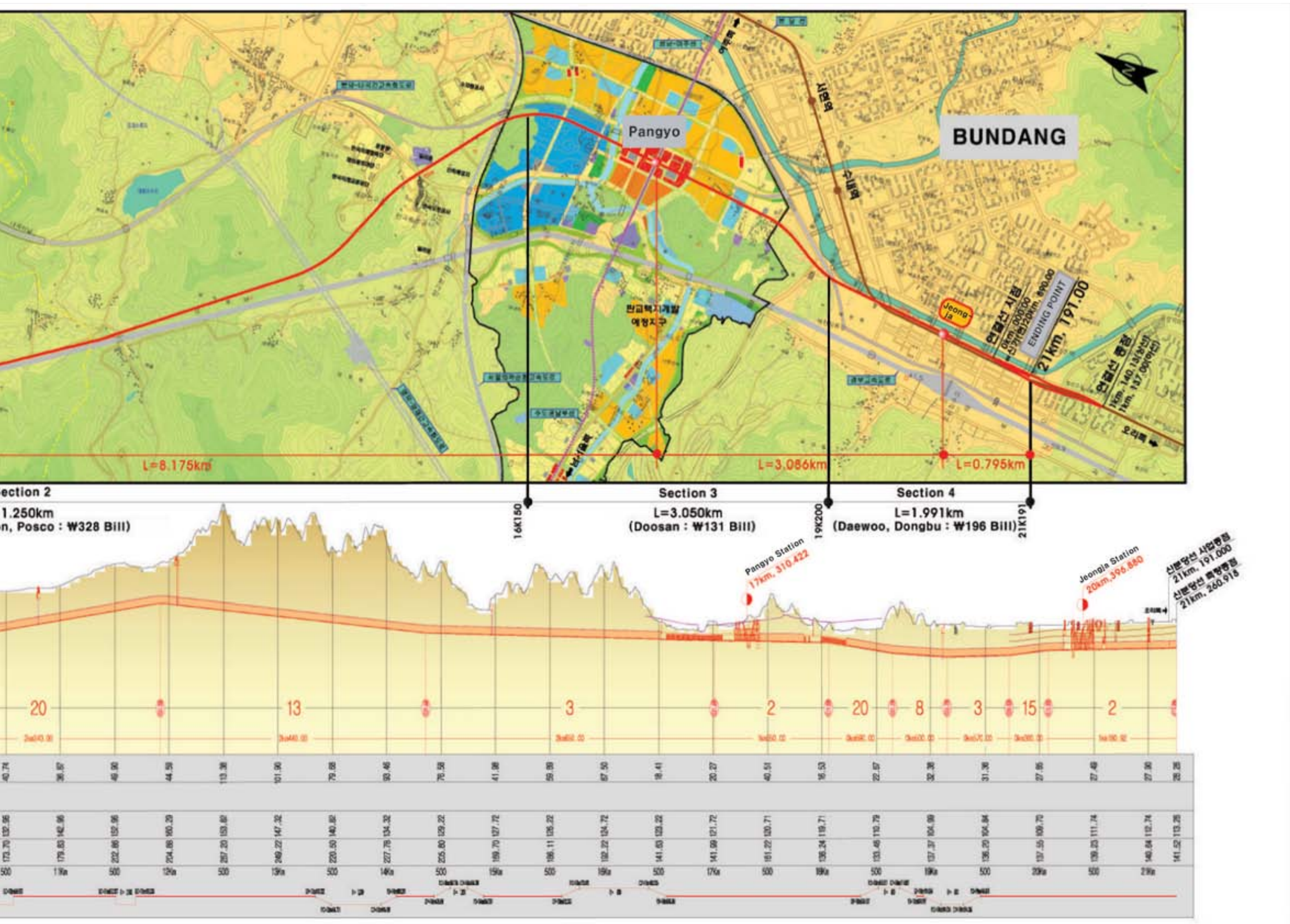
Bundang has become known as a popular residential area, giving easy access to the Seoul Gangnam district, the busiest business and



Map showing route, distance and depth of tunnel commercial centre of the nation. The new town rapidly gained in popularity and it has been fully occupied since the start of the new Millennium. However, new residents continue to be drawn to the area, and the demand has not abated. It was decided by the government to build another new town, to be called 'Pangyo', immediately adjacent to Bundang. It was therefore necessary to provide an effective transport system to cover not only the expanding population of Bundang, but also for the new residents of Pangyo.

The Shinbundang Line is being constructed using the BTO (Build-Transfer-Operate) model, which means that ownership will revert to the nation at the completion, while the concessionaire Shinbundang Railroad Co., Ltd operates the system for 30 years. The Shinbundang Railroad Co., Ltd is a consortium of 7 companies, including Doosan Construction & Engineering Co., Ltd.

Track with VANGUARD fastenings prior to concrete slab pour



VANGUARD assemblies pre-assembled on the rail complete with anchor fastenings

The construction of the line commenced in July 2007 and is scheduled to be completed in September 2011. It is a rapid transit system with a maximum operating speed of 90km/h. There will be 6 stations between Gangnam and Jeongja. It will take 16 minutes to ride the total length of 18.5km, on driverless, fully automated 5-car trains. Trains will run 312 times a day at 8 minute intervals and at 5 minute intervals during rush-hours.

The Shinbundang track will be constructed with concrete slab throughout, including all turnout sections, so it was essential to have an effective vibration attenuation system.

The problem faced by the design team was that the existing track system specified would not meet the reduced noise and vibration requirements for the areas of track directly below new residential buildings. Excluding costly floating slab, the Pandrol VANGUARD system was the only system that could reduce noise and vibration to the required level of 55 dB and below in this residential area, over a length of approximately 2km and involving 14,284 baseplates.

Following the selection of the Pandrol VANGUARD system, a small party of engineers from KTRC and the Shinbundang project team visited the Pandrol Development Laboratory in Nottinghamshire in the UK, to approve the system and finalize the track build method. Pandrol VANGUARD installations on the Shinbundang line will consist of 14,284 units over 2 phases over the next 2 years.

The first installation of the Pandrol VANGUARD system was made on June 30th, 2009 near Pangyo station. The particular configuration that is being used on the Shinbundang line project is a standard 4-hole Vanguard baseplate for direct fixation on to a stage 2 fixed concrete slab, using bolts into cast-in inserts. The build method used on this project is a so-called top-down construction "plunge" method, described below and similar to that used to install Pandrol VANGUARD at St

Concrete Slab being poured

Pancras station in London. The baseplates are first pre-assembled on to lengths of continuously welded rail. These sections are lifted into position and set to line and level using the existing design of track-adjustment system jigs.

Due to the location of the Pandrol VANGUARD track sections within the tunnel and the distance from the construction access point, the concrete contains a greater proportion of water than usual to allow it to be pumped to the required area. It was feared that the effect of the high water content could be that if the concrete were simply to be poured directly under the Pandrol VANGUARD baseplates, then moisture exuded from the concrete could form voids beneath the baseplates. Therefore, the "plunge" method has been adopted. The whole track is raised an additional fixed 5mm above the final poured concrete datum level. During the concrete pour stage, the final concrete level is obtained, and top surface then floated flat to the required surface finish. The concrete is monitored directly after the pour stage to assess the amount of water separating from the concrete top surface. Any surface water is removed prior to the complete track section being lowered by the 5mm initial offset into the still-wet concrete slab. In this way the required track height is achieved while removing trapped water and avoiding voids beneath the baseplates.

After the concrete had set for 28 days to obtain full hardness, the anchor bolts were fully torqued to the required 120Nm ± 20Nm (maximum limit 150Nm), and any final gauge adjustments made.

The project now foresees a second installation of the Pandrol VANGUARD system towards the end of 2009. With these further installations of VANGUARD, the residential areas of Pangyo new town will benefit from a high-performance system to control ground vibration and the resulting secondary noise. ■

VANGUARD assemblies are protected during the concrete pour to prevent ingress of concrete into the fastening

Track after concrete pour: making the final height adjustment

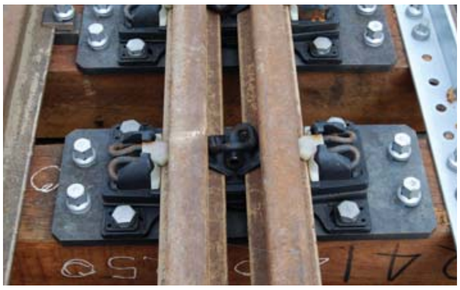
Port River Expressway Rail Bridge – Adelaide, Australia

CUSTOM DESIGNED PANDROL VIPA-SP BASEPLATE FOR DUAL-GAUGE APPLICATION.

A bascule rail bridge spanning the Port River in Adelaide, Australia was officially opened to rail traffic in June 2008. The dual-gauge track on the bridge has been installed using Pandrol VIPA-SP FASTCLIP baseplates to attenuate vibration and reduce noise from the structure in this urban location.

This was the first time that the VIPA system had been adapted for a dual-gauge configuration. Special baseplates were designed and tested by Pandrol Australia to meet the requirements for direct fixation and the track gauges of 1600mm and 1435mm. Due to space constraints, an 'e' clip was used between the two rails. Standard VIPA-SP baseplates were used on the common rail.

At specific locations, there was a requirement for the VIPA-SP baseplates to be fitted with Zero Longitudinal Restraint (ZLR) FASTCLIP fastenings to allow the rail and bridge to move independently and so minimize the stresses in both the rail and the bridge deck.



View of Dual Rail VIPA-SP Assembly with 3rd Rail Installed and 'e' clip fastening

ALIGNMENT

The track section on which the VIPA-SP baseplates have been installed is 1010m in length and consists of two curves of radius 385m (30m transition length and with 50mm superelevation), separated by a 57m tangent on the bascule bridge span. The vertical alignment has a maximum allowable rising grade of 1 in 70 (1.429%) up to the bascule section. Here it passes through a 1450m radius vertical curve on the summit before running down at a grade of 1 in 9.

View of the Bascule Rail Bridge with the adjacent Bascule Road Bridge

View of the bridge approach to the Bascule section with the mitre joint in the foreground

TRACK CONSTRUCTION

On the concrete viaduct sections, a 'top down' construction method was employed to install the track at the designed alignment. The 'Iron Horse' system was used to align and level the rails - with the VIPA-SP assemblies attached to them - before pouring epoxy grout to fix the baseplates to the concrete slab. Anchor bolts were grouted into holes drilled in the slab.

RAIL MOVEMENT JOINTS

The bridge design required four rail joints, in conjunction with the ZLR fastenings, to prevent excessive loads being transferred between the rails and the bridge due to differential thermal expansion.

Two mitre joints are provided at the bascule bridge. These were designed by CMI-Promex and feature a short length of manganese steel profiled to provide a ramp over the gap in the rails. The mitre is bolted to a machined rail web and is located during closure by guide plates that ensure alignment. Proximity switches, which are a critical control point in the bridge operating system, check vertical closure of the mitre.

A special design of lapped-mitre had to be prepared for the other two rail movement joints, because of the specified movement of 200mm and the restricted short length of tangent track in which to locate them. The lapped-mitred joint provides continuous support for each wheel across its whole operating range. The joint rails are supported and guided by rail-guides mounted on canted baseplates. These support arrangements were designed to maintain adequate track stiffness through the discontinuous rail at the joint.

View of dual rail VIPA-SP assembly on lift up bridge span without 3rd Rail

View of track on Bascule Bridge section

Iron horses used to level and align track
Prior to grouting of VIPA-SP assemblies

View of mitre joint

BASCULE BRIDGE DETAILS

The railway bascule consists of a through-steel box-girder superstructure. This was required because of the limited clearance between the top of the rail and envelope of the channel. Each is a welded steel box girder 60.5m in length, with 47.25m from bearing to bearing. The girders vary in depth from 2.9m in the main span to 4m deep through the counterweight. The deck is supported on two bascule girders.

The counterweight required to balance the rail bridge is approximately 460 tonnes. The single leaf bridge rotates about and is supported on two trunnion-shaft assemblies, one mounted in each bascule girder. Each trunnion-shaft is simply supported between two plain bronze sleeve bearings. The bridge is operated by drive machinery located beneath the track level. A 75kW (100hp) span motor has been selected to operate the span in normal conditions, through a 384:1 reduction ration gearbox. The machinery is also equipped with an 18kW (25hp) auxiliary motor that is operated by an independent electrical supply system to provide complete redundancy. In the event of an electrical supply failure, a back-up generator is located on site. The bridge-operating machinery consists of a primary reducer, which is coupled directly to the main pinion shaft. Each main pinion shaft is simply supported between two spherical roller bearings. The main pinions mesh with rack segments - which is the means by which rotation of the span is driven - mounted to the bottom flanges of the railway bascule girders. Two drum brakes, mounted on the motor shafts, provide braking for both bascule spans. To secure each span in the seated position, lock bars are driven by machinery mounted at each rest pier to a receiving socket located at the toe of each bascule. The actuator for each leaf is remotely operated during normal operation, but is also equipped with a manual hand crank for emergency operation.

View of Bascule span

FIXED BRIDGES

There are three types of fixed bridges – steel box girder with reinforced concrete deck for 60m spans over water; pre-stressed concrete box girders with concrete deck for 40m spans for high level bridge over land and pre-stressed concrete planks with concrete deck for 10m spans at low level. The bridge sits on reinforced concrete columns, which have piled foundations.

The bridges are conventional structures, with the exceptions that in order to transmit emergency braking forces to the ground, 'lock up devices' (LUD) are fitted to nine piers. These devices, typically used in earthquake prone areas, are silicone filled two-way pistons that have a small hole to allow gradual movement as a result of temperature changes. However, under shock loading the viscous silicone filler is unable to pass from one side of the piston to the other, effectively locking the girder to the substructure. ■

Pandrol, Vortok and Rosenqvist: Increasing Productivity During Tracklaying

PANDROL FASTCLIP was the world's first fully captive, self-tensioning, resilient rail fastening. It is delivered to the tracklaying site pre-assembled on the sleeper, eliminating loose component distribution and handling on the track. The underlying principle of the PANDROL FASTCLIP is a 'switch on/switch off' one. It is a 'total' system - once the sleepers are laid and the rail installed, the clip is simply pushed onto the rail by means of a simple 'drive' action. For de-stressing, the rail is quickly and easily released. The system is 'switched off' leaving the clip in a parked position, with all the components remaining captive on the sleeper.

This singular development in rail fastening technology has changed the way in railway track is laid, de-stressed and maintained by enabling contractors to automate the entire tracklaying operation and thus take advantage of the associated cost and time savings.

INCREASING TRACKLAYING PRODUCTIVITY

The next stage was to look for areas where tracklaying methods could be improved further. Pandrol's vision is to offer a system which can offer significant savings not only in labour, but in valuable and costly possession times. Working with two Pandrol subsidiary companies, this system incorporates:

- the pre-assembled PANDROL FASTCLIP rail fastening,
- high output mechanised installation equipment from Rosenqvist Rail
- stressing rollers from Vortok International ...which working in combination offer a unique system for the highly efficient installation and de-stressing of track.

VORTOK INTERNATIONAL

Vortok International joined the Pandrol group in 1991 and has developed a reputation as an innovator in the design and development of products offering significant benefits through the reduction of track possession time and the improvement of work practices and safety standards.

Vortok's latest development, the Vortok Stressing Roller (VSR), assists in the rail stressing operation, which ensures that the rail is safe both in extremely hot and in bitterly cold weather. It replaces less sophisticated

Vortok Stressing Rollers

Track Renewal Train working on Network Rail

Vortok Stressing Rollers in track

techniques which require three different pieces of equipment - an under-roller, a side-roller and a rail raising device. The VSR combines the functions of all three of these pieces of equipment in one unit, resulting in savings in labour, time and therefore costs.

In a conventional stressing procedure, an operator uses a jack to lift the rail from an unclipped sleeper. A second operator inserts the under-rollers before the rail is lowered back into position. In addition to the time and labour requirements for these operations, the procedure itself is open to risks, such as hands being trapped under the rail when the under-rollers are being placed, or the roller itself being damaged when the rail is lowered.

The VSR simply drops into place and self-locks onto the PANDROL FASTCLIP shoulder housing. The roller is then rotated into the 'raised' position and the installation is complete – all accomplished in under ten seconds. The action of raising the rollers is very easy and requires little exertion on the part of the operator. The function of rollers during the stressing operation is to minimise friction and to ensure an even distribution of stress along the length of the rail. This is achieved by reducing the coefficient of friction using high quality roller bearings.

VSRs combine a simple raising function with a very low friction contact bearing under the head of the rail. Additionally, the life expectancy of a VSR is many times that of conventional under- or side-rollers. Over the lifetime of the equipment, a cost saving in the region of 75% can be achieved, and fewer rail breaks at the weld occur thanks to the reduction in localised tension, thus offering additional savings. More importantly, with track possession times becoming increasingly restricted and costly, the time savings achievable using VSRs are extremely valuable. A typical saving is around 90 minutes in the preparation of the rail prior to stressing and welding, with a further 60 minutes being saved in returning the rail to a serviceable condition. The VSR brings unprecedented levels of performance, safety and efficiency to the re-

Rosenqvist Handycliper

stressing process. They are now in service in the UK, South Africa, Sweden, Denmark, France, Germany, Australia, Brazil and the USA.

ROSENQVIST RAIL

Rosenqvist Rail AB are specialists in the design, manufacture and marketing of high production machinery, equipment and working processes for the construction and maintenance of railway track.

On 1st December 2008, the company became a fully owned subsidiary of Pandrol International Limited.

Rosenqvist Rail AB was established by Anders Rosenqvist in 1994, who at the time had an assignement for the Swedish State Railways to upgrade part of the Swedish East Coast Line.

Whist developing his excavator, he realised the enourmous potential for efficiency improvements in the construction and maintenance of railway tracks. This led him to develop new methods and to design various equipment with the aim of speeding up and improving productivity of work on the railways.

The knowledge of practical track work that Anders and his team has acquired since then has been successfully transferred into continually improving methods and equipment for the benefit of the railway industry.

The company is based in Hudiksvall in Sweden, from where it carries out all of the research and development and prototype work that goes into the design and manufacture of high output equipment for the mechanised installation and extraction of rail fastenings.

Before joining the Pandrol group, Rosenqvist had already worked closely with Pandrol's engineers to develop a range of machinery to install PANDROL FASTCLIP rail fastenings.

The Handyclipper is manufactured as a versatile hand-held tool for smaller installations or spot maintenance. The product consists of a power unit and two different working tools – an installation tool (either standard or heavy duty) and an extraction tool.

The power unit is supported by a wheel which sits on the rail to relieve the operator from the weight thus preventing possible injury. By design, the machine raises the sleepers by up to 10mm when installing the fastening. Installations ratges of up to 10 sleepers per minute are achievable.

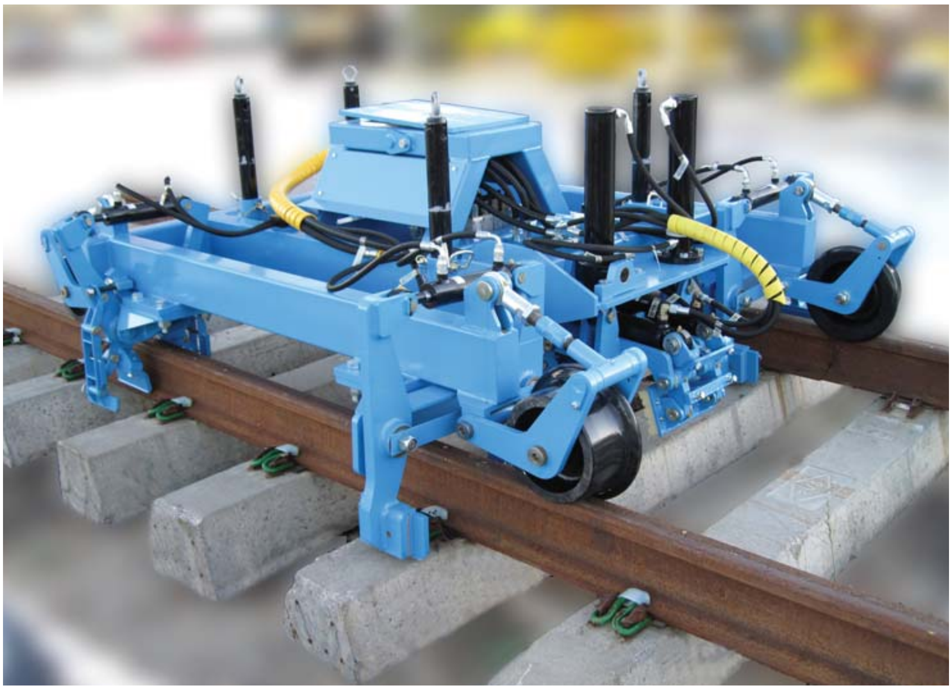
The Rosenqvist CD400 clip driver is designed for use with a road/railer vehicle that can supply hydraulic power to the operating unit. The clip driver can both install and extract FASTCLIP fastenings and can be combined with accessories for raising low-lying sleepers if necessary.

A further option is the possibility to equip the unit with sensors for automatic fastening, which further increases productivity. The sensor detects the clip, activating the installation action automatically.

The unit is capable of achieving installation rates in the region of 40 sleepers per minute.

The most recent development demonstrates how far the company has progressed in terms of increasing productivity in the installation of FASTCLIP fastenings.

The Rosenqvist CD500 Hi-Output clipping machine is a self-propelled machine that uses a pincer method to insert or extract four FASTCLIP fasteninings at a time. The clipping function can operate, at choice, in manual, semi-automatic or fully-automatic modes, and



Rosenqvist CD400 Clip Driver

CD400 clip driver hydraulically powered by road/railer

Rosenqvist CD500 hi-output clipping machine for Fastclip

in the latter mode, the machine can clip up fastenings at a rate of 70 sleepers per minute, with no intervention by the operator.

The CD500 has an on and off-tracking system that enables it to 'walk' on and off the track using hydralically powered legs. An advanced computer-based control system means that this feature can be activated either by the operator on board, or remotely from the ground.

Once on the track, an electrical back-up hydraulic system allows the machine to off-track again in the unlikely event of engine failure.

The CD500 is also fitted with an automatic avoidance system, which prevents it from striking objects such as fishplates or welds in the rail and a rail lift feature, to assist during destressing.

Additional optional extras include a sleeper lifter, to lift low lying sleepers. This also enables lateral adjustment of the sleeper of up to ±35mm.

Versions of the CD500 are currently operating in the UK, USA, Australia and France.

MAJOR RAIL PROJECT IN NORTH AMERICA

In the USA, a modified CD500 machine is currently in use installing Safelok III rail fastenings, which work on the same principle as FASTCLIP. Concrete sleepers pre-assembled with Safelok III fastenings are delivered to the track site, with the clips in a parked position, ready to be installed by machine.

Balfour Beatty Rail, Inc. is about to finish the rehabilitation of 68 miles which is the major portion of the 90 mile project on Kansas City Southern's route from Victoria, Texas to Rosenberg, Texas. When this line opens this year it will ease congestion and shorten the KCS Texas to Mexico route by 70 miles. This newly reconstructed rail line will have new ballast, concrete ties, rail and Pandrol Safelock III clips. Balfour Beatty is the main contractor and accepted a very aggressive production schedule that started in February and completed the 90 miles in June. Jose "Pepe" Garcia, Balfour Beatty's Area Manager, stated: "One of the most challenging portions of this project is the rail de-stressing job, we needed to complete 65 miles in 60 days. We had a tough time meeting this production rate with the machines we had clipping and de-clipping, until the Rosenqvist CD500 clip machine arrived". The Rosenqvist CD500 was brought into the project by Mark Meyer, Balfour Beatty's Director of Equipment U.S.A. in February. Since the machine has been on the project they have been able to meet the production rates required, de-stressing and welding over a mile a day 7 days a week. Mark Meyer was quoted saying, "The Rosenqvist CD500 clip machine was the key to our success in meeting the high production demands the de-stressing portion of this project required". Mr. Meyer went on to say that since "Esco Equipment Service Co. (Rosenqvist U.S.A. distributor) put the machine in service and trained our operator, the machine has been very reliable. We have continued to receive service from Esco, which helped us keep the machine very productive."

When this line is finished the Kansas City Southern says it will help to bring products from Asia to the U.S. via their Mexican Pacific coast ports.

These three components - the PANDROL FASTCLIP rail fastening, Vortok Stressing Rollers and Rosenqvist's high-output track machinery - have placed Pandrol in a unique position to offer a system which offers maximum time and cost savings in the fields of tracklaying and maintenance. ■

Rosenqvist CD500 hi-output clipping machine for Safelok 3

PANDROL FASTCLIP on the Gaziantep Light Rail System, Turkey

Located in southeastern Turkey, Gaziantep is the sixth province of the country in terms of provincial centre population size. It has 2% of Turkey's total population and a population density which is 2.3 times that of Turkey and Southeast Anatolia. Within its population, 35% are working people, and 15% are students.

Gaziantep is a city with a 5000-year history. It has been home to various civilizations over the centuries, however, all of them have a feature in common; Gaziantep has always been the centre of commerce and culture. Today, it is one of the industrial and commercial centres of Turkey with an important export volume, contributing to the regional economy by marketing at home and abroad the products that it manufactures with its own resources. Developments in industry have made the province the region's centre of attraction.

In addition to its industrial zone, the city is also home to various historical and cultural monuments, such as the Gaziantep Castle in the city centre, which is notable for its splendour and history; the mosaics of the ancient city of Zeugma and the second largest museum of ceramics in the world. These attract many tourists and visitors, making a good public transportation system a necessity.

Rails are jigged to line and level

Twin-block sleepers with steel reinforcement prior to concrete pour

Construction of a new light rail transportation system began in September 2008 and will be carried out in three stages.

The line consists of 9.5km of double track, with 13 at grade stations, one depot and a workshop, which has a capacity of 31 vehicles. The line starts at Gar station, continuing on through Stadyum and University stations and terminating at Burç station.

The line will have a maximum operating speed of 50 km/h, although commercial speed will be 22km/h. Track Gauge is 1435mm.

A total of 15 vehicles will operate on the route, each with a capacity of 6 person/m2, carrying 250 passengers in total.

It was the first time the FASTCLIP system had been installed in Gaziantep. Twin-block concrete sleepers pre-assembed with FASTCLIP fastenings were supplied by Yuksel, with the installation of embedded track carried out by the contractor Borege.

The sleepers are being laid directly onto the base slab, short lengths of rail are then threaded into the rail seat, the rails are clipped up using hand tools, and then the rails jigged to line and level.

FASTCLIP FC Assembly

An excess of steel reinforcement is placed all around the sleepers and concrete is then poured to embed the sleepers.

Sleeper lifters were used to lift any low sleepers if necessary.

Overall, all parties are very happy with the way in which the project is progressing and commented on the ease of use of FASTCLIP.

The new line is expected to be completed in the first quarter of 2010. ■

Preparation of base slab

Even distribution of poured concrete

Concrete being poured to embed the sleepers

The Arad Tram Modernisation- the most environmentally-friendly means of public transport.

by Eng. Gheorghe Falca, Mayor of Arad

The town of Arad, situated in Northwest Romania, has the most extended tram network in Romania in relation to the population, namely 100 kilometres of track for 165,000 inhabitants. Tram is the traditional means of transport in Arad. The tram track coverage in Arad municipality is also very good: 17 urban routes and 5 sub-urban ones. During the year of 2007, 200 tram vehicles carried 7,362,000 passengers and the 22 routes amounted to 5 million kilometers covered.

This year, the town celebrated 140 years of public transport ,when the first horse-drawn trams were put into service on three routes. They operated until 1916. A suburban tram line was inaugurated in 1910, connecting the town to the Arad Vineyard Region, the agricultural products supply source for the town's markets. The line Arad – Podgoria was electrified in 1913, becoming the first such tramline in Romania and among the first in the world. In 1946, the electric tram was put into operation in Arad and since then, the network has gradually extended, along with the urban development.

For the last four years, Arad has invested extensively in tram transport modernization, as this is the most environmentally-friendly means of transportation and at the same time, the one the people of Arad use the most. At present, Arad Municipality is carrying out the most important urban transport project of Arad, co-financed by the European Bank for Reconstruction and Development that imply the rehabilitation of urban infrastructure on the main axis of Arad, from its Western entrance to its exit towards Timişoara.

The first stage of the project, amounting to over 30 million Euros will be completed by the end of this year and modernizes 11.765km of track and the adjoining roads. The works for the second phase of the project, starting next year, will cover 6.39km of track

The project consists of rehabilitating the

The Arad road/rail bridge

Original tracks fastened with screwspikes

1000mm gauge tram track by replacing the old, worn-out S40 rails which were fixed by screwspikes directly onto the wooden sleepers.

The rehabilitated tracks utilise a far more modern system, whereby the S49 and Ri60N rail is fixed to new concrete sleepers by the FASTCLIP FD rail fastenings. These fastenings are designed for mainly tram track and traffic conditions with lower levels of axle load, speed and curve – therefore typically suited to trams operating low or medium density operations, such as those in Arad.

This fastening system has no threaded components – anchorage is by cast-in shoulders that hold the rail at the correct gauge and FASTCLIP FD automatically sets the deflection. The shoulders are set into the sleepers during the sleeper manufacturing process.

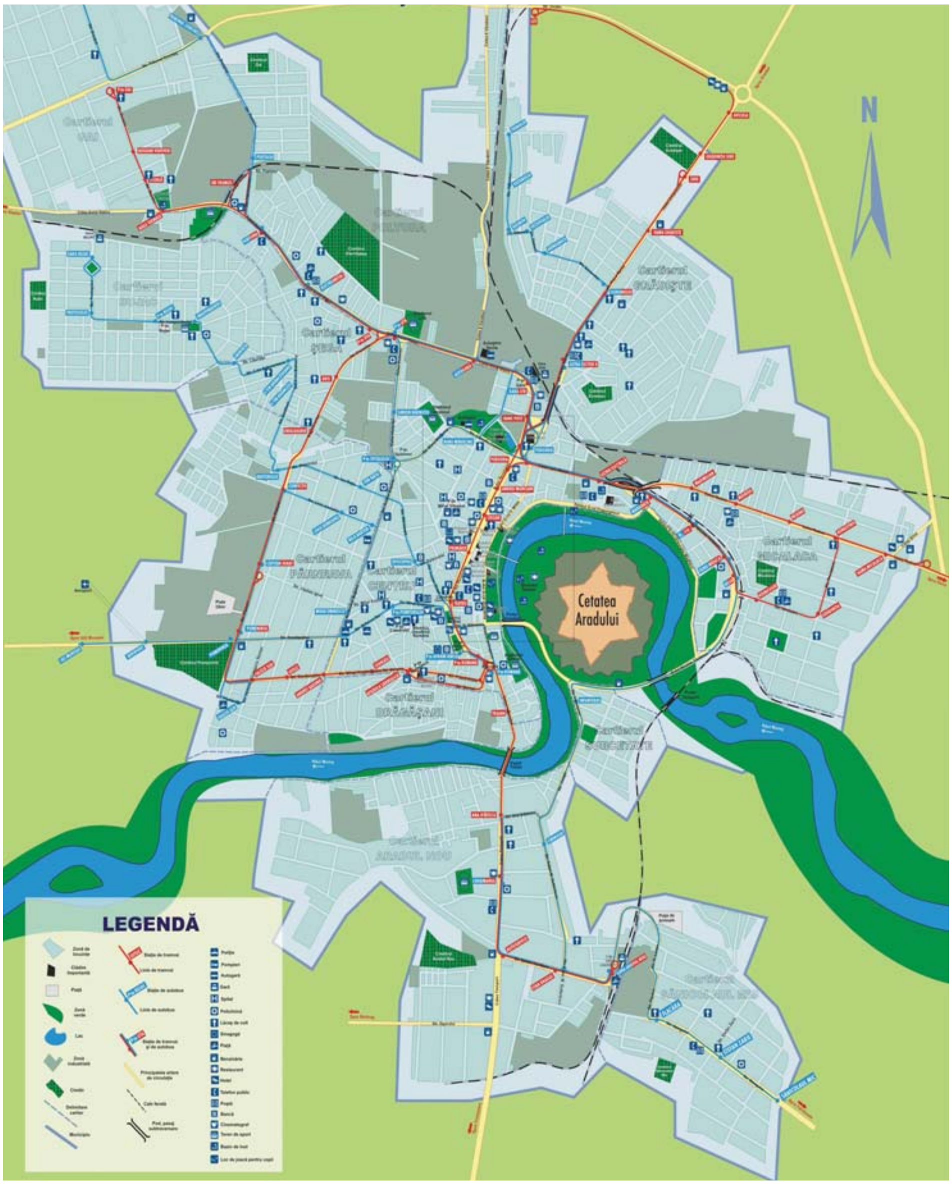
Out of the entire route length, about 75% is on concrete sleepers and the remainder on concrete slab track.

The main features of the track are:

- track gauge 1000mm
- minimum radius 50m
- uncompensated cross acceleration 0,65 m/s2
- shock co-efficient 0,40m/s3
- maximum allowed declivity 45 0/00
- sleeper spacing 0,75m
- rail inclination: 40:1 for Ri60N rail, 20:1 for S40 rail

The main features of the rolling stock are:

- static load on axle 12 tonnes



Caption here please

Modernised track with Pandrol Fastclip FD fastenings

- wheel diameter 900mm
- cart axle base 1800mm to 2000mm
- wagon axle base 6000mm to 10000mm
- utility wagon axle base 3000mm to 6000mm

The works contract for the Arad Urban Transport Project was awarded based on open public tender, with pre-selection, in accordance with the EBRD Procurement Policies and Rules.

The project required an elastic rail fastening system and based on this requirement, the Pandrol FASTCLIP FD assembly was selected by the Contractor. Tender procedures don't allow the Municipality to choose the suppliers, but we are pleased to say that the Contractor's decision meets all our technical requirements and international quality standards.

The track was mounted in accordance with the project design and the tender specifications, Pandrol FASTCLIP FD met UIC 864 norm and complies with the international standards. On the sections where the track is mounted on sleepers, the track has been de-stressed by dismantling and reinstalling it, followed by welding. This technological requirement was easily accomplished, as the dismantling and installing of the FASTCLIP FD is performed in a single operation.

This method ensures a high productivity, namely fast and easy installation and this is one of the reasons the Contractor appreciates the simplicity and the efficiency of the FASTCLIP FD rail fastening.

In 2010, Arad municipality also plan to start the works for the Old Historic Centre Rehabilitation, another important project for the municipality, financed by European Union structural funds. It includes the modernization of 1.80km of tram tracks and the catenaries in the old historic centre and also 0.4km on the "Traian" Bridge. At the same time, we intend to make an investment in rehabilitating 0.75km of tracks inlaid in the carriageway on Renaşterii Street. ■

**Eng Gheorge Falca is also President of the Romanian Municipalities Association. Mr Falca is a great supporter of the continued development and expansion of the tram network, believing that continued investment in public transport is the only way to Arad achieved its goal to have modern and less polluted public transport. Arad has received an award for the development of the local tram transport system at the Romanian Railway Gazette, and at European level it was nominated for the European Mobility Week awards in 2008 alongside Frankfurt (Germany) and Koprivnica (Croatia) on traffic issues.*

Managing the Rail Thermal Stress Levels on MRS Tracks - Brazil

by Célia Rodrigues, Railroad Specialist, MRS Logistics, Juiz de Fora, MG-Brazil
Cristiano Mendonça, Railroad Specialist, MRS Logistics, Juiz de Fora, MG-Brazil
Cristiano Jorge, Railroad Specialist, MRS Logistics, Juiz de Fora, MG-Brazil
Alexandre Bicalho, Track Maintenance Manager, MRS Logistics, Juiz de Fora, MG-Brazil
Walter Vidon Jr., Railroad Consultant, Ch Vidon, Juiz de Fora, MG-Brazil

SUMMARY

Prevention of excessive longitudinal thermal stresses in welded rails, generated by lower or higher current rail Stress Free Temperature (SFT) or Rail Neutral Temperature (RNT), is an important track maintenance and safety issue. The effective management of the Neutral Temperature in welded rails has a fundamental effect on heavy haul operations. This paper shows the steps taken by MRS and actions to reduce both rail pull-aparts and track buckling. MRS has set up a system approach to get RNT measurements on track sections, by surveying their track. This is allowing rail de-stressing to be based on the database of real time RNT profile measurement data as well as rail de-stressing control and checking systems. The main goals are to reduce rail pull-a-parts, track buckling and train delays, providing alerts against potential hazards to rails and the monitoring of rail joint condition.

Figure 01 MRS 136 RE rail section pull-a-part

INDEX TERMS

Safety and Monitoring; Track Maintenance Technology; Rail Neutral Temperature; Track Buckling and Rail De-stressing.

1. INTRODUCTION

Since 1996, the beginning of MRS railway operations, there have been hundreds of rail pull-aparts, even during mild tropical winter weather and also many thermal track buckles imposing reduced speed railroad traffic in several locations during hot tropical summer days when the risks of thermal track buckling increase.

In 2006, after a major derailment involving 32 iron ore loaded cars had occurred during a cold winter day caused by rail pull-a-part, MRS decided to invest and to look for possible preventive actions. Due to all of the buckling events that had occurred during winter and summer, it had been necessary to undertake a high number of longitudinal stress measurements. In September 2007, MRS set up a systematic approach to take RNT measurements using the non-destructive and portable equipment called VERSE® provided by Vortok International. Based on RNT measurements, the most critical locations could be selected to schedule rail thermal stress relief (rail de-stressing). These activities have allowed MRS to correct the sites where there were serious anomalies and to plan the correction of less crucial points in conjunction with other maintenance activities.

The current field measurement teams are working using three VERSE® units. They are responsible for establishing the actual RNT Profile Data and also checking the rail de-stressing history from a database of real time RNT measurement profile data. MRS's maintenance planning team provides the priority list of rail de-stressing schedules based on these track measurements.

Besides the rail de-stressing control and checking system, the results are monitored and recorded in the system.

RNT constantly changes along a given section of track due to several factors:

- Track maintenance services
- Increased railroad traffic.
- Train acceleration and braking forces.
- Locations where clips can no longer support the axle forces.
- On severe track gradients.
- Where there is rail seat erosion and the

Figure 02 MRS buckled track section and derailed car

ballast condition is poor.
- As a consequence of tamping and ballast cleaning services.

High compressive longitudinal thermal forces will be produced whenever the current rail temperature is higher than its actual RNT and the reverse also applies; high tensile forces are produced when the current rail temperature is lower than its actual RNT. High compressive longitudinal thermal forces cause buckling while high tensile forces accelerate the growth of internal rail defects and cause rail fractures, weld failures, rail joints to pull-apart and rail joint bolts to fail on cold nights. The greatest risk is of derailment. The main goals are to reduce rail pull-aparts, track buckling and train delays and to provide alerts against potential hazards to rails and monitoring rail joint condition.

Figure 03 VERSE® and RADIX

2. SCOPE OF THE PROJECT

The project consisted of introducing effective technologies and developing a methodology entirely guided by the process of measurements of rail longitudinal stress levels and de-stressing welded rails subjected to high compressive and tensile forces. The main steps of the system were:

PHASE I – RNT Surveying & Corrective Service Schedule

a) Identify the causes of anomalies on MRS track
b) Track field tests to determine the actual RNT from each track segment on MRS's network by a reliable and accurate rail stress measurement system
c) Survey RNT and stresses along the MRS track sections through measurements and monitoring
d) Provide alerts by comparing the current RNT measurements with the adopted RNT

PHASE 2 – RNT Surveying & Corrective Service Schedule

e) Introduce the methodology of planned rail de-stressing supported by a reliable measurement system
f) Provide guidance to rail de-stressing track gangs from RNT profile data
g) Monitor de-stressed track sections to provide continuity to MRS track mapping
h) Check the performance and quality of rail de-stressing track gangs by RNT measurements
i) Report the results and control actions.

3. MRS RAIL STRESS MANAGEMENT SYSTEM

MRS Rail Stress Management System is composed of several activities or steps that have resulted in the reduction of rail breaks and track buckling on MRS track:

- A contract for RNT data collection services using VERSE® units to support MRS's track surveillance
- The data analysis and organisation of RNT ranges
- The creation of a Track Stress and Temperature Surveying Map
- Work instructions to rail de-stressing services and establishment of priorities based on VERSE® measurement results
- The planning of rail de-stressing services, training of track gangs and the management and selection of most critical track segments
- Data input of work instructions into the MRS Asset Management System (ORACLE - EAM)
- Inspection, monitoring and control of rail de-stressing services by VERSE® measurements in each track section where the service was undertaken
- Use of the Result Evaluation System
- Management Reports

3.1. Technology Acquisition and Application

MRS Track Engineering evaluated several technologies available in the railway market and decided to acquire three VERSE® units from Vortok International and to develop its implementation with its own team, establish the appropriate methodology and data organisation and management system.

VERSE® (Vertical Rail Stiffness Equipment) is a portable mechanical system to provide a fast and accurate non-destructive determination of RNT through measurement of current rail longitudinal thermal stress.

This equipment is capable of measuring the actual RNT by applying a rail deflection force to a suspended rail by establishing its stiffness. For data input and collection, a RADIX computer is utilised.

3.2. Measurement Procedure

- Un-clip 30-35m (100 - 120 ft) of rail
- Elevate the rail 60mm (2.6 inches) using two spacers (each one spaced 10m (32.5 ft) from VERSE®)
- Apply vertical force (1 metric tonne) to lift rail
- Measure the load and vertical displacement
- Use load/deflection relationship to calculate RNT

Figure 04 MRS' team applying VERSE® on the track

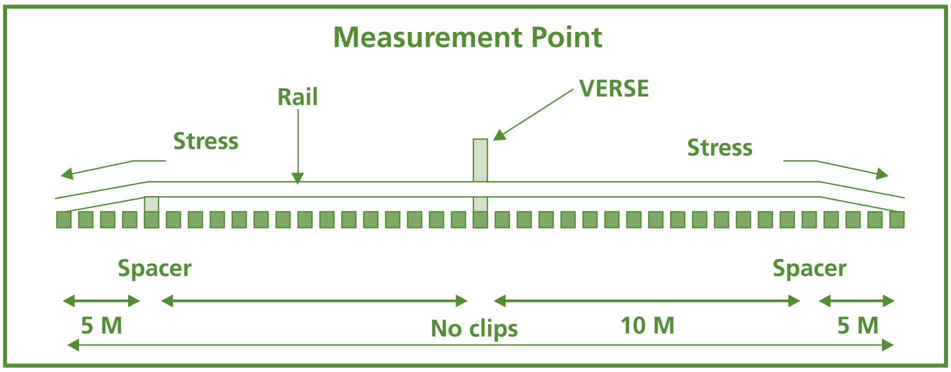


Figure 05 Schematic of rail stress measurement using VERSE®

4. RAIL DE-STRESSING SYSTEM

Rail de-stressing is a maintenance practice applied to reduce the effects of temperature changes on MRS lines with long or continuous rails, allowing more stability of track and lower internal longitudinal stresses in the rails.

4.1. Equipment adopted for rail de-stressing

The same tools are used as applied in rail replacement practice, adding hydraulic tensors, four 5kg bronze hammers, jacks, rail thermometers, stressing rollers and mechanical extensometers.

4.2. Maintenance Procedures created for MRS Track Conditions

a) Joint disassembly at the rail end (or rail cutting), releasing the end of the rails to allow their free movement
b) Un-clipping the rail 120m (half the length of MRS's CWR) to each side of the rail string from the relief joint
c) Applying hydraulic tensors and with the rail temperature below the specified neutral range, mark the rail foot and tie plates to determine the rail movement and ensure even stress distribution through the stressing length. (Note: if the rail is within the NT range, the use of hydraulic rail tensors is not required)
d) Rail de-stressing is not possible when the measured rail temperature is above the NT range (de-stressing must be scheduled to a period of the day when the measured rail temperature is below the RNT range)
e) Cleaning debris away between the rail foot and the tie-plate to allow rail free movement
f) Insert stressing rollers under the rail, spaced correctly to allow rail free movement with reduced friction
g) Adjustment of the joint gap by rail cutting or displacement to enable joint assembly or spacing to weld the rail
h) Removal of the stressing rollers and clip the rail
i) Joint assembling or rail welding
j) Removal of the hydraulic tensors after checking the stress distribution.

Checking De-stressing executed in Barra do Piral

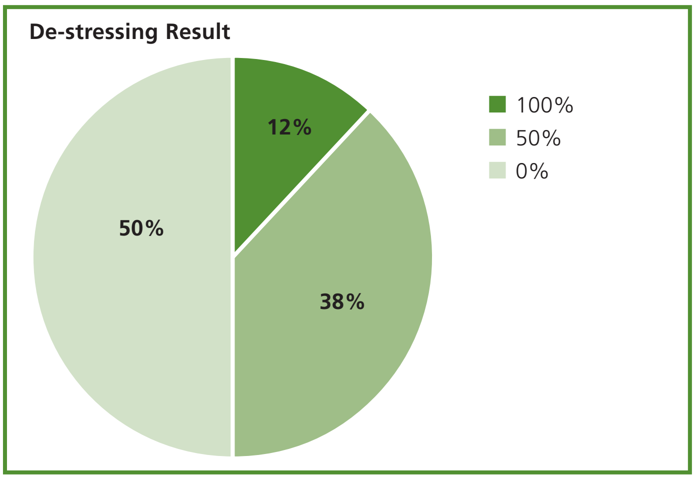
RAIL	CURVE BEGINNING	SFT	CURVE ENDING	SFT	EXTENSION	DE-STRESSING DATE	VERSE MEASUREMENT DATE	DE-STRESSING DATE
Left	073+300	27.1	073+580	23.7	280	13/09/2007	24 and26/05/2008	0%
Right	075+000	24.1	075+980	48.1	980	13/09/2007	26/05/2008	50%
Left	093+060	36.7	093+420	22.3	360	13/09/2007	08/05/2008	50%
Left	093+060	28.2	093+420	42.4	360	13/09/2007	08/05/2008	50%
Right	094+300	18.7	094+600	32.4	300	13/09/2007	9 and 16/05/2008	50%
Left	094+300	22.4	094+600	30.8	300	13/09/2007	9 and 16/05/2008	0%
Left	094+300	35.6	094+600	29.1	300	13/09/2007	09/05/2008	50%
Right	100+0650	21.2	100+420	49.2	370	13/09/2007	14/05/2008	0%

Table 01 Example of Rail Stress Measurement & Rail De-stressing Results in MRS Track

Legend

0% De-stressing non complete in the curve extension
50% De-stressing done in one curve side (rail)
100% De-stressing complete

Measure below 31°C buckling risk
Measure between 30°C and 46oC - normal range
Measure above 46°C -fracture risk



5. RESULTS

5.1. Rail Stress Measurement and Rail De-stressing Results

Table 01 shows an example of the rail stress measurement and rail de-stressing results made by track gangs that used VERSE® and rail de-stressing equipment in a short track section of MRS's heavy haul main line (Barra do Pirai – RJ).

From September 2007 to March 2009, MRS accomplished 2,000 rail stress measurements using VERSE® along 742km of rail length (31% of MRS's heavy haul lines), requesting rail de-stressing 204km of rail to prevent track buckling and rail breaks caused by longitudinal thermal stresses. 500km of rails are scheduled to be measured using VERSE® in 2009. There have been no derailments due to rail pull-aparts or track buckles since rail stress monitoring and rail de-stressing services were introduced in MRS track. In 2008, track buckling was reduced by 52% compared to 2007 and rails pull-aparts showed a 25% reduction between 2006 and 2008. Furthermore, no there have been no derailments due to these anomalies since then.

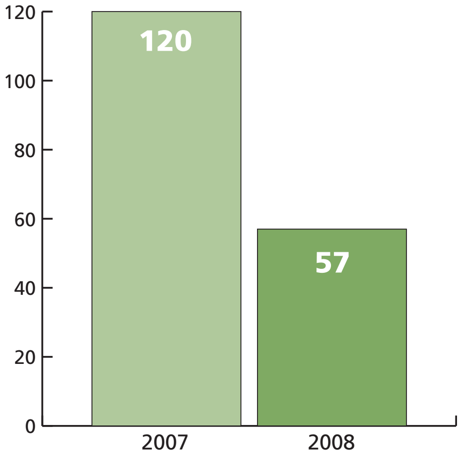


Figure 07 Track Bucking Reduction

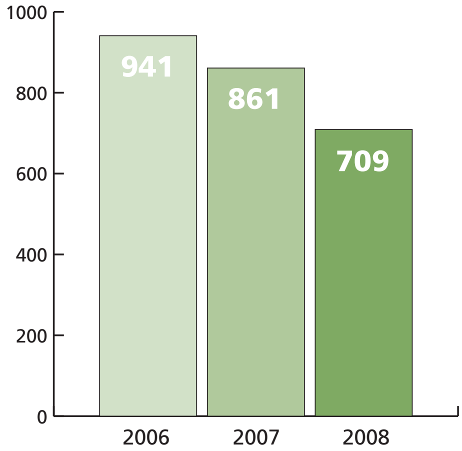


Figure 08 Rail Pull-apart Reduction

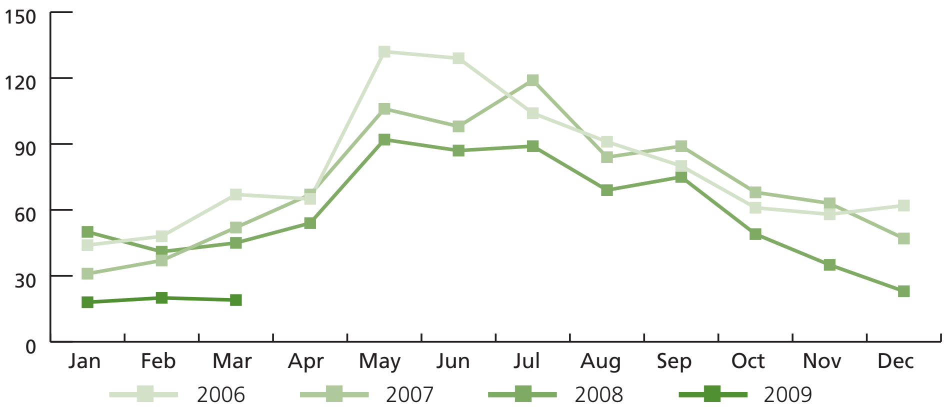


Figure 09 Annual comparative and monthly behaviour of rail pull-aparts

5.2. Status of Systems

SYSTEM	STATUS
RTN Track Surveying	Ready & installed
Rail De-stressing Planning and Executior	Ready & installed
Rail Break & Track Buckling Monitoring	Ready & installed
Performance Indicators (Rail break & track buckling reduction)	Ready & installed
Rail De-stressing Control	Being installed
Management System	In development
Interface with other MRS systems & interlinking with systems modules	In development

Table 02 Status of systems involved

6. BENEFITS EXPECTED

MRS intends to use both VERSE® measurements and rail de-stressing with the aim of achieving, as a minimum, the following benefits:

- Annual reduction of 25% of rail pull-aparts and track buckles in future years
- Track maintenance cost reduction of 3 to 5%
- Operational safety improvement
- Reduction of delayed trains
- Elimination of derailments due to winter rail pull-aparts and summer track buckling.

7. CONCLUSION

In 2008, the reduction of rail pull-aparts and track buckling was satisfactory.

Until March 2009, the levels of track buckling remained stable even in hot summer weather and its high temperatures. Rail breaks have been decreasing in comparison to previous years.

Rail management is complex and dynamic. Historically, RNT data collection was based on previous knowledge that often, could not be logically applied, rather than in a structured and organised way. It meant that when MRS acquired the VERSE® technology the main challenge was to introduce measurements as a routine part of track maintenance that informed subsequent track maintenance planning.

MRS Track Engineering established a challenging aim to provide and maintain a continuous, reliable and effective system of rail maintenance management based on effective monitoring. ■

Rosenqvist Rail's Track Renewal Clipper

Rosenqvist Rail AB have developed a new FASTCLIP clipping module that fits underneath a track renewal train.

It can be folded up and secured underneath the carbody of the train during transport. It has inductive sensors which trigger the clipping operation when it senses the shoulder of the next sleeper. The clipping tool sides on a bar and stands still when clipping up to avoid moving sleepers. It catches up with the train via a hydraulic cylinder.

As it works at the same speed as the track renewal train, the performance of the clipping module is not of significance. On its own it could probably clip up 40-60 sleepers/minute.

It can also be operated manually, for instance when checking the tool settings.

The clipping module can be used in other applications where you have a track machine as it is small and can fit into narrow spaces. The wheels have UIC profile.

The track renewal clipper was delivered to Banverket in 2008 and was successfully first used for track renewal in the northern part of Sweden.

Location of the module in the track renewal train

Sensor

Height adjustment

Clips correctly installed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