

Track Report



The Journal of Pandrol Rail Fastenings 2011

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Back Cover: PANDROL FASTCLIP installed on High Speed Tracks, China.

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Pandrol Rail Fastenings gratefully acknowledges the co-operation of all those contributing to the production of this journal and who have given permission for the use of photographs.

The technical information given in ‘Track Report’ was correct at the time of printing, but the company undertakes a continuing programme of research and development, and improvements may have since been introduced.

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VANGUARD in Singapore

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Increasingly, environmental legislation aims to control the amount of vibration energy that can be transmitted into sensitive structures adjacent to railways. Where new buildings are erected it can be the case that the structures themselves are isolated using resilient bearings. It is most common, however for the railway itself to be treated by means of resilient track supports. This is known as “vibration isolation at source”.

In tunnels on Singapore MRT, the track formation is concrete slab. Slab track has evolved considerably over the last few decades and there are numerous rail fastening options available to the track designer. Principal amongst these is the resilient baseplate, which directly anchors the rail to the correct alignment.

LOW STIFFNESS BASEPLATES

The baseplate most widely used on Singapore MRT slab track is the Double FASTCLIP (DFC) (Figure 1). It is characterised by having four FASTCLIP spring fastener clips per rail seat. Two outer FASTCLIPS fix a baseplate on a resilient studded rubber pad. Two inner FASTCLIPS anchor the rail on top of another resilient rubber rail seat pad.

As with all baseplates that utilise spring clip fasteners, there are limits to the lowest vertical stiffness that can be provided. Since the efficiency of fastener vibration isolation is directly related to low vertical stiffness, spring clip fasteners are useful to a point, but for increased vibration mitigation alternative track support products must be considered.

Typically, DFC has a vertical static secant stiffness of around 20kN/mm. In order to significantly improve the vibration performance of such a fastener, a step change in the vertical stiffness value is required.

It was on recognising the limitations of conventional baseplate technology during the 1990s that Pandrol began to work on what developed into the Pandrol VANGUARD system for control of railway vibrations. This works on

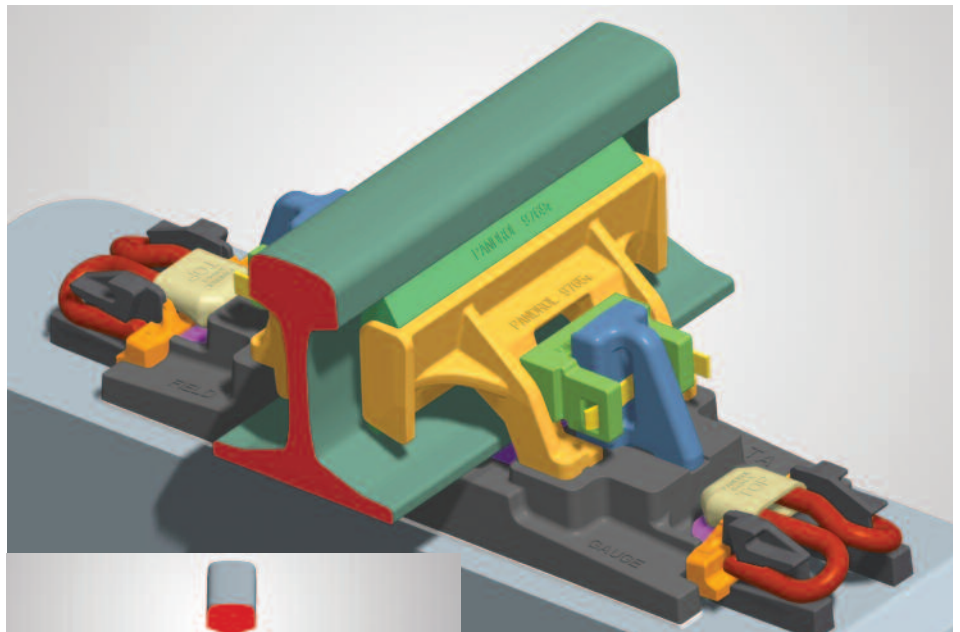


Figure 2 VANGUARD DFC Retrofit

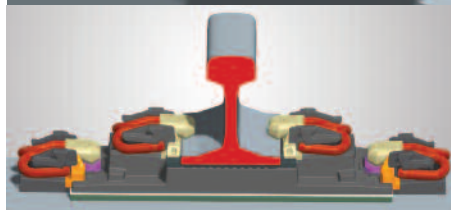


Figure 1 Original Pandrol DFC Assembly

a quite different principle to conventional baseplates, in supporting the rail under its head rather than at its foot.

The wedge-shaped elastomeric elements are compressed against the rail, so that as well as being supported, the rail is also fastened to the track foundation and maintains the required resistance to longitudinal loads. The principal advantage of the system over more conventional rail fastenings is that it allows significantly greater vertical deflections under traffic without unacceptably high rail roll. The low stiffness of the track leads to an improved attenuation in the dynamic forces generated at the wheel-rail interface, reducing the level of dynamic forces transmitted through the fastening, into the track foundation and beyond.

These elastic elements now act in shear, rather than in compression, which is the case with DFC. Natural rubber, which also provides

resilient vertical support in DFC, exhibits outstanding dynamic performance when used in the shear mode in the VANGUARD assembly. Unlike a permanently bonded baseplate, the whole system does not need to be replaced if the rubber eventually wears in time – the rubber elements can be removed and replaced in-situ.

Using this system Pandrol VANGUARD delivers a vertical static stiffness of approximately 5 kN/mm and a dynamic stiffness of around 7 kN/mm in a safe manner and without excessive rail roll. The loaded track resonance of Pandrol VANGUARD in combination with typical railway vehicles - which have an un-sprung wheel mass in the range 600-900kg – occurs in the low 20's of Hz. This means that the Pandrol VANGUARD system is effective in eliminating many railway vibration problems.

In 2008, together with the LTA, Pandrol set about designing a version of the VANGUARD system that would directly retrofit into the

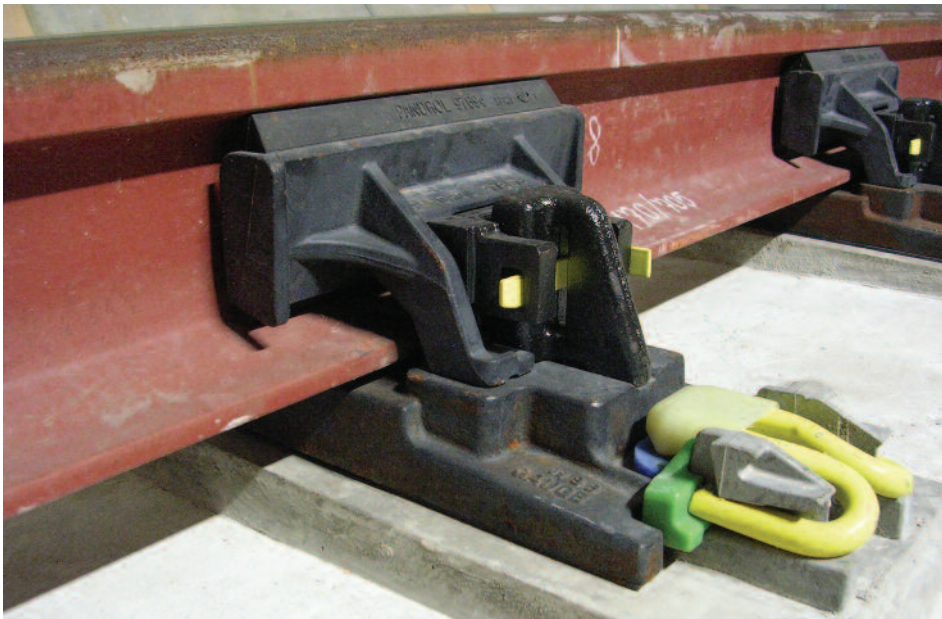


Figure 3 VANGUARD DFC Retrofit in track

locating shoulders used by the DFC baseplate.

Retrofitting VANGUARD for DFC (Figure 2) is a direct swap. This has advantages for Singapore MRT in terms of a reduced stockholding inventory. There is no change to the track structure or the means of anchoring the baseplate. The rail will remain in the same position geometrically for both fasteners. By swapping to VANGUARD from DFC, large reductions in ground vibration can be achieved with minimal impact on operational parameters.

In a trial, the rate of baseplate changeover from DFC to VANGUARD was timed at 40 units per hour.

SCOPE OF STUDY

Having devised a concept for a retrofit VANGUARD baseplate and demonstrated its function and safety in laboratory tests, a full live track trial was proposed (Figure 3). For this new application on Singapore MRT, the purpose of a track trial was twofold. Firstly, to demonstrate the ease with which this new VANGUARD fastener could replace existing DFC. Secondly, to show the typical reductions in vibration that could be achieved on the tunnel floor. A 40 metre length of single track was chosen to confirm both conjectures – see map Figure 4.

The track chosen was on a curve of 300 metre radius. Superelevation was 80mm and

the equilibrium speed was 46kmh. Singapore MRT uses UIC60 head-hardened rail with a fastener spacing of 700mm. The trial was conducted during September 2009. At this time the CCL2 was not open to revenue traffic, hence test trains were running at tare weight.

MEASUREMENT AND RECORDING

Readings of rail dynamic deflection, slab vibration and tunnel wall vibration were taken.

Rail deflection

Deflections of the rail relative to the concrete slab were measured using strain gauge displacement transducers. The transducers were mounted on brackets, which were fixed to metal plates glued down to the slab. The transducers measure deflections of up to $\pm 5\text{mm}$, with an accuracy of 0.1%. All deflection measurements were made at mid-span between baseplate positions.

Vibration measurement

Rail vertical and lateral vibration was measured on both gauge and field side rails using calibrated accelerometers. Concrete slab vibrations were measured on the centre line of the track and at mid-span relative to the rail fastening assemblies. In addition tunnel wall vibration measurements were taken in both the lateral and vertical axes.

RESULTS AND DISCUSSION

The average speed of the trains was measured to be 61km/h and all trains travelling between 60km/h to 62km/h were analysed. Recordings for trains within this speed bracket were averaged. The vertical deflections of the rail foot at both field and gauge side were averaged to estimate the rail deflection at the centre. The rail roll was calculated by subtracting the field side recordings from the gauge side recordings. This method was used because the gauge and field side deflections can be easily found by adding and subtracting the roll component to the centre position. The rail head lateral deflection was calculated by multiplying an appropriate factor derived from the geometry of the rail to the rail roll and then adding the average lateral deflection of the rail foot. This multiplying factor is the ratio between the height of the gauge corner and half the width of the rail base.



Figure 4 VANGUARD Trial Site

		Vertical (mm)		Foot Lateral (mm)		Roll (mm)		Head Lateral (mm)	
		DFC	VG	DFC	VG	DFC	VG	DFC	VG
High Rail	Leading axle	-0.87	-3.57	0.56	0.75	0.36	0.08	1.31	0.92
	Trailing axle	-0.86	-3.48	0.05	0.32	0.02	-0.12	0.10	0.06
	Average	-0.86	-3.52	0.31	0.53	0.19	-0.02	0.71	0.48
Low Rail	Leading axle	-0.75	-2.81	0.57	-0.90	0.56	1.00	1.76	1.20
	Trailing axle	-0.83	-3.34	0.11	-0.65	0.13	0.58	0.39	0.58
	Average	-0.79	-3.08	0.34	-0.78	0.35	0.79	1.07	0.89
Average		-0.83	-3.30						

Table 1

Rail deflection

The mean deflection values for both the leading and trailing axles on low and high rails are given separately as shown in Table 1. Negative vertical values represent a downward deflection relative to the slab. Positive values for the rail roll and lateral deflection indicate a gauge increase or outward deflection from the track centre line. The maximum lateral deflection of the head of the rail is shown in bold.

Averaging all leading and trailing axles on all bogies reveals that the net rail vertical deflection for DFC and VANGUARD is 0.83mm and 3.30mm respectively. The maximum rail head lateral deflection values for the DFC and VANGUARD fastening systems are 1.76mm and 1.20mm respectively. It is therefore clear that VANGUARD has a much lower vertical stiffness than DFC without compromising the lateral rail stability.

Slab and tunnel wall vibration

On the slab the frequency range of greatest interest for vibration is between 20 and 500Hz. This is because the vibration is transmitted through the ground before it can reach buildings and cause annoyance, and the ground acts as a filter, which attenuates high frequencies. Hence, the lower frequencies measured on slab are those of most interest. Figure 5 shows the one-third octave band spectra of the slab centre in the vertical direction. There are peaks in the response at 50Hz band with the DFC and 25Hz with the VANGUARD, which correspond to loaded track resonance.

Figure 6 shows the same results, plotted as insertion loss measured on the slab. The vibration insertion loss in the vertical direction

is about 10dB at 50Hz and 6.3dB in total velocity level.

The tunnel wall 1/3 octave band vibration spectra in the vertical axis is shown in Figure 7.

The tunnel wall 1/3 octave band vibration spectra in the horizontal axis is shown in Figure 8.

The total vibration velocity levels in lateral and vertical directions are shown in Figure 9.

CONCLUSIONS

Average rail deflection in the vertical direction has been shown to be 0.83mm for DFC and 3.30mm for VANGUARD, whilst lateral rail deflections remain more or less the same for both fasteners. This demonstrates one principle advantage of VANGUARD, which is that it will prevent excessive rail roll whilst providing very low vertical stiffness.

The main purpose for installing PANDROL VANGUARD system is to reduce transmitted vibration and the slab insertion loss showed a substantial vibration reduction of 10dB at 50Hz and 5.7dB overall.

This means that the VANGUARD rail fastener can be swapped for DFC to substantially reduce ground borne vibration in areas of high sensitivity.

The Singapore MRT authorities now have a new option for combating ground vibration where this has reached nuisance levels. VANGUARD can be deployed as a fastener for new lines in areas where higher attenuation is required than can be provided with conventional fastening systems.

In both new and retrofit applications the DFC fastener can be simply swapped for VANGUARD without any geometrical implications on the track. ■

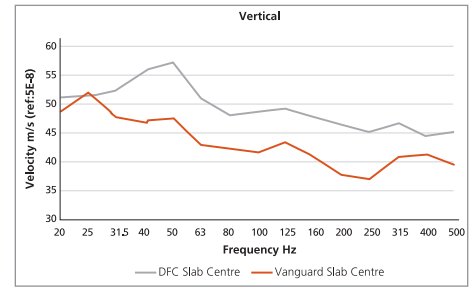


Figure 5 Slab centre vibration

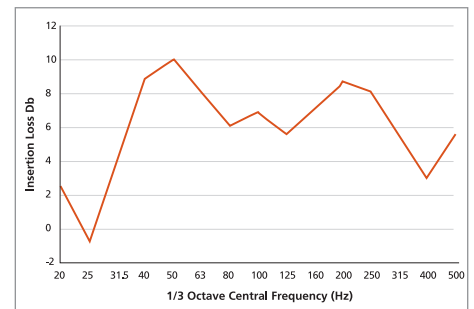


Figure 6 Slab insertion loss (VANGUARD vs DFC)

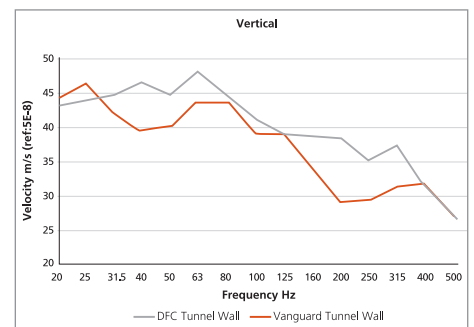


Figure 7 Tunnel wall vertical axis

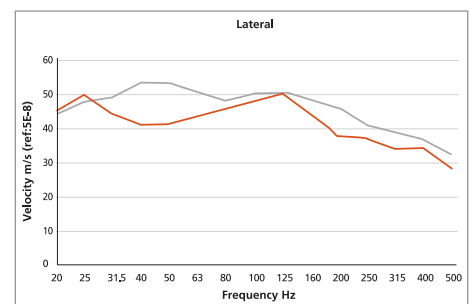


Figure 8 Tunnel wall horizontal axis

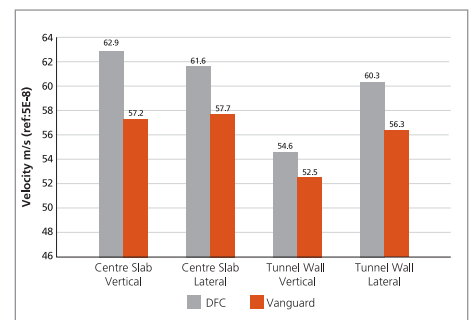


Figure 9 Total vibration levels

Pandrol Success at Belgrade Central Station

Construction of Railway Tracks on Continuous Concrete Slabs in Belgrade Central Railway Station



Overview of the construction area

Belgrade Central Railway Station is a passenger station with 10 tracks/platforms, designed as a part of the main railway station in the City of Belgrade. In the city transport system, Belgrade Central Railway Station together with the New Belgrade station and the standing platform “Vukov spomenik” will form part of the urban mass transport system and stations on the underground line. The Station will be constructed at ground level and covered with 50,000 m² of concrete slab, which will be the base for a Commercial Centre and internal traffic network with parking lots and connection to the city street network.

Belgrade City administration decided to improve their entire public transport system, and this included improving urban rail transport as well. One of the main investments was construction of missing tracks in Belgrade Central Railway Station. The Contract for construction of the Tracks 5 and 6 in the station was signed in December 2009 and certificates for works issued in June 2010. The Station construction started with operations based on a temporary certificate for use on June 31st 2010.

Prior to the construction of tracks 5 and 6, operations in the Station had been performed on only two tracks (9 and 10) out of 10

planned tracks. These tracks were constructed on classical permanent way with ballast, wooden sleeper and rigid “K” fastenings. Design documentation was carried out by the Consultant – Traffic Institute CIP, Belgrade. CIP’s consultants envisaged tracks 5 and 6 to be built on continuous reinforced concrete slabs equipped with state of the art elastic fastenings and resilient rail pads, a modern system which would be used for the first time on the Serbian Railways network.

The main contractors responsible for the installation on behalf of Serbian State Railways were Energoprojekt, who in turn subcontracted the Permanent Way works to a

specialised subcontractor, ZGOP-Novi Sad, who undertook the installation of the superstructure and concrete slab track. Both companies worked closely with CIP and Pandrol when specifying the track construction method and rail fastening product to meet the requirements of the client.

Track numbers 5 and 6 were constructed under the covered reinforced concrete slab level 105, between the existing platforms, a total length of 460m. The width of the concrete base plate is 4,08m and thickness 30cm.

The Concrete was of C40 quality with polypropylene fibre added to a mix ratio of 900gr/m³. Construction joints were at 6m spacing and expansion joints set at 48m apart.

It was a key design concern that any vibration generated by train traffic was not transmitted into the structure, thereby causing disruption to the retail units above. The EN60E1 rails were fixed with VANGUARD rail fastenings produced by the reputable manufacturer Pandrol UK, from Great Britain. These baseplate assemblies have a very low vertical stiffness, providing high levels of vibration isolation, without compromising the retention of track gauge, and reduce noise and vibration by



PANDROL VANGUARD in the station area



Transition track

preventing them being transmitted through the concrete base plate, subbase and to the foundation of the columns and structure of the upper concrete slab.

This feature was of great importance to limit noise to the level specified in the track design standards, hence reducing noise disruption to the occupants of the retail space above the concrete slab on level 105.

Connections of the concrete slab track within the platforms and the ballasted tracks outside the platforms were made by using transitional sections on one end length of L=11,70 and on the other end length of L=7,80, using the VIPA elastic baseplate fastening system manufactured by Pandrol UK. This transition stage was necessary as the change in stiffness from the ballasted track outside the platforms to the VANGUARD section on slab track meant trains would experience too large a change in stiffness over a very short length of track.

Trackwork on the section approaching the Station did not require protection from noise and vibration, and was constructed using prestressed concrete sleepers in ballast with prestressed type B70 equipped with the FASTCLIP FE fastenings from Pandrol UK. Again, the rail type was EN60E1.

Serbian State Railways' existing concrete sleeper Putevi-Invest Stalac, who are the only supplier of the FASTCLIP fastening in the region, adapted their moulds to produce FASTCLIP FE sleepers on an existing approved sleeper design. These sleepers were used on the sections of track leading up to the Station building, where vibration isolation

was not as important.

This track system comprising of VANGUARD and VIPA fastenings on concrete slabs and FASTCLIP on ballast is a unique system providing an ingenious technical solution to meet the need for reduced noise and vibrations. It also offered additional benefits, such as a longer period of track exploitation, minimum maintenance costs, simple cleaning of the platform track section and aesthetic effects fit to the station space.

Belgrade is one of a few European cities to install these types of rail fastenings assemblies to try and reduce environmental noise pollution from railway traffic.

Track construction was by the 'Top Down' method. The rails, pre-assembled with the VANGUARD fastening, were suspended by track jigs to obtain line and level. Anchor studs were then core-drilled into the base slab, before a grout plinth was poured. Two lines were constructed using this method.

Pandrol supported the client and contractor throughout the installation, achieving an excellent result and a satisfied client. There are eight more tracks to be installed through the Station, and there is every confidence that these will utilise Pandrol brand products.

The track has now been opened to traffic, with approximately one train every 20 minutes on each track and it is clear that VANGUARD is reducing vibration into the structure, as even with a combination of passenger and freight trains travelling through the station, the amount of vibration felt on the platform is minimal. ■

Photographs by Mr Miloš Mrdjenović



PANDROL FASTCLIP FE in ballasted track

VANGUARD on São Paulo Metro, Brazil

Vibration and Secondary Noise Reduction with PANDROL VANGUARD



The PANDROL VANGUARD fastening system was recently installed in a section of Line 1 on the Metro São Paulo in Brazil. A total of 1,600 units were installed, 900 on concrete slab track and 700 on timbers (embedded in concrete), substituting Landis and Vossloh plates respectively.

As part of the homologation procedure requested by Metro SP, vibration measurements were performed on the track and in nearby buildings both before and after installation of the VANGUARD fastenings (Figure 1).

The section where these fastenings were installed is a slab track without floating slab or ballast, therefore any reduction in vibration is due exclusively to the performance of the fastenings. Alongside the vibration reduction requirement, the track gauge had to be guaranteed, even in extreme conditions, such as when rails break.

In order to prove the performance of the fastenings, trials in the track under loaded

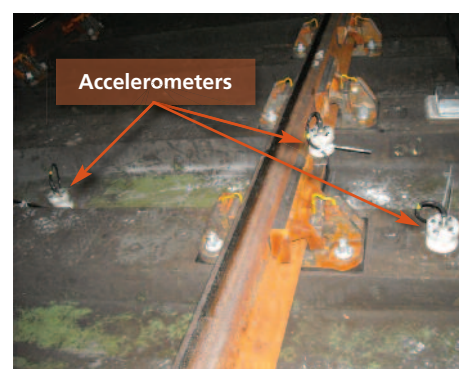
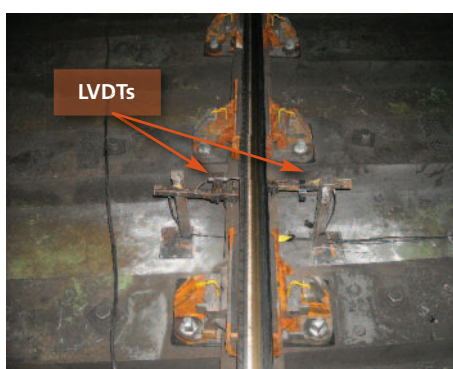


Figure 1 Track measurements

trains, and measurements in nearby buildings were performed as part of an extensive investigating program. In addition, a computerized numerical model was prepared to simulate a rail break. The aim of the trials was to measure the acceleration against the time, the speed and sound pressure level in the frequency field.

As well as vibration trials on the track, rail strains, vertical and horizontal displacement, gauge widening and dynamic stiffness were recorded. These measurements were used in the numerical model, based on finite elements, for the case of a supposed accidental rail break.

NUMERICAL MODELING

The first step for analysis is to establish the dynamic stiffness of the track. This was derived from the rail foot strain and the "Beam on Elastic Support" theory by an interactive process. The result was a vertical axle load of 15,5 ton. For this load, the maximum vertical displacement between two fastenings with a spacing of 750mm was 4,38mm downwards, as shown in Figure 3.

Also, it is very important during fastenings homologation to satisfy the requirement for gauge widening (lateral displacement) which is limited to 3mm in normal working conditions. With PANDROL VANGUARD the gauge widening measured obtained in the trials was approximately 1,2mm, complying perfectly with the requirement.

Now simulating the accidental rail break between two fastenings (Figure 2), the gauge widening predicted by the numerical model was around 8,00mm. So for this safety critical factor, a horizontal strength equal to 15% of the vertical strength was derived, which was also deemed acceptable.



Figure 2 Broken rail simulation

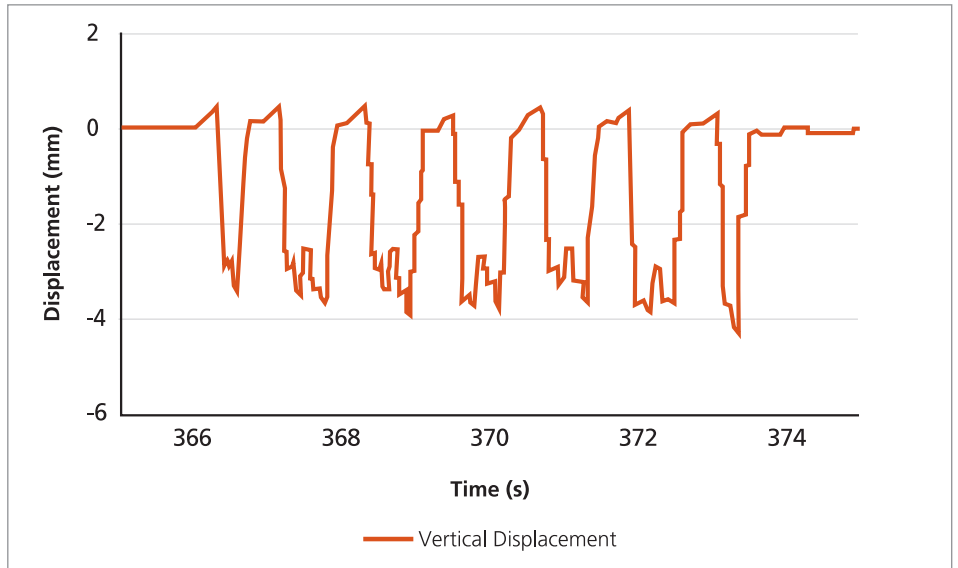


Figure 3 Regular rail displacement

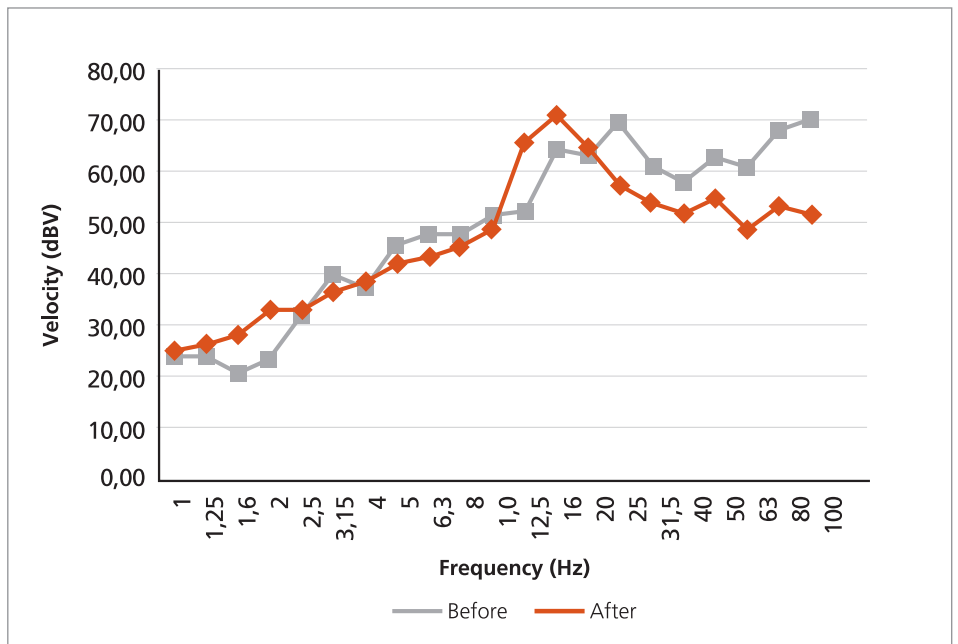


Figure 4 Vibration measurements

CONCLUSION

One of the main reasons to change the original fastenings to PANDROL VANGUARD was the high vibration level. That was around 78,8dBV at 25Hz in the nearby buildings, at 25 meters from the tracks. After the VANGUARD installation, the global vibration level was reduced to 66,2dBV at the same frequency and location (Figure 4).

Regarding the secondary noise measured in the nearby buildings, the trial results showed that after installation of PANDROL VANGUARD, the noise measured was less than the limit value given in Brazilian law.

A final analysis was possible regarding the

natural frequency of the system before and after. Prior to replacement, the natural frequency was approximately 25Hz. After, the natural frequency changed to approximately 16Hz as a result of the lower track stiffness, causing a vibration diminution in frequency bands between 16Hz and 25Hz that was not previously present.

Based on the obtained results, it can be concluded that PANDROL VANGUARD showed a fully satisfactory performance. ■

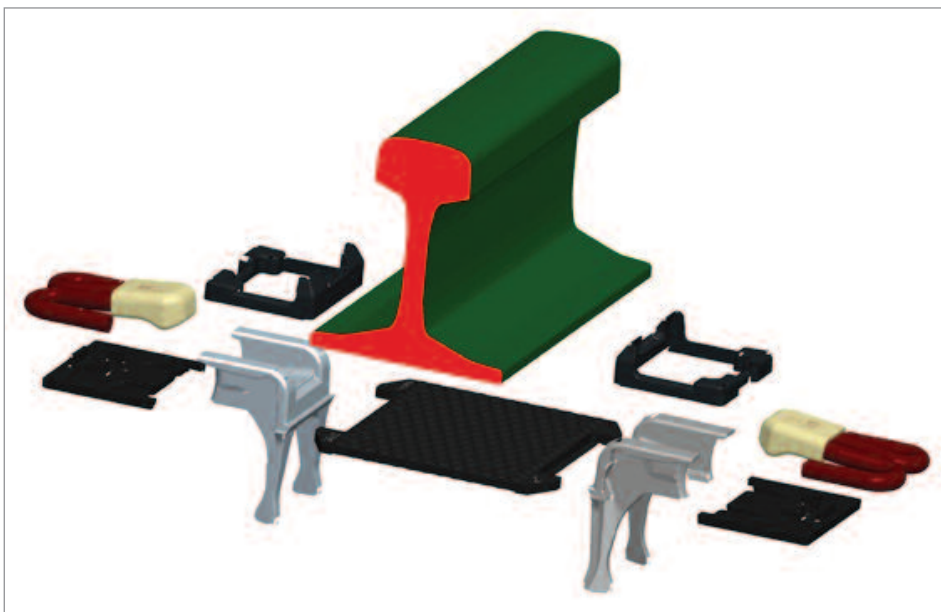


Fig 5 Finished track

PANDROL FASTCLIP FE



FASTCLIP FE



Exploded view

PANDROL FASTCLIP FE is the latest generation rail fastening from Pandrol, a value engineered variant of the FASTCLIP system, which can be used in all applications where FASTCLIP FC is currently used.

Commercial pressures to continually drive down costs within the railway industry and comments from railway contractors initiated an engineering exercise based upon the current PANDROL FASTCLIP system to try and achieve significant overall cost savings for railway operators, without any compromise to the performance of the assembly.

FASTCLIP FE is identical to FASTCLIP FC in the following respects:

- The system remains a captive system.
- It is delivered to site installed on each sleeper.
- Sleeper makers assemble all the components on each sleeper prior to delivery.
- It is designed for mechanised track renewals, using automated clipping machines or hand-tools.
- The system uses an M shaped clip, driven at right angles to the rail.
- Designed for 26 T axle loads.

The benefits that FASTCLIP FE offers are:

- Shoulders not susceptible to accidental damage.
- Robust toe insulators.
- A few, simple hand-tools.
- Easy to use in the concrete sleeper factory.

The design and manufacturing processes for the clip itself ensure that the high performance of Pandrol systems is maintained but steel is used very efficiently.

One of the key features of the FE system is a new plastic seal plate, which seals the hole in the sleeper mould and is then cast into the sleeper. This minimises contact between the steel mould and the cast iron shoulder of the assembly, increasing mould life. It also prevents slurry leakage into the shoulder during the casting process, increasing the quality of the final product.



Rosenqvist CD200 installation machine for FASTCLIP



PANDROL MARK1V FASTCLIP installation machine

SUCCESSFUL TRIALS OF PANDROL FASTCLIP FE

Pandrol UK has been undertaking trials of the new 'FASTCLIP FE' rail fastening in Hungary, Romania and Norway. Each of these projects has used a different installation method and various combinations of machines and manpower. On all the sites, the work was completed quickly and efficiently and was well

received by the local contractors. Vortok and Rosenqvist, both subsidiaries of Pandrol, have also been involved in the development and implementation of the FASTCLIP FE system. An FE compatible version of the successful Vortok Stressing Roller (the FeVSR) has been used successfully in Hungary, allowing for very quick and safe stressing operations. Rosenqvist's high-output clipping machines are

easily adjustable for use on FE assemblies, including the Clip Master units attached to the Rosenqvist SB60 Sleeper Changer, which was used in the Norwegian trial.

Pandrol UK and other subsidiaries have further trials planned in the upcoming months including a heavy haul version going into tracks in Australia and Brazil.



Case Study: FASTCLIP FE installation on MAV tracks, Hungary

The first installation of FASTCLIP FE in Hungary took place on tracks run and maintained by MAV. The installation site was 300m from the station at Zichyújfalu, near Gardony on the Szekesfeheruar to Pusztaszabolcs line. Installation work was carried out by the contractor Mavepcell.



1. 300 FASTCLIP FE sleepers with UIC54 rails were supplied by RailOne Labatlan and delivered to the installation site by road.



2. Sleepers were unloaded using a road-railer and moved into position using the Pandrol 4-sleeper lifting beam and lifting chains.



3. The sleepers were spaced with a tape measure and aligned to a string line on a bed prepared by a bulldozer and roller. Once all 300 sleepers had been laid out and roughly aligned, the rails were threaded using a pair of road-railers.



4. The rails were bolted up to existing rails at the end of a crossing using temporary joints.



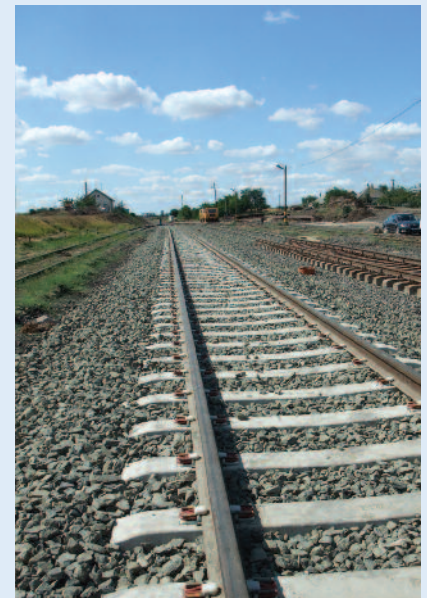
5. A 5-man working team began the clipping work, using clip installers and sleeper lifting tools where required. Stressing of the tracks took place approximately three weeks later. The rail was to be stressed naturally, without tensor or rail warming equipment, so work was delayed slightly until the rail temperature was within the range of 15°C-23°C.



6. Walk-behind machines were used to unclip all 300 sleepers, one machine on each rail, and the unclipping procedure was completed in under 45 minutes.



7. Vortok Stressing Rollers (VSRs) were placed at a spacing of 12 sleepers in the curved section off the back of the S&C, and at 15 sleeper spacing on the straight. This increased spacing was because both rails were being stressed simultaneously. Once installed, the raising of the rail into the stressing position took only five minutes. Once the MAV engineers were happy that the stress was distributed through the rail, the VSRs were dropped and every fifth sleeper clipped up prior to welding.



8. The welders dropped two welds, one on each rail, and after approximately 45 minutes, the remaining sleepers were clipped up. The total time taken to unclip, natural stress, weld and reclip 200m of track was four hours, including time spent demonstrating the use of the equipment to the MAV operatives. The FE installation was then complete, and the track opened to traffic on Thursday 10th September. ■

Kadiköy-Kartal Metro Line, Turkey



Route overview

THE PROJECT

The Kadiköy-Kartal project involved the construction of a 22km long metro rail line on the Anatolian (Asian) side of Istanbul, which includes 16 metro stations. The aim of the project was to help reduce travel times and improve mobility along one of the most congested traffic corridors on the Anatolian side of Istanbul, by providing a clean, safe and efficient mode of public transit.

The new line will relieve traffic congestion at peak hours by an equivalency of 100 buses and 4,300 minibuses, increasing the traffic flow capacity by about 30%.

The alignment began in front of the Kadiköy landing stage and extends to the Kartal Interchange by following the route of the D-100 highway corridor. The route meant the new line could be integrated with the metro system in the European Side of Istanbul, via the Marmaray Strait Tube Crossing at the transfer center planned at Ayrılıkçeşme Station.

The D-100 state highway is one of the most significant main arteries in the eastern



Split of works

side of Istanbul and sees intense traffic all day every day.

This corridor is the artery which connects regions like Kartal, Pendik, Gebze and leads to the downtown and western sides of Istanbul, and has become one of the most strategic regions of Istanbul, sociologically and economically.

The line will relieve the E5 highway at peak hour by an equivalency of 100 buses and 4,300 minibuses. This will increase the traffic flow capacity of about 30%.

The Kadiköy-Kartal Metro Line was tendered for the first time in 2004 by the IETT

(Istanbul Public Transportation Directorate) as surface LRT. The Contract for civil works was awarded to Yapi Merkezi-Dogus-Yuksel-Yenigun-Belen Insaat J.V, named AnadoluRay Consortium on 28.01.2005. The first contract value was 139 million USD. AnadoluRay began the works on 11.02.2005. However, after new studies by universities, local authorities reached a consensus that the line should be fully underground. As a natural consequence of this decision the total construction cost of the line increased. Therefore, a new tender for the remaining part of the civil works and the whole line's E&M works was completed.



PANDROL Resilient baseplate assembly

The new tender was won by Avrasya Metro Grubu (AMG JV) and a contract signed with the IMM, Head of Transportation Department, Rail

Systems Directorate on 06.03.2008. AMG JV consisted of ASTALDI (%42), MAKYOL (%41), and GÜLERMAK (%17) companies. Astaldi

S.p.A was appointed as the leader of the JV. The new contract value was 751.256.043 Euro.

AMG JV were in charge of Supplementary Construction and Supply, Assembly and Commissioning of Electromechanical Systems. The figure shown previously shows the split of works between AnadoluRay and AMG JV. The blue line shows the AMG JV's responsibility for E&M works and station civil works. The red line shows tunnels to be built by the JV and the yellow line shows the section where AnadoluRay is responsible for the tunnelling job by means of TBMs.

In order to comply with strict deadlines, both NATM and TBMs were used to complete the tunnelling. The alignment comprised 16 stations to be carried out by open excavation and cut & cover systems according to location and site accessibility. Each station underpasses the E5 Motorway by means of an underground passage crossing the E5 horizontally and connecting the both ends.

Daily average rates of 110m were achieved during the excavation progress, and 4.5 tonnes of explosives used everyday. 72% of the tunnel excavation works were completed by the



Completed track

end October 2009.

Excavation works in all 16 stations also progressed very quickly, with the first station building construction finished by the end of November 2009.

PANDROL fastenings were used throughout the new line. The assembly supplied is similar to the e2007 e-clip baseplate assembly, which was installed on the Dubai metro project, but the version for Kadiköy – Kartal is more resilient at 15kN/mm, to meet the exacting specification of the railway.

Variants of this solution have been operational in tracks worldwide for many years and provided the Operating Companies with an easy to use, low maintenance rail fastening assembly.

The Greater Istanbul Municipality Railway Authority (IBB) were closely involved in the decision to specify the Pandrol system, and continued to work closely with AMG throughout the tendering and evaluation/approval process. ■



Track construction on the Kadiköy-Kartal project

The track was built using a top-down construction methodology, using temporary construction plates to ensure that the concrete finish beneath the rail fastening assemblies was to an acceptable level. The construction plates used were made to a design agreed between Pandrol to AMG and provided fabrication work of a very high standard.



1. With the first pour slab and exposed concrete reinforcement already in place, rails are placed and held to a rough alignment using track jigs.



3. Next, laser alignment ensures the rails are accurately placed before wooden shuttering is built around them.



5. Any extra concrete was cleaned off using water and brushes and the concrete left to cure for 2-3 days before removing the construction plates. In areas where thermal expansion of the rail is expected, the rail clamps could be loosened or removed, once the concrete had sufficient strength to support the weight of the rails and fastening assemblies.



2. Construction plates are attached to the rails and the anchor studs fixed into their correct positions.



4. Assemblies were also covered in plastic to protect them, before the concrete is poured. The concrete was delivered by a mixer lorry and transported through the tunnels by barrow. Careful placement of the concrete meant that minimal use of poker vibrators was required and the surface was finished to a high standard by hand.



6. With the concrete cured, the assemblies were built up over the cast-in anchors. The rails were then threaded and insulators and clips installed before tightening the nylock nuts to their working position.

The Gautrain Project, South Africa

Rail transport in South Africa entered a new era with the successful opening of phase 1 of the Gautrain rapid rail project on the 8th of June 2010. The opening came 3 weeks ahead of schedule and just 44 months after the first sod was turned.

Within days of opening in time for the FIFA Soccer World Cup, the Gautrain was carrying approximately 80,000 passengers per week. Post world cup, the train service has stabilized at about 50,000 passengers per week with bus passengers at about 4,000 passengers per week and showing steady growth.

The project is a Public-Private-Partnership and includes a 15-year maintenance and operating period after construction. Following an international tender process, the Gauteng Provincial Government awarded the project to the Bombela Concession Company consisting initially of Bombardier Transportation UK Ltd, Bouygues Travaux Publics SA, Murray & Roberts Ltd and SPG Concessions Ltd. Latterly ABSA Capital and the J&J Group have also

taken up equity stakes in the Bombela Concession Company. The operations are led by RATP Development – the transit operator responsible for public transport in Paris and its surroundings.

THE PROJECT

Phase 1 of the project comprises an airport link between the Sandton CBD and OR Tambo International Airport; as well as two intermediate commuter stations – Marlboro and Rhodesfield. The balance of the project will be completed during 2011 and consists of six further commuter stations connecting the Johannesburg CBD with Pretoria and Hatfield. The project is designed to carry 100,000 passengers per day at start-up.

The network will be nearly 80km long once both Phases 1 and 2 are completed.

The Gautrain offers international standards of public transport with high levels of safety, reliability, predictability and comfort. Travelling

at a maximum speed of 160 kilometres per hour, it will connect Hatfield Station with Johannesburg Park Station in about 42 minutes and Sandton station with OR Tambo International Airport in less than 15 minutes.

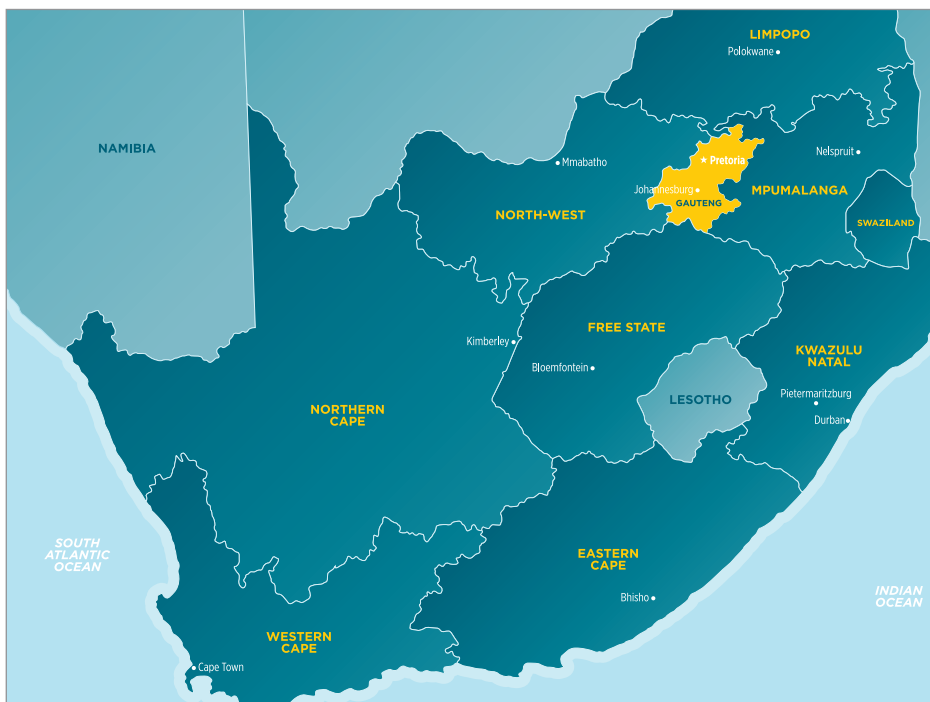
The train service is complemented by a dedicated bus fleet which will transport passengers in air-conditioned comfort between the stations and surrounding suburbs and business nodes.

Both the trains and the buses are accessible to people with disabilities.

ROLLING STOCK

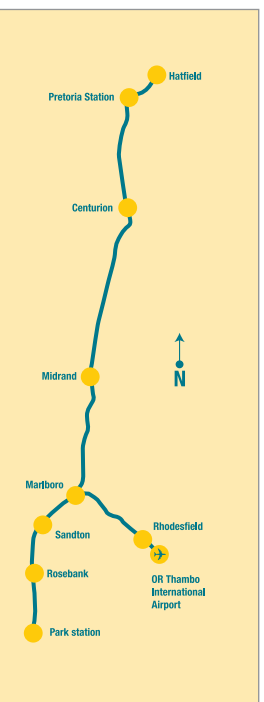
Bombardier will supply a fleet of vehicles based on the tried and tested Electrostar train-set already in common service in the UK. In South Africa, they will be formed into four-car sets to carry up to about 450 passengers per train, and will run at 160km/h (100mph).

The vehicles will be manufactured at Bombardier's Derby works in the UK with final



Gauteng Province

- 20% of South Africa's population resides in Gauteng
- 33% of the GDP is generated in Gauteng
- Gauteng boasts the most developed infrastructure in South Africa
- 52% of South Africa's 7 million international tourists pass through Gauteng



assembly taking place in South Africa. The fleet will be based at a purpose built maintenance facility located at Midrand, just South of Allandale road.

SIGNALLING AND COMMUNICATIONS

An operational control centre (OCC) located at the Midrand depot controls all train movements as well as comprising a communications and control hub for the monitoring and control of the bus feeder system and key station and tunnel equipment.

The signalling solution comprises Bombardier's CITYFLO 250 system which is a fixed block signalling system based on 'distance to go' principles with vital information being transmitted to the onboard automatic train protection (ATP) system from balises in the track. The ATP supervises the driver and train movements.

Communication points will be provided at stations for passenger information and safety.

FARES & TICKETING

Gautrain has a balanced approach in its fare policy aimed at making the service attractive and affordable to broad sectors of the population. In principle, Gautrain fares are designed to be lower than the cost of using a private car for the same journey but more expensive than those of existing public transport options.

The fare collection system is based on a contactless smart-card (CSC) system, which enables customers to load a variety of different journey products, ranging from "top-up-and-go" to period passes, onto the same card and to re-use this card over and over again. Customers will have the opportunity to register their cards, which will enable immediate blacklisting of the card should it be lost or stolen. Any unutilised value on the lost card can then be transferred to a new card.

So-called "Gautrain Gold Cards" are available from all ticket offices and ticket vending machines at Stations as well as from selected off-site retailers. The Gold Card allows seamless transfers between Gautrain's bus, train and parking services. Customers using more than one service within a single journey also enjoyed a reduced fare. ■



Sri Lanka – Steel Sleepers for the Sri Lanka Railways Hill Sections

by Dr M. Seshagiri RAO, FICE, FPWI, Rahee Track Technologies Pvt Ltd, Kolkata, India



Passenger train in tea country



Steel sleepers replacing life expired timber sleepers

With the rising cost of timber and tighter environmental requirements, most World Railways started switching over to pre-stressed concrete sleepers in the 1970's and 1980's. The Railways of timber rich Sri Lanka, however, continued the use of wooden sleepers until recently. The present policy is to phase out the wooden sleepers to ensure conservation of forests. The price of timber has been increasing and the life of wood in track has been going down tilting the economics in favour of other types. Many track renewals over the Southern and Eastern Lines of Sri Lanka Railways (SLR) are being constructed using PRC sleepers. The Northern Line disrupted during the strife is being re-built with new rails on PRC sleepers and fresh ballast.

The Central Line (also known as the main line, being the first Railway of Ceylon) is special. It rises up into the tea country attaining the highest elevation for Broad Gauge in the World at nearly 2,000m at Pattipola. The gradients are

steep (2.5% is very common) and the curves are sharp (100m radius). Consequently, long welded Rails and pre-stressed concrete sleepers had to be ruled out.

Steel sleepers require minimum use of ballast and have a low life cycle cost. It is ideally suited for the hill sections with steep gradients where use of mechanized track laying equipment is restrictive. Proposals for the use of steel sleepers of a design well established on the Bailadilla Hill Railways of India (also known as the KK Line) were initially made. However, the maximum axle load on SLR is only 20 T against that of 23 T in India. Freight traffic is rather modest against 30 GMT per annum on the KK line. Individual trainloads are also very low when compared to 5,200t on the KK line. It was therefore decided to use a value engineered sleeper section providing adequate strength.

While a UIC standard code of practice exists for the design of PRC sleepers, there isn't any for that of steel sleepers. Recourse had to be taken to the US or Australian codes and the



Indian Standard IS 800 for the structural steel design. The Indian practice of 1:2 load distributions under the rail seat and 1/6 centre binding reaction were adopted. Different profiles of sleeper bars were considered and



Initial trial installation



Close up of FD 1408 assembly

strength analysis was made by computer simulated softwares. Finally, a rolled profile section weighing 23.2kg/m was found to be most appropriate. Against a permissible stress of 17.1kg/sqmm, the calculated stresses did not exceed 15.08kg/sqmm. The Sri Lankan Government Design Bureau however desired that the worn-out (after 50-year life) geometrical properties should be taken into account and the centre binding reactions should be as for a beam on elastic foundations. This too was done using Prokon software to confirm that the permissible stresses would still not be exceeded.

The fastening system needed a lot of detailed examination. Considering the curvatures, the lateral forces were bound to be large and the system needed a good lateral support as well as suitability for fitment of check rails.

After detailed examination, the PANDROL FASTCLIP model Type FD 1408 was adopted. Its hold is positive, lateral support excellent and it is possible not only to insert insulating liners but also to provide for extra gauge on sharp curves by using nylon insulating liners of different sizes. It needs special tools for installation but yet offers a "fit and forget" arrangement.

Installation of the FASTCLIP needs shoulders, which, in PRC sleepers, are cast into the concrete. In the case of SLR sleepers, hook-in shoulders have been used. These are loose pieces, which are slipped into the rectangular

hole in the sleeper and hold the PANDROL FASTCLIP firmly in position. Another advantage of FD Clip is its low profile design, which protects the clip from getting entangled with any loose component of the rolling stock. It provides ample toe load on the rails, which is quite adequate to the requirements of SLR. The clip contact points on the shoulder are less vulnerable to corrosion expansion. This poses a problem on coastal lines. The FD system is also very easy to inspect that it is installed in the correct working position due to the fact that the clips are applied laterally to the rail.

Materials in the insulator and pad provide greater longevity and are less susceptible to installation damage.

After successful trials in stages, initially 3,250 sleeper sets and later 50,000 sleeper sets with FD clips were ordered by Sri Lankan Railways, have been laid in track and have withstood two monsoons.

We are illustrating the SLR track with a few photographs. Notwithstanding the limited ballast and occasional inadequacy of drainage, these sleepers appear to be behaving well. ■



Finished track after rehabilitation

Field Repair of Concrete Gauge Convertible Sleepers – Australian Rail Track Corporation (ARTC)

by Ben LESKE, Infrastructure Manager East West, ARTC

In 1990 the broad (1,600mm) gauge timber sleepers between Adelaide and Melbourne were replaced with gauge convertible concrete sleepers that would allow for future conversion to standard (1,435mm) gauge as part of the national mainline concrete re-sleepering and gauge standardisation program. This line was subsequently converted to standard gauge in 1995.

The design of these sleepers, which allows for assembly of the track at either of the above track gauges, consists of one fixed rail seat that accommodates a single rail, and a 'double-width' rail seat that has a central cast iron 'socket' embedded within the sleeper. This central insert is used to attach a hook-in cast shoulder, which can be rotated depending on which of the two available track gauges are required.

Once converted to standard gauge, the rotatable shoulder/socket combination became the rail restraining feature on the field side of one end of the sleeper.

In certain areas of this track, namely through the Adelaide Hills, high wear of both the sleeper insert and the rotatable shoulder became apparent after approximately 10 years

of service. This wear has resulted from a combination of tight track curvature, trains up to 1,500 metres long with a combined loading of up to 5,000 tonnes, relatively high annual rainfall and heavy sanding of the track to aid locomotive traction.

Not only was this wear causing obvious concerns with respect to the longevity and integrity of the sleepers, but it was also creating problems through excessive widening of the track gauge.

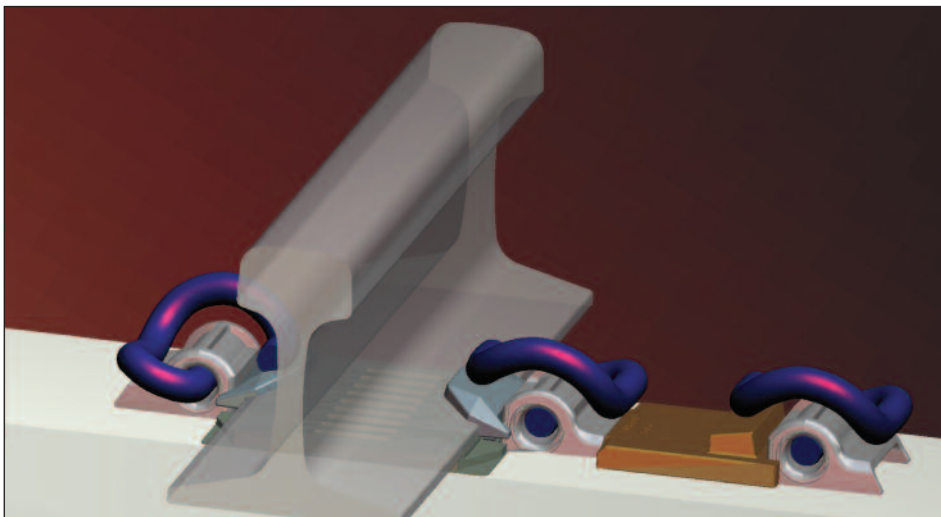
In 2010 a repair system was developed by Pandrol that would restore the correct functionality of these sleepers whilst enabling easy track installation during short possession times.

This system consists of a cast iron spacing plate that is inserted between the rotating shoulder and the now redundant broad gauge field-side shoulder. This plate is secured to the rotating shoulder by the existing rail fastening clip and an additional rail fastening clip is used to secure the plate to the otherwise redundant shoulder.

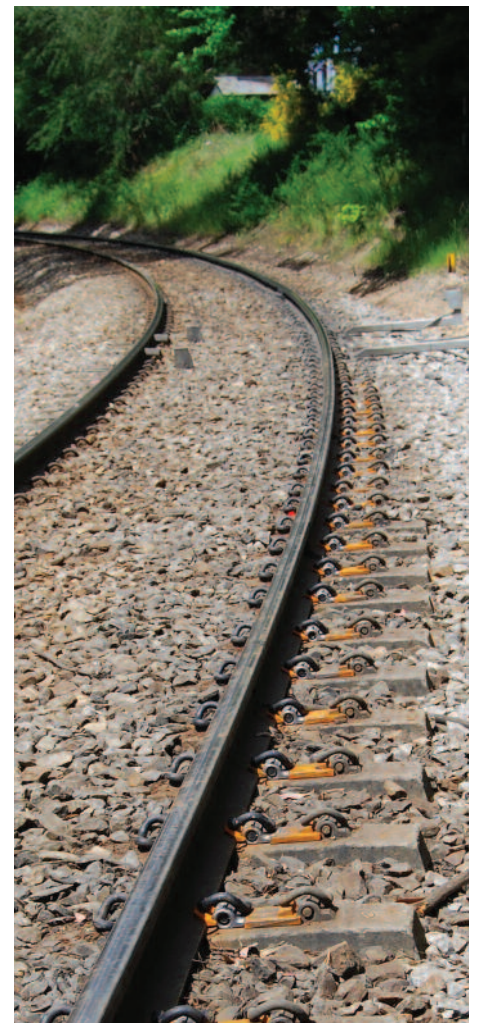
Additionally, to re-instate the assembly prior to clipping up, the now worn rotating shoulder is replaced with a new unit, and secured to the worn insert using a high strength epoxy.

Following successful repeated load testing of the assembly to 3 million cycles in the laboratory, a field trial was conducted with satisfactory results in terms of both system performance and ease of installation.

ARTC have now initiated a program to repair these sleepers, starting with those currently exhibiting excessively wide track gauge. This program will then progress to cover all sleepers in the network that could potentially develop this problem in the future, with the projection that all of the sleepers will reach their full service life, instead of having to be replaced. ■



Gauge convertible assembly



Installed in ARTC track, Australia

VICTOR Baseplates for CSX Transportation

by Kelly PICCIRILLO, Assistant Chief Engineer of Capital Projects, CSX

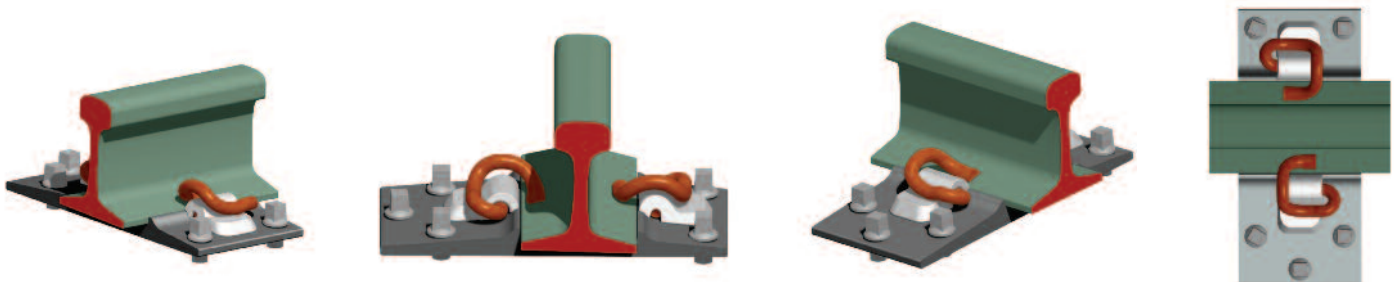


The PANDROL VICTOR plate, first introduced in 2005, continues to gain widespread acceptance by major Class I railroads using timber ties. As freight railroads continue to push the limits of track design and structure with increasing loads and speeds, an elastic fastening system supported by a heavy duty tie plate, was required. The primary customers for this product have been the Norfolk Southern Railway, New Jersey

Transit and CSX Transportation.

Pandrol's answer was to design a system which incorporated both capabilities. The VICTOR plate utilizes a standard asymmetrical 18" AREMA tie plate, with its full 139.5 square inch bearing area, and then integrates a robust cast swaged shoulder into the plate. The swaging process is similar to riveting as the cast shoulder is set into a heated plate which is then hit with a die in a 1,200 ton press. When the

plate is struck, it causes plastic deformation of the metal to flow into grooves in the shoulder. The shoulder is then swaged up and locked into place. The shoulder also has an additional groove and matches the plate profile to resist torsion. VICTOR plates can be manufactured to utilize either "e" clips or FASTCLIPS. The clips, with all the inherent advantages of a resilient fastening system, have nominal toe load of 2,750 pounds (1,250kgf).



PROJECTS

After nearly five years of in-track testing and service, the VICTOR plate is proving to be excellent at retaining gauge, maintaining rail cant and preventing rail rollover, with a minimal amount of maintenance required. The plate is primarily being used on bridges and curves with significant annual tonnage, traditionally shown to be tough environments to hold gauge.

Plates are delivered either palletised or loose to the jobsites. Likewise, VICTOR plates can be manufactured to utilise either standard cut spikes or screw spikes.

In the summer of 2010, CSX chose to install approximately 21,000 VICTOR plates on an Ohio River bridge.

The CSX Louisville Division completed the installation of approximately 36,000' (11,000m) of new 136# premium rail across the C&C (Cincinnati & Corbin) and the CUT (Cincinnati Union Terminal) Bridges at Cincinnati, Ohio.

This open deck bridge structure had several curves ranging from 6 degree to 10 degree (175m to 300m radius). Due to the degree of curves with skewed steel girders, and the present maintenance requirements, CSX installed 136# Premium Rail using the Pandrol VICTOR 18" Premium tie plate fasteners.

The VICTOR tie plates were fastened to the ties with two standard 5/8" cut spikes while the rail was fastened down with two rail holding spikes and two Pandrol e-clips. The use of the 18" PANDROL VICTOR plates will reduce the plate cut, rail cant, gauge conditions, and distribute the load across the timber ties, thus greatly reducing the previous weekly maintenance requirements. ■



VICTOR baseplates with PANDROL brand e-Clips



VICTOR baseplates with PANDROL FASTCLIP



The Vortok Measure and Detect Sensor

Train detection and condition monitoring of track and trains are essential parts of maintaining safety and reliability. Conventional track-based monitoring systems though, face many challenges; physical bulk, unfriendly connection systems, poor mounting techniques and fragility are the main problem areas.

The importance of good quality data cannot be overstated as this allows management decisions to be made and a good understanding of the duty cycles of rail fasteners, sleepers and vehicles allows proper design and maintenance plans to be instigated.

The new Vortok Measure & Detect sensor integrates three measuring technologies into a single compact, rugged device. Easily inserted into a single 10mm diameter hole in the rail web, the Measure & Detect sensor measures rail strain in either a vertical or horizontal plane, rail acceleration both vertically and laterally as well as rail core temperature.

By incorporating these elements into a single sensor body, the M&D sensor allows us to attach a number of applications which deliver benefit to both infrastructure and vehicle operators.

HISTORY

Originally developed by Roger West Laboratories for realtime weighing of road vehicles the Axload sensor began life as a single measurement device embedded into the axles of lorries in the UK.

Railways appeared an obvious development and the sensor body was further developed to incorporate a long nose which could place the strain sensor at the core of the rail. The benefits of this type of attachment to the rail were appreciated by Vortok Engineers who shared RWL's vision of incorporating additional sensing elements into the sensor body. The latest development from Vortok packs all of this technology into a neat, rugged



VORTOK measure and detect sensor

stainless steel device which provides positive location for the solid-state sensing elements.

TECHNOLOGY

The result is a compact, rugged, general purpose device that can simultaneously sense a number of parameters. Each M&D sensor becomes part of the rail it is inserted into and measures:-

- Either vertical or horizontal strain in the rail (The sensor can be installed at 45 degree increments).
- Rail core temperature.
- Vertical acceleration.
- Lateral acceleration.

The M&D sensor uses a high quality instrumentation amplifier for the strain gauge allowing connections to be made near the sensor. The acceleration and temperature channels are both high level outputs that do not require amplification.

INSTALLATION

The M&D sensor is installed by simply drilling a 9.8mm hole in the rail at the neutral axis and then reaming to an H7 interference fit on the sensor's 10mm diameter barrel. Typically, the rail will be drilled with a Cembre type rail drill and the sensor can be pressed in at the desired alignment; a horizontal cable outlet indicates a vertical shear strain measurement while a 45 degree outlet allows the sensor to measure horizontal strain.

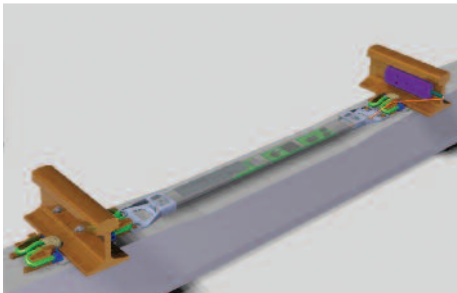


PROJECTS

The M&D sensor can be installed in around 1/5 the time taken to install bonded (either adhesive or micro spot-weld) gauges. It is also immune to changes in environmental conditions such as rain and cold temperature. This removes risk and uncertainty from the installation process.

Taking advantage of modern low-power electronics and communication equipment the electronics required to interface between the sensors and the outside world can easily be fitted in to Vortok's balise beam technology. Combined with the quick to install sensors, this means that a complete monitoring installation can be complete in less than half an hour.

The M&D interface provides in excess of 1,000 volts isolation and can be battery powered for low speed logging situations such as rail strain monitoring.



VORTOK smart beam data acquisition unit

Currently the system uses a 3G wireless modem to transmit data but future developments will offer WiFi and short range RFID type interfaces so that railways in remote areas can use locomotives as a means of relaying data from monitoring systems.

DATA COLLECTION/ INTERPRETATION

Data acquisition depends upon application and can vary between measurements taken at intervals of minutes or hours for horizontal strain measurements up to measurement frequencies of 10kHz for Wheel flat detection. The M&D sensor is able to facilitate measurements up to speeds of 400km/h.

The M&D interface allows data collection up to 10,000 samples per second so that we can use it for production equipment and data gathering for future developments. The interaction between strain measurements and accelerations will be analysed at high speed to determine future uses for the M&D sensor.

The train above is interacting with the



Low rail temperatures and wheel damage present a large risk of rail breaks

railway as it goes and the ability to monitor and understand this interaction allows optimal running of the railway in terms of performance, safety and reliability.

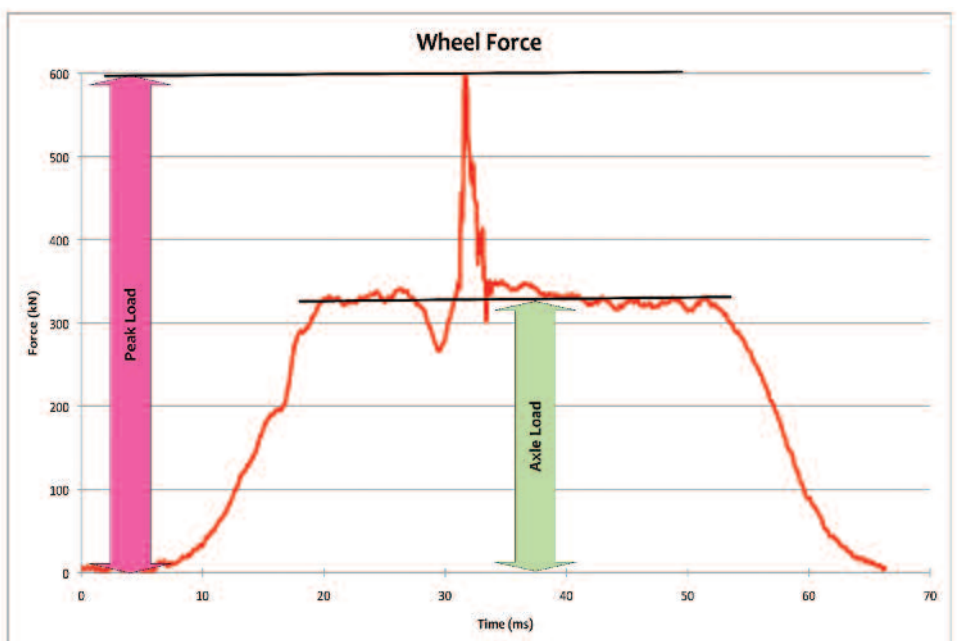
The data below is a small sample of data collected at very high speed. The red line shows the combined output from a pair of sensors as a train passes over an instrumented sleeper bay. The 'plateau' section of the blue trace is the axle load of the train and the spike is the additional force created by a wheel flat.

This small data trace represents three

things; the axle load of the train, the condition of this particular wheel, and the presence of a wheel over this bay (axle counting). By taking the component traces from each sensor we can also determine train direction and the horizontal width of the red trace (with a known sleeper spacing) indicates train speed.

In the real world, each of those deduced parameters may have a different customer so any data analysis system needs to deal with this.

Temperature readings can tell us about the



tension and SFT in the rail plus it can help understanding of suitable impact limits at different times of the year.

The forces generated by this train (load and impact) plus the SFT of the rail and ambient temperature can determine the risk of the rail breaking or buckling underneath it

APPLICATIONS



VORTOK multi-sensor logger

Rail Stress Free Temperature

Vortok's extensive experience and reputation from marketing the VERSE SFT measurement system around the world provides an ideal cue to the development and marketing of a continuous Stress Free Temperature monitoring system. Many clients have expressed interest in continuous monitoring of SFT after the SFT has been established with VERSE.

By fitting an M&D sensor to the rail after the SFT readings are confirmed, the rail strain can be simultaneously tracked and recorded or transmitted to the client. The M&D logging system complements the M&D sensor and incorporates wireless technology so that data and alarms can be transmitted using the internet.

Demonstrations are planned for Autumn 2012 with Queensland Rail in Australia and CSX Corporation in the United States.

Axle Counting

As track circuits are phased out, axle counters have become an important way of detecting trains, their direction and speed. Typically, this is done with large magnetic devices bolted to the rail web. These sensors are prone to working loose and being damaged by rail grinding operations as they sit proud of the rail

top. Additionally, they are susceptible to electromagnetic interference. The M&D sensor deals with all of these problems.

It is light, offering greater immunity to working loose. It is compact, giving better protection from grinding and tamping. Because the sensor measures physical train load it does not need setting up once in the rail and the sensor electronics are sealed within a cast body providing excellent electrical and environmental immunity. The M&D sensor is

also immune to being triggered by other metal objects such as steel toecaps and track maintenance tools.

The M&D sensors' ability to work as an axle counter arises from its design as a vertical load sensor and wheel flat detector and is accomplished by positioning a pair of sensors at each end of a sleeper bay.

Train Weighing and Wheel Impact Detection

Weighbridges and impact detectors are common around railways all over the world. They can be used for measuring compliance to standards and also provide input to maintenance management systems. Sensor installation and maintenance are big issues for these systems and often require the railway to be closed for inconvenient periods for installation and maintenance.

The M&D sensor can provide major advantages in quicker and more reliable installation as well as greater reliability and availability of the system.

In addition to simplified installation the M&D sensor can provide enhancements to the data available from a typical site without increases in installation costs.

Accelerometers and temperature sensors within the M&D sensor allow monitoring systems to achieve greater probability of single-pass damage detection and will potentially allow systems to be built with fewer sensors. Lateral acceleration sensing using the built-in accelerometer will enable a multi-sensor equipped site to assist with collection of data for the analysis of bogie hunting problems and other train defects.

IN SUMMARY

The Vortok M&D sensor represents an exciting development for us and our industry. The widespread adoption of an easy-to-use sensor for the measurement and detection of important realtime data about the railway and our ability to understand and control it leads to a number of possibilities. n



Embedded strain sensors are used on Delta Rail's WheelChex system for Metro-North Railroad

Rosenqvist CD200 FASTCLIP installation machine

The Swedish company Rosenqvist Rail AB joined the Pandrol Group in 2008. They develop, manufacture and market modern machinery, equipment and working methods for efficient construction and maintenance of railways, allowing Pandrol to bring engineering capabilities for the installation of the FASTCLIP system in-house.

ROSENQVIST CD200

Drawing on their many years of experience in designing track machines to install FASTCLIP fastenings, the design team at Rosenqvist Rail have just launched the CD200, another example of high quality engineering which delivers a fast, robust and easy-to-use machine.

The CD200 is a high performance, robust, walk-behind clipping machine, designed for use by a single operator and capable of achieving speeds of up to 30 sleepers per minute.

Backwardly-compatible, the CD200 is capable of installing the latest versions of the

FASTCLIP rail fastening system; it also has the facility to intuitively and easily lift any low sleepers up to 50mm, independent of rail height, should it be required.

ROSENQVIST RAIL – HY-RAILS

Denmark – like most parts of the world – has had an increased demand in the railway construction and maintenance market in the past few years. This attracts new contractors seeking profitable business in a vibrant market. Many of the contractors and plant-hire companies choose to equip their earthmoving excavators and machinery with "hy-rails" (i.e. equipment which allows road or tracked vehicles to run on railway tracks), which adds to the flexibility of the application and utilisation of their machinery.

This concept of "road-railer construction equipment" offers huge advantages over big, heavy, immobile traditional machinery. The excavators become more versatile hence they are more profitable for their owners. Hy-railed

excavators get on and off track quickly and easily which makes them excellent for the limited hours of track possessions, or between trains, which is the norm for the railway maintenance business.

The contract hire, or own/operate/maintain, business of heavy specialised equipment is not an insignificant cost, but the small incremental investment in customised "Hy-rails" for an excavator can pay huge dividends in increased flexibility and utilisation.

Rosenqvist Rail AB in cooperation with Danish Takeuchi dealer Øbakke A/S has delivered approximately 30 hy-rail sets for Takeuchi machinery in the past 2 years. This splendid cooperation has led to Øbakke A/S becoming the Distributor of the Rosenqvist range of products in Denmark.

This successful Danish case study is a winning formula that Rosenqvist is pro-actively rolling out around the world and is an excellent reference for Rosenqvist Rail AB continuing to add value to the world's booming railway markets. ■



Rosenqvist CD200 machine



Rosenqvist Hy-rails

JH Spårservice experience with Rosenqvist installation machines for PANDROL FASTCLIP

JH Spårservice AB, based in Hallstahammar in Sweden, is a railway maintenance company, specialising in new track construction in Sweden, Norway and Denmark.

The company was started as a one-man business in 1991 by Hardy Skog, who gradually expanded, bringing in two additional staff members in the formative two years, but the most notable progression was two years on, when the company acquired two articulated backhoe loaders equipped to work with railway maintenance and new track construction. This acquisition enabled JH Spårservice AB to take on more complicated and labour intensive work and the company has expanded gradually over the years. Today the company has about 55 employees and 45 construction machines, of which 35 units are equipped for all types of railway maintenance. The company owns five Rosenqvist CD400 rail fastening installation machines.

Hardy Skog received the "Entrepreneur of the Year" Award in his home town Hallstahammar in Sweden earlier this year, in

recognition of the entrepreneurial spirit he has shown in piloting his company JH Spårservice AB forward in a difficult and labour intense industry with heavy investment and skills needs.

A few years ago the company was appointed the "company's Gazelle winner of Västmanland" (another award in the area). With the on-track traffic needs of maintenance and new construction in mind, Hardy Skog and JH Spårservice AB are in a key position for future development.

In 2006 JH Spårservice AB had taken on a contract for works maintaining rail in a town called Trollhättan in Sweden. They unfortunately underestimated the need of high output performance machinery and rented a home made construction machine to do the job, generating nothing but problems, issues and obstacles.

At a trade machine show he saw the Rosenqvist Clip Driver CD400 for the first time and was thrilled by the concept. He bought the very first CD400. His first job with the machine was de-stressing and track renewal in Morjärv. "I was very impressed with both performance

and technique" says Hardy

Since then he has bought another 4 units of CD400 and they have never let him down. JH Spårservice AB has the largest fleet of CD400s in Sweden. That in itself has created a lot of job opportunities for the company. "The new proximity sensors for automatic fastening are spectacular for de-stressing and the customers notice it" says Hardy.

HISTORY OF THE CLIP DRIVER CD400

The CD400 Clip Driver is an attachment designed and manufactured for use on a road rail vehicle (RRV) using the host machines hydraulic power for operation. It performs high-output clipping and declipping of PANDROL FASTCLIP and e-clips.

One of the advantages of PANDROL FASTCLIP is the fact that the pre-assembled clips, insulators and pads make it very easy to mechanise the clipping and declipping process in track.

In the summer of 1996 Rosenqvist was contacted by the Swedish Banverket Industridivisionen to assist in the development of a machine for the installation of PANDROL FASTCLIP on the Gardermoen Airport railway line in Norway.

The initial design was for installation equipment mounted on a road/rail machine, such as a tractor or an excavator, meeting the following demands:

- The machine needed to have the capability to be very flexible and get on and off track quickly and easily.
- It should be used for other operations on track (a multi-function machine).
- It should be fast and effective.
- It should be able to lift low sleepers, if required.
- The installation should be carried out by only one operator.



Rosenqvist CD400

NEW PRODUCTS

The machine chosen as the carrier was the Huddig road/rail tractor, which was already in Rosenqvist's product programme. This Huddig machine has all the required power and capacity for the necessary hydraulic support and with its hydrostatic controlled hydraulic power it is a great machine for performing several functions at the same time. The machine also benefits from its ability to operate in difficult terrain, on the road as well as on the track, by virtue of its four wheel drive.

After tests, the machine was put into full operation at the end of 1996.

The benefits of the CD400 are the versatility and the high output rate. The operators are happy with them, they keep on working without any setbacks or problems. If you adjust the machine correctly according to clips, rail and sleepers you have a good result and an output rate that beats most machines on the market.

Hardy Skog reports vastly increased company profits due to the CD400s, as the company is able to charge a higher machine hourly rate when using advanced equipment. The company has grown really strong in this line of work, having the largest fleet of CD400s in Sweden. With that capacity and the continuously growing experience bank, customers turn to JH Spårservice AB with confidence; from the South to North of Sweden, in Denmark and Norway as well. Even contractors in the same business rent machines, operators & CD400s from JH Spårservice AB to provide their customers with the best possible service.

Hardy has just bought the very first CD200, the new Rosenqvist invention introduced on the market in 2011 and is looking forward to seeing the results of this new invention. JH Spårservice AB is always striving forward. ■



The PANDROL 'Re' assembly



PANDROL Re assembly

The PANDROL 'Re' System has been designed to achieve savings in manpower during the re-railing process and also to improve the longevity of the rail fastening components on older types of concrete or steel sleepers, by extending the durability of components towards the residual life of the sleepers.

The 'Re' system uses recent major improvements in technology to simplify handling of components, by reducing the number of components from 5 per rail seat to 3 per rail seat. It also adopts the two-part insulator concept that was developed with the

PANDROL FASTCLIP system.

With the 'Re' System, the rail pad is supplied with the side post insulators already attached, reducing time and labour when laying out and installing the components on site. The 'Re' System is also supplied with toe insulators already in place on the toe of the clip, again reducing installation time and the number of loose components on site.

Separating the insulator into two parts has demonstrated greater component life for this vital element of the rail fastening assembly. The separate parts can be made from the same or different materials to further tune track performance.

It also modernises the material used for the new composite components, whilst configuring the designs to improve rail threading and clipping rates. This leads directly to reduce the manpower requirements on all re-railing sites, and Pandrol has assessed savings of about four men per shift.

The design of the 'Re' clip also takes advantage of a new manufacturing process, patented by Pandrol, known as "Intelligent Cold Setting". Clips are individually loaded in a

press which has sensors capable of measuring their mechanical properties. These measurements are used, in real time, to calculate the optimum amount of force that should be applied to produce a clip with the required geometry and material characteristics, and the peak load applied by the press is controlled accordingly. With modern transducers, computing and control systems, this whole process can be completed in a few seconds with no manual intervention so that each and every clip is manufactured to give the best possible performance.

COMPONENT RATIONALISATION

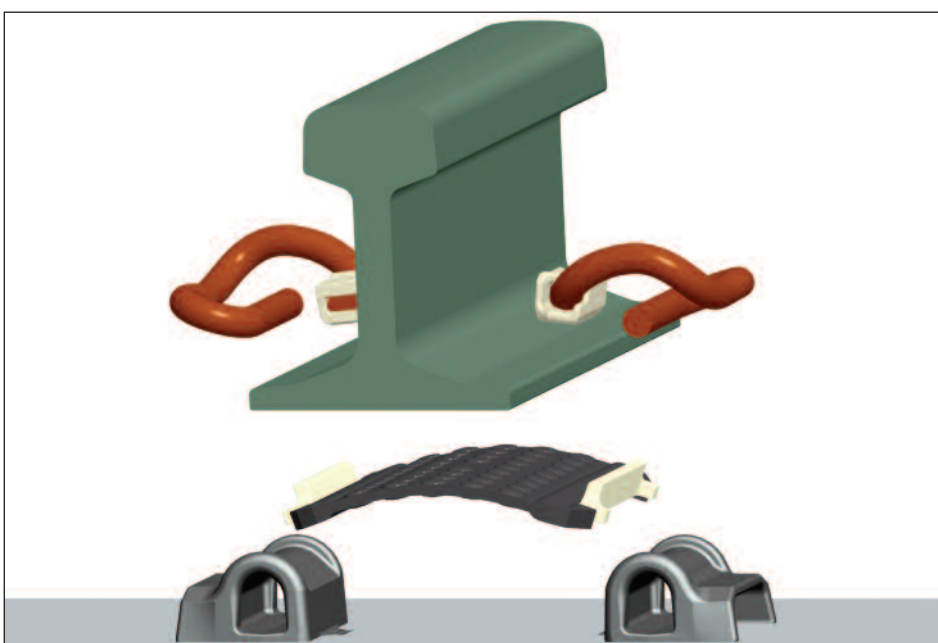
The current assembly of components per rail seat used for replacement of clips, pads and insulators on Network Rail F27 concrete and W400 steel sleepers is:

- 2 x e1809 clips.
- 2 x 724a orange insulators.
- 1 x 7.5-mm grooved rubber rail pad (NB.

This assumes the need for a 7.5-mm 'maintenance' pad).

The assembly above will be replaced by the Pandrol 'Re' system using 3 components per rail seat comprising:

- 2 x Re1609 clip complete with toe insulator
- 1 x Composite 7.5-mm rail pad complete with side post insulator.



Exploded detail



Curved rail pad with integral side post insulators

This means that there are two fewer components per rail seat, and a significant reduction in the time need to centralise the rail in the rail seat during the rail threading and clipping process.

The novel aspect of the 'Re' system is the composite 7.5-mm rail pad attached to the side insulators. This makes the pad and insulator placing quicker and more accurate because the pads are made in a curved condition, as shown on the previous page.

The single composite rail pad is curved to enable easy placing of the pad into the rail seat and stacking of the pads into 'nested' bundles. It should be possible to devise an automated installation method of the composite pad from these nested bundles as a second phase of the adoption of the 'Re' System, leading to still greater efficiency on site.

Rail threading will be easier using a recently developed technique for 'captive' fastening systems evolved for the FASTCLIP

system. The curvature of the pad creates an 'open-jaw' of the side insulators and an inclined plane to receive the rail; the pad is flattened by the weight of the rail as it is threaded into each rail seat. The insulators close on to the foot of the rail as the pad is flattened, centering the rail in the rail seat.

FIRST INSTALLATION ON NETWORK RAIL

The first installation of the PANDROL 'Re' system took place in April 2011 on Network Rail tracks near Bawtry in the UK. The site was on the up fast line, with an approximate 3,000m radius curve, 150mm cant and line speed of 125mph. Sleepers were predominantly F27 but F40s had been installed on an average of one in six sleepers.

Works consisted of re-railing two 709ft lengths of Continuous Welded Rail (CWR). Within this length, 212 F27 sleepers (on the

high rail only) were to be fitted with the new 14,229 composite rail pads and 'Re' 1609 clips.

Work commenced with all existing clips being removed. The rails were then threaded out of the railseats with a McCulloch rail threading machine. The new 'Re' components were then laid out into position on the sleepers from a rail trolley located on the adjacent track.

'Re' pads were then placed into the railseats and the new rails threaded into the railseats. Vortok Stressing Rollers were positioned fifteen sleepers apart, the rails were welded at each end and then destressed in the middle.

Clipping up was completed using standard Panpullers.

On 1st May 2011, the high rail was re-railed. All remaining stock of the new 'Re' system was installed, amounting to 509 F27 sleepers, the whole 709ft length of installed CWR, with the exception of approximately one in eight of them which were F40 sleepers.

The contractors required very little product training as the 'Re' system is not very different from the usual components. However, it was very evident when re-railing of traditional components was taking place that more ten men were used for installing clips, pads and insulators.

Four/five men (two to three of them on their knees) were employed placing insulators. When installing the 'Re' clips, these five men were not required. In general, all that is required to install 'Re' after the components have been distributed is a team of two or four men on Panpullers and one or two men placing clips into the housings (dependent on the length of the installation). ■



Installing Re clips using a Cembre installation machine



Rail threading is easier thanks to the curved pad



Completed track on Network Rail, UK

