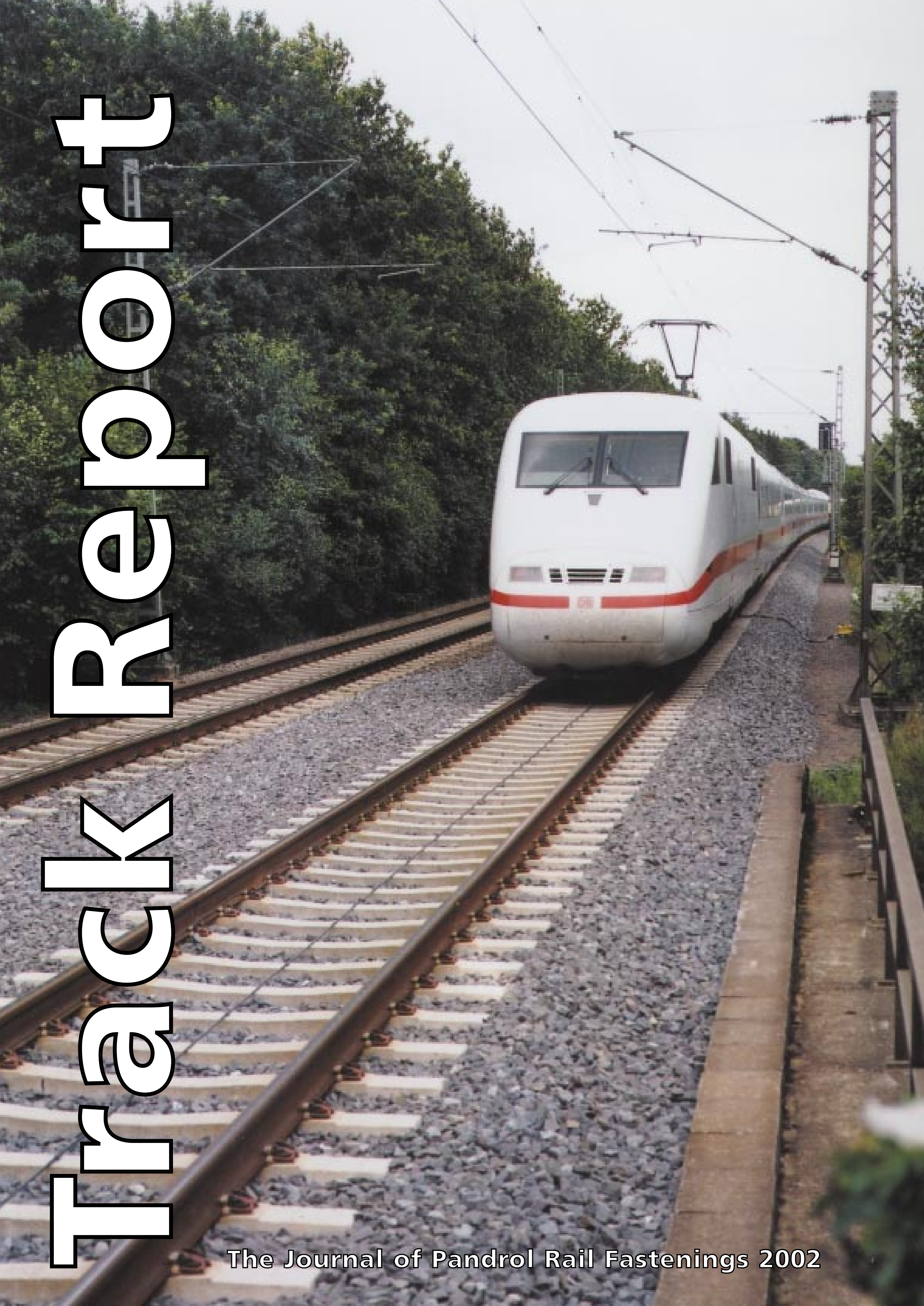
Track Report



The Journal of Pandrol Rail Fastenings 2002

Contents

TRACK SUPPORT SYSTEMS

PANDROL FASTCLIP

PROJECTS

NEW PRODUCTS

Front Cover: Pandrol FASTCLIP installed on the Hanover-Hamburg ICE line, DB-Netz, Germany.

Track Report is published by Pandrol Limited,
63 Station Road, Addlestone, Surrey KT15 2AR England.
Telephone: +44 1932 834500
Telefax: +44 1932 850858
E-mail: info@pandrol.com
Website: http://www.pandrol.com

Pandrol Limited gratefully acknowledge 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.

PANDROL®

Testing the PANDROL VANGUARD Baseplate on Hong Kong's MTRCL Test Track

by David England, Design Manager (Permanent Way), MTR Corporation Ltd, Hong Kong

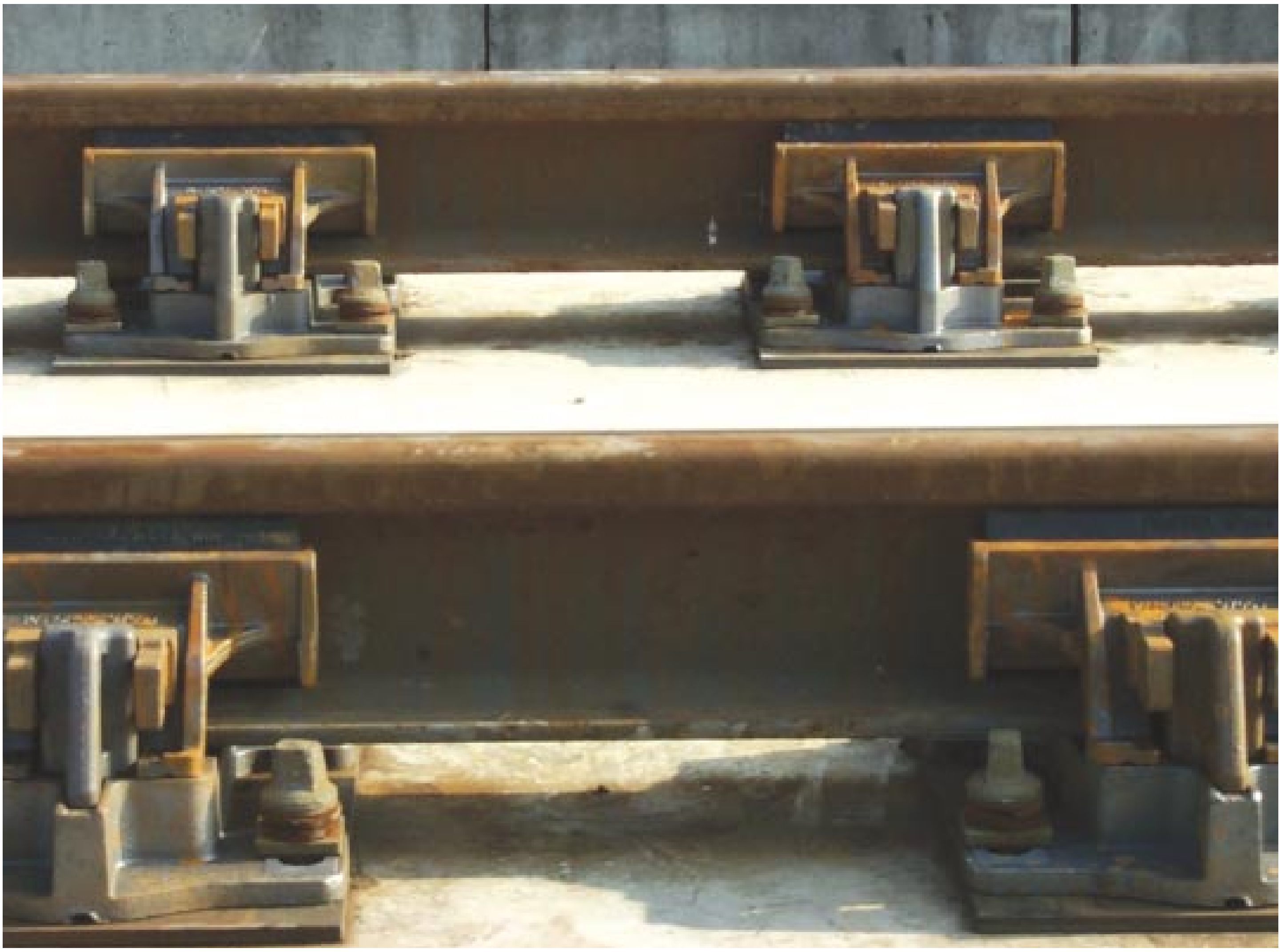
Hong Kong's Mass Transit Railway Corporation operates metro railway services in one of the most densely populated areas in the world. Owing to the proximity of the railway to residential, commercial, educational and hospital developments it is often necessary to attenuate noise and vibration levels to a minimum in order to satisfy Hong Kong's stringent Noise Control Ordinance. The foremost method of ensuring that railway vibration transmission is minimised in environmentally sensitive areas has been, in MTRCL's experience, to employ sections of Floating Slab Track (FST). However this is both costly and slow to construct.

An alternative to FST is Isolated Slab Track (IST), a mass spring system employing a rubber ballast mat. IST trackform is quicker and easier to install but does not provide the exceptional level of vibration attenuation of the FST. However there are many locations where IST performance is sufficient to meet requirements and this trackform was extensively used on the recently opened Tseung Kwan O Extension.

PANDROL VANGUARD

The recent development of a revolutionary baseplate system by Pandrol that supports the web of the rail with resilient blocks held in place by cast side plates transferring the load to the track invert, provides another trackform option for vibration sensitive areas. This development is the Pandrol 'VANGUARD' which supports the rail above the track base rather than supporting the rail on resilient elements beneath it, allowing the system to achieve a lower stiffness than any conventional baseplate.

MTRCL operates a policy of installing only tried and tested components on the rail network and it was agreed to test the Pandrol VANGUARD on the Test Track located adjacent to Siu Ho Wan Depot on Lantau, prior to testing in a revenue



service track. The Pandrol VANGUARD was tested on three different configurations – on a solid concrete slab, on an IST with one particular proprietary ballast mat and on another IST with a different ballast mat installed. In all cases, the Pandrol VANGUARD's performance was compared to the standard resilient baseplate fasteners used by MTRCL (the Pandrol VIPA and the Delkor Alt 1). Each test slab is approximately 42 metres in length and all tests were undertaken using a two-car Tung Chung Line E.M.U. operating at 60 km/h with an axle load of 13.5 tonnes. This was the first time that Pandrol VANGUARD had been used to support UIC60 (EN60E1) rail and the first time that the fastening had been configured as a separate baseplate to be bolted to a slab. This required new castings to be manufactured that would be compatible with the existing rail height. The Pandrol VANGUARD baseplates arrived in Hong Kong in late December 2001 and the installation was scheduled for mid-January 2002.


Fig 1: Installing VANGUARD using a hydrolically powered hand tool to apply clamping force


Fig 2: Checking track gauge

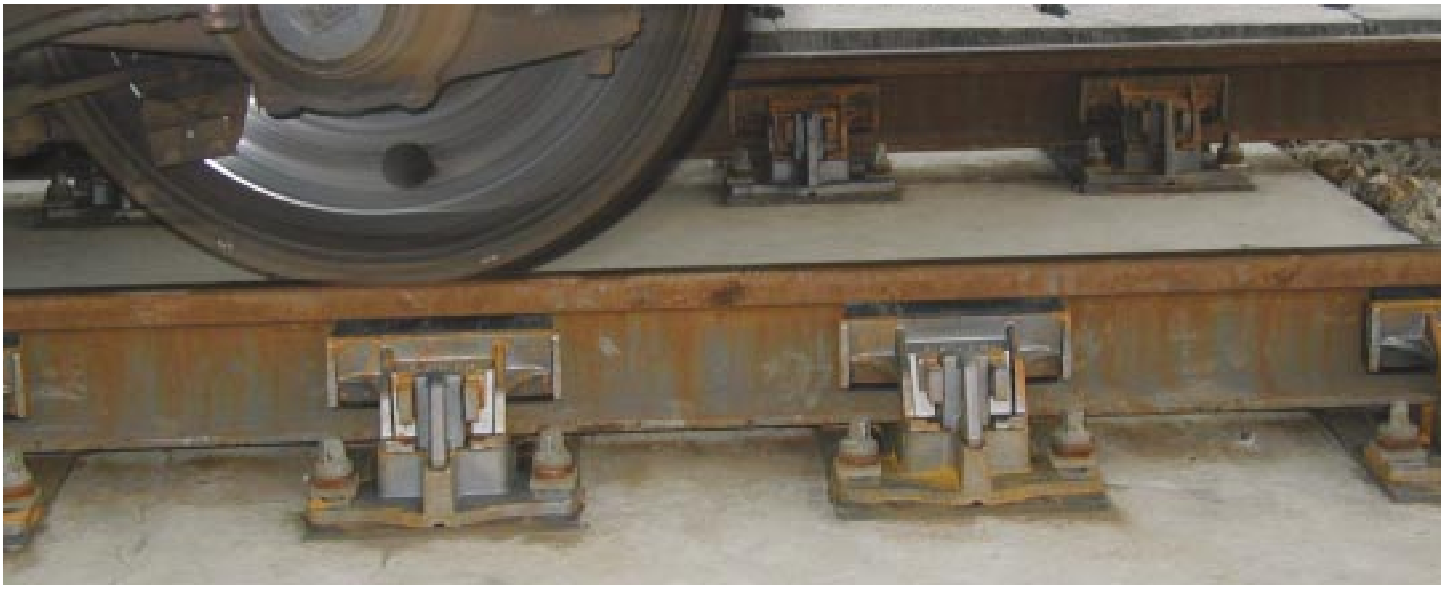
TEST RESULTS

Although Pandrol had arranged for its own staff to undertake a rigorous testing regime, MTRCL policy dictates that an independent consultant monitor and analyse all test results. For this particular installation, Messrs Wilson, Ihrig and Associates (Hong Kong) provided these services. Therefore two sets of test data were obtained for each of the tests.

Testing commenced in mid-January 2002 with measurements initially taken (with standard resilient baseplates fitted) of vibration at three different locations – under the rail, in the centre of the track slab and at the edge of the track – and of rail deflection. Wayside noise measurements were also taken using microphones. Once these tests had been completed, the screwspikes from the baseplates were removed, the rail jacked and the existing baseplates replaced by the Pandrol VANGUARD. Both baseplates have an identical 'foot print' as far as the holding-down assembly is concerned. Therefore the same cast-in sockets in the slab can be used to secure both types of baseplate. The field-side hook-in shoulders were placed in position and the rubber rail supports located approximately before using the clamping tool to finally position the fastening onto the rail. Finally the gauge was set and the screwspikes fastened down.

Testing recommenced using the same two-car E.M.U. at 60 km/h and further measurements were then recorded for the other two slabs, with both the standard resilient baseplate and the Pandrol VANGUARD baseplate installed. When testing was complete, the raw data was analysed and compared. The measurements taken by Pandrol's engineers were almost identical to those recorded by Wilson, Ihrig and Associates, displaying good correlation.

Vertical rail deflection was measured to be an average of 4.5mm for the Pandrol VANGUARD whilst for the standard resilient baseplate deflection it was less than 1mm. Readings for lateral movements were measured and found insignificant, owing to the test site being located on tangent track.



With regard to vibration, the introduction of the Pandrol VANGUARD on the plain slab resulted in an average reduction of 7.3dB in the frequency range between 20Hz and 500Hz, and 13dB in the critical frequency range between 40Hz and 80Hz.

By adding Pandrol VANGUARD to the two IST slabs, a particularly effective vibration reduction combination was achieved, giving an average reduction of 11dB between 20Hz and 500Hz, and about 18dB in the frequency range between 40Hz and 80Hz, when compared to conventional resilient baseplates on the plain slab.

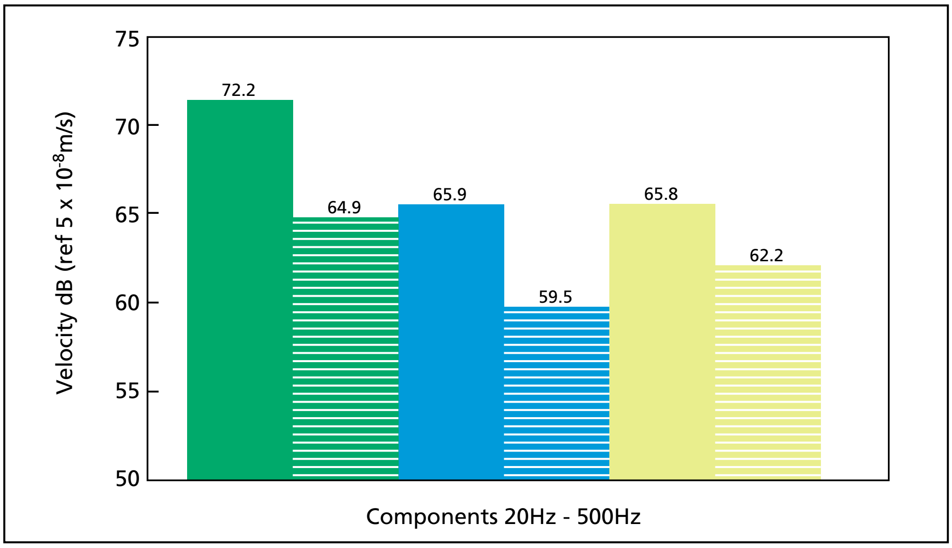
The Pandrol VANGUARD baseplates remain in track at Siu Ho Wan Depot and no adverse reports on their performance has been received. Their performance will be monitored at regular intervals for the foreseeable future.

THE FUTURE

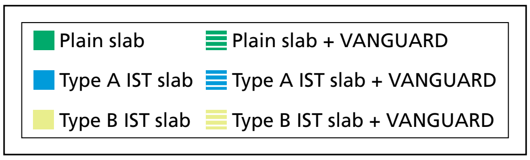
A further trial of the Pandrol VANGUARD is planned in the platform areas of Hang Hau station on the recently opened Tseung Kwan O Extension. This particular site incorporates a 2000 metres horizontal radius-curve and will provide further detailed information on vibration reduction at existing locations on the operating MTRCL railway, which may be applicable for other vibration sensitive areas on existing tracks.

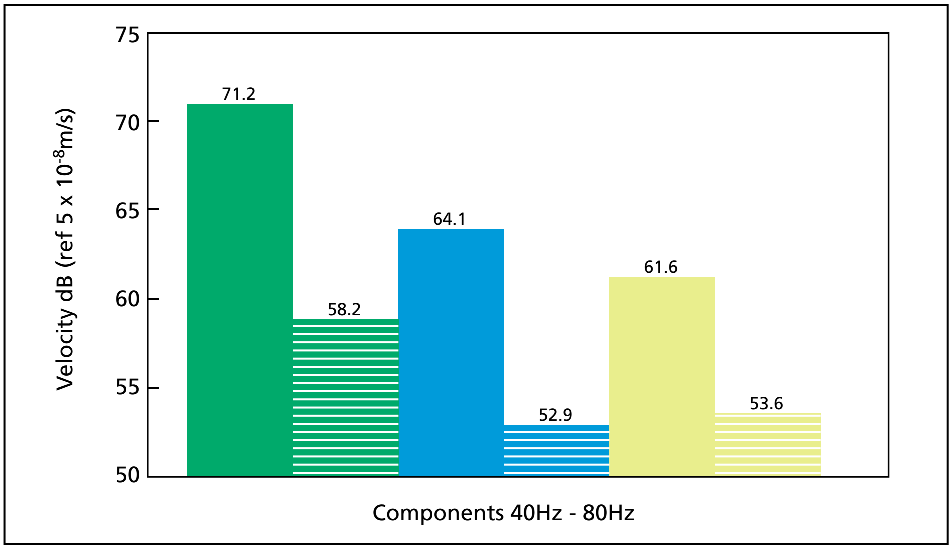
CONCLUSIONS

The Pandrol VANGUARD baseplate offers substantial vibration attenuation performance but with the advantage that replacement of any components can be far more easily achieved than on existing IST or FST systems. Pandrol VANGUARD in combination with an IST trackform gives a particularly effective means of reducing vibration. ■



Total velocity levels on side of slab 20Hz-500Hz





Total velocity levels on side of slab 40Hz-80Hz

PANDROL VIPA Installation on Banverket, Sweden

by Martin X. D. Li, Ph.D., Track Engineering, Swedish National Rail Administration (Banverket), Sweden

Fig 1: VIPA bridge in Karlstad

The PANDROL VIPA track support system was installed on a new railway bridge on Banverket in Sweden in November 2000 to control vibration and noise radiation from the bridge.

Comparative noise and vibration measurements were then made on two steel bridges. The bridge on which PANDROL VIPA was installed was a straight new steel bridge, 140m long, about 0.75km west of Karlstad railway station. A view of this bridge is shown in Figure 1.

This bridge is of a modern design, with parallel spans for the railway track and for a footway. The railway bridge has a single track and is about 7m wide, and the footway bridge is 2.5m wide. The BV50 rail was fixed directly to the steel deck of the bridge with PANDROL VIPA baseplates (Figure 2).

Fig 2: VIPA Assembly

The other measurements were made on an older steel bridge, about 1.75km east of the Karlstad station. This bridge was originally constructed for two tracks but only one remains in use. The bridge is about 220m long and 5.3m wide, which includes 1.1m for a footway. The BV50 rail is fastened with Heyback baseplates (Figure 3) on 2 wooden sleepers fixed to the bridge girder.

Fig 3: 'Heyback' Assembly

The objective of the measurements was to collect data on vibration and noise levels for the two different bridges under traffic. The aim was to show that noise levels from new bridges of modern design fitted with resilient baseplates compare favourably with those for older types of bridge with timbers and stiffer baseplates.

There are a number of potential noise sources on a bridge. These include the rail, the sleeper and the bridge girders.

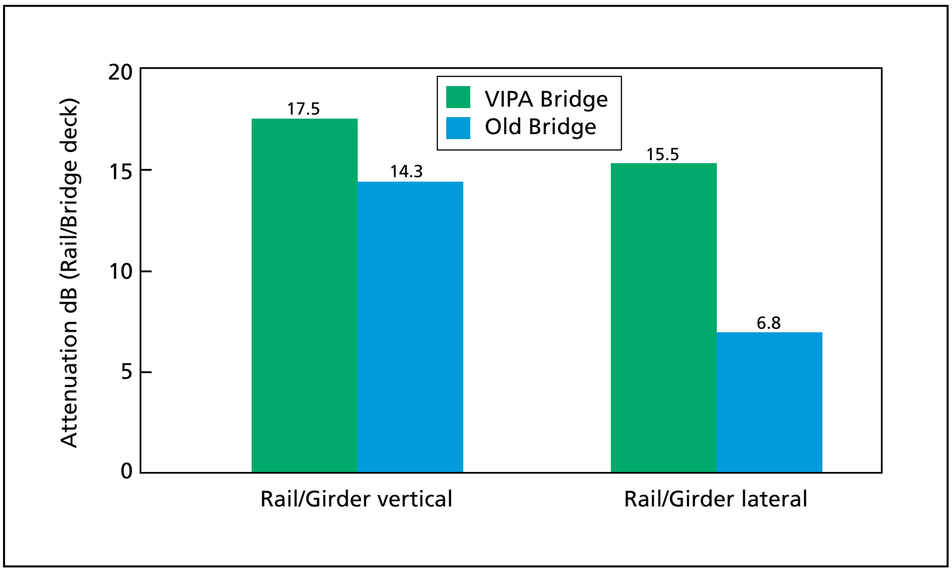


Fig 4: Vibration attenuation between rail and bridge girder

VIBRATION MEASUREMENTS AND RESULTS

Vibration measurements were made in the vertical direction on the rail foot, and in the lateral direction on the rail web. Bridge vibration measurements were made in both the vertical and lateral directions. The frequency range of greatest interest is from about 20Hz up to about 2500Hz. Results were averaged for at least 2 trains of each type.

A direct comparison of the effects of the rail fastening alone is not possible, due to the different rail/wheel roughnesses, different train speeds, and the different bridge structures. However, the vibration attenuation between the rail and the bridge girder indicates that the new bridge fitted with the VIPA system has a lower transmission than the old bridge. This is shown in Figure 4. The attenuation of vibration between the rail and bridge girder on the bridge with VIPA baseplates was about 3dB greater in the vertical direction and about 9dB greater in the lateral direction when compared with the old bridge.

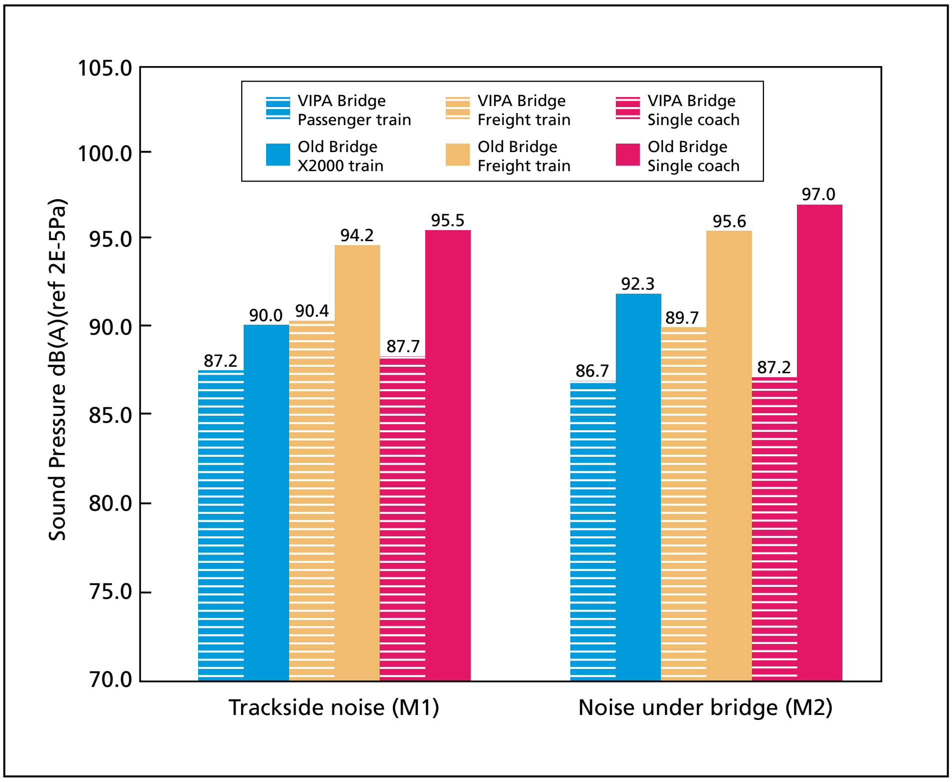


Fig 5: Track side noise measurements

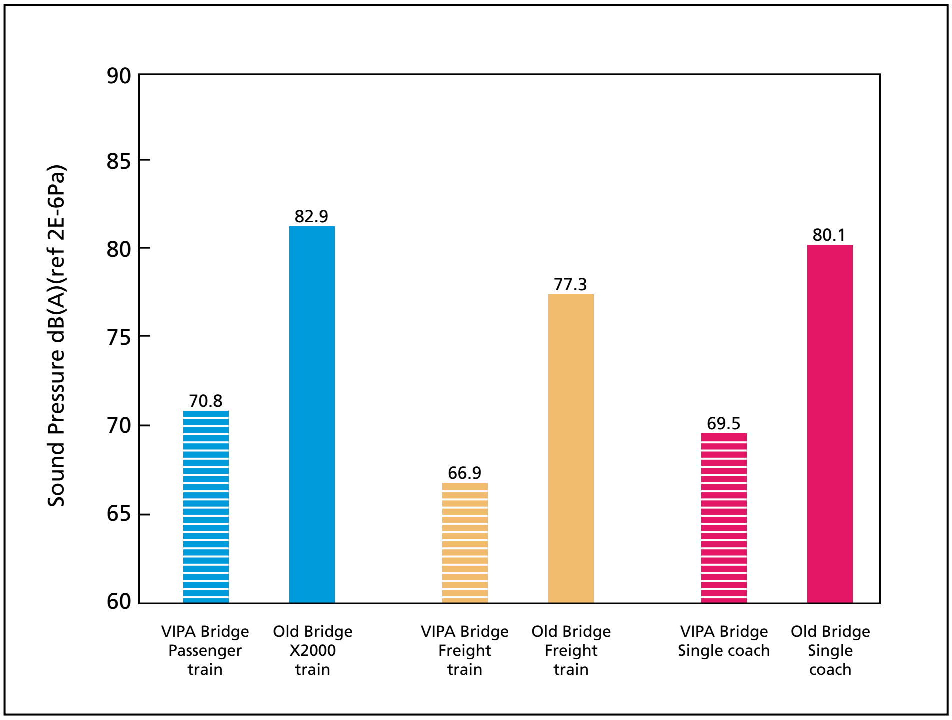


Fig 6: Noise measurements at 50m from bridge

NOISE MEASUREMENTS AND RESULTS

Noise measurements were made at three positions. One was a track side measurement at 3m from the near rail. The second was under the bridge, 3m below rail head level, and directly below the first microphone. The third was about 50m from the track centre and 1.5m above the road surface.

Noise levels were shown to be lower on the bridge with VIPA baseplates than on the old bridge. The average noise level was 4.8dB(A) lower at track side and 7.1dB(A) lower under the bridge (Figure 5). On the old bridge, the noise under the bridge is higher than the noise at the track side. This indicates that the component of noise radiation from the bridge may be higher than that from the track itself. On the bridge fitted with VIPA baseplates, the noise levels near the track and under the bridge are similar.

The noise level at 50m from the bridge was 11dB(A) lower for the bridge fitted with VIPA baseplates than for the older bridge (Figure 6). There are significant differences between the bridges and the traffic running over them which mean that these difference cannot be attributed to the VIPA baseplates alone. However, the measurements do show that where bridges of the new type fitted with VIPA baseplates are used to replace older existing bridges, there is unlikely to be a rise in wayside noise, and indeed, a significant reduction is likely.

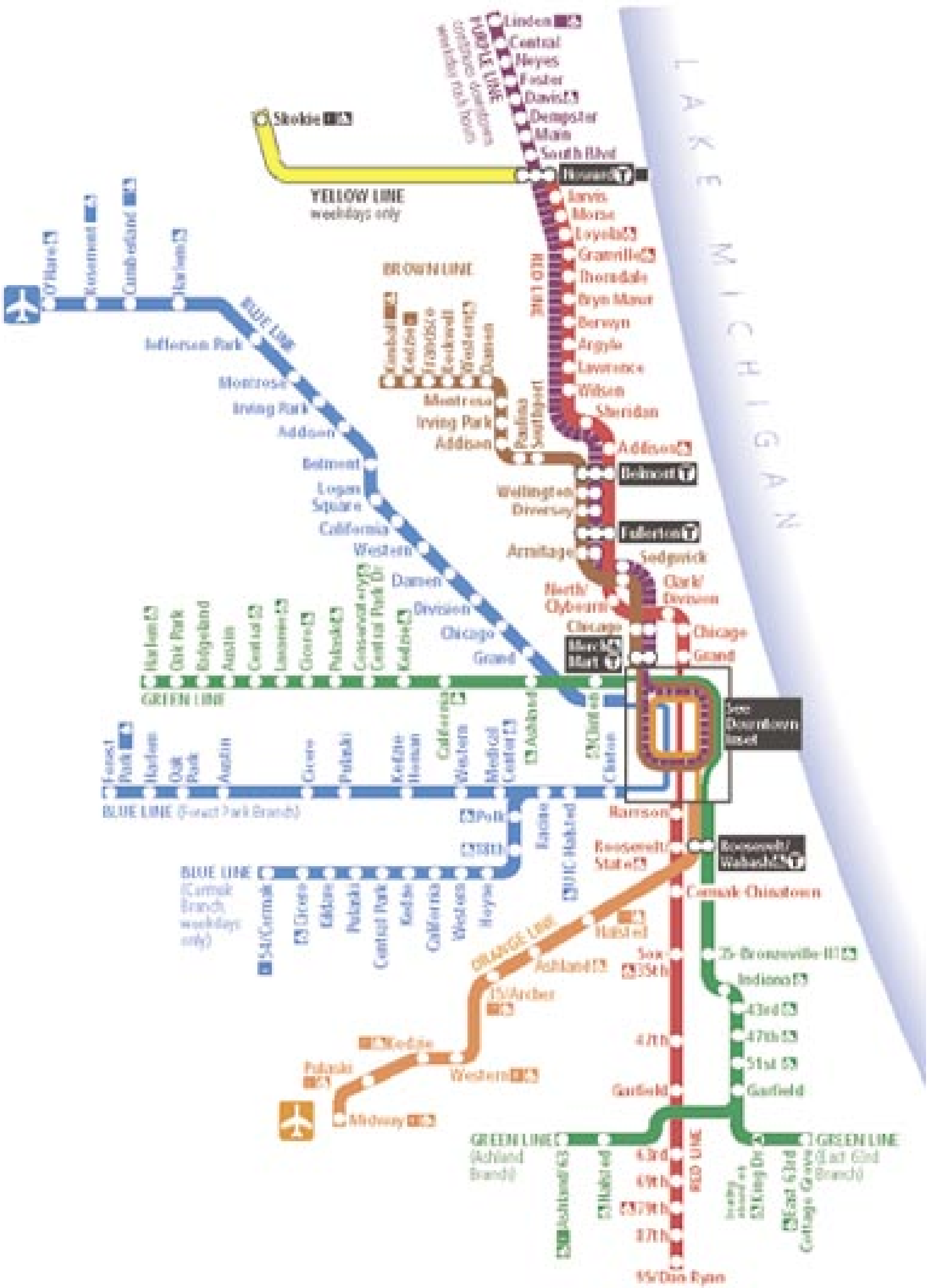
CTA Blue Line (Douglas Branch) Rehabilitation

by Ray Schriks, General Manager, Power & Way Engineering, Chicago Transit Authority, USA

The Chicago Transit Authority began operations as an independent governmental agency in 1947 after acquiring the properties of the Chicago Rapid Transit Company and the Chicago Surface Lines. It is recognised as the United States' second largest public transportation system and operates approximately 1,900 buses along 134 routes and over 1,900 route-miles in addition to its rapid transit rail system.

CTA's rapid transit rail system, one of the few in the world that provides service to two major airports – O'Hare and Midway – and one that serves 144 stations, consists of 291 miles of track over seven routes. The CTA track structure is a combination of ballasted track with either red oak or plastic ties, red oak half ties embedded in concrete in both subway tunnels and steel bridge elevated track with azobe, Douglas fir, southern yellow pine, or plastic ties. The world famous elevated configuration referred to as "The Loop" defines the hub of downtown Chicago and all but one CTA Rapid Transit routes pass through the "Loop" to serve the city. The Skokie Swift – Yellow Line operates an out and back, single stop route through Skokie, a northern suburb of Chicago.

Rehabilitation of existing track using Pandrol "e" clips began in the early 1990's when the CTA renewed the track in the State Street Subway and along three routes of ballasted track. Complications experienced during the Green Line reconstruction in the late 1990s provided the CTA with the impetus to implement a design modification that included a polyurethane insulator bushing to isolate the screwspikes from the tie plates. On the CTA structure, one running rail carries a low voltage signal-based current. Should the screwspike used to fasten the tie plate to the tie penetrate through the tie and contact the hook bolt that fastens the tie to the structure or contact the structure itself, the signal system grounds and the signal system and third rail power system try to use the same ground, thereby shorting out the signal system. The repair for this is time consuming and very expensive.



CTA route map

Stray current corrosion of screwspikes is a similar corrosive problem for the fasteners on ballasted track. Track inspectors may see what appears to be a new screwspike or lockspike head and think the fastening is solid; however, upon closer inspection the fastening is found to be "floating" in the hole since electrolysis has corroded all but the top portion. In both cases, introducing a small, inexpensive part that removes electrical conduction to the tie plate screwspike eliminates major maintenance problems and expensive repairs.

The use of non-conducting plastic ties still requires the use of insulator bushings to protect the fastenings; however, a plastic tie's service life is expected to far outlast that of its wood counterpart. Plastic ties are expected to be more resilient than wood, and are an environmentally sound initiative as well. CTA has already installed thousands of plastic ties in ballast and is now expanding its installation program to include them in the elevated structure; more are expected in future projects. All of these innovations are designed to lengthen the service life of products on the CTA system and improve the quality of ride for its passengers.


Detail of track structure

Vibration emanating from the CTA track is the biggest problem experienced by the non-fare paying public and this concern is reflected in the re-design of both track and support structure involved in the continuing Blue Line Douglas Branch Rehabilitation Project. The Douglas Branch, the portion of the Blue Line that diverts from the Forest Park Branch at Loomis Jct. and


Track structure

runs to the 54th / Cermak Station terminal, is in the midst of a top-to-bottom rehabilitation that began in the fourth quarter of 2001 and is expected to be completed within five years. Six stations are to be reconfigured from separate, direction-specific platforms to single, centre island platforms serving both directions of traffic. The new stations will be constructed on a mixture of concrete and steel structure.

In all, around five track miles of elevated bridge track and over a mile and a half of ballasted track will be renewed. Once construction is complete, track speeds will be dramatically increased from pre-contract days of mixed slow zones. The speed increase will be achieved through track structure improvements that include Pandrol P60 rolled steel tie plates with Pandrol "e" clips on plastic ties for all ballasted track renewal. The elevated structure will be renewed with a mixture of rolled steel tie plates with Pandrol "e" clips on plastic ties and the Pandrol 9938 Single Resilient System Track Fastening Assembly. All of the rolled steel tie plates shall be modified to accept the polyurethane insulator bushings to protect the screwspikes.

Pandrol 9938 Single Resilient System

The CTA decided to use the Pandrol 9938 assembly, designed by Pandrol in conjunction with CTA Engineering, in acceleration/ deceleration zones before, through and after the new stations because of the anticipated cost savings associated with reduced vibration achieved using a single pad vibration isolation assembly. The reduced vibration will increase rail life by decreasing rail corrugations in these high stress areas of the track. At the heart of the Pandrol 9938 assembly is a double-studded natural rubber resilient railseat pad designed to dampen vibration. Resilience of this assembly is estimated to be between 185,000 lb/in and 225,000 lb/in (33 and 40MN/m). The plate size is limited by third rail proximity and the exterior plastic tie guard block location, thus eliminating use of a double resilient pad assembly. The Pandrol 9938 SRS Track Fastening Assembly will be installed over plastic ties through the station platform areas and over wood ties through the reverse curves that approach and trail each station. In all, over 14,000 assemblies and over 40,000 Pandrol P60 tie plates will be installed during the project.

Although the net effect of the Douglas Branch rehabilitation work on vibration reduction cannot be quantified until the project is complete and measurements can be taken with trains operating at scheduled speeds, it is expected that the end product will provide a quieter, smoother ride through reduced vibration-induced noise in the neighborhoods through which the line runs.

Future CTA projects expected to involve the latest Pandrol line of vibration reducing assemblies (to include a restraining rail version of the 9938 assembly) are the Harrison/Wabash Curve Reconstruction south of "the Loop," and anticipated work along the Red and Brown Lines. ■

Old steel support structure

New concrete support structure

PANDROL FASTCLIP: DB Project Hasenwechsel 2 The Langenhagen – Celle Track Renewal Project

By Professor Dr. Ing. Johannes Franz, Consulting Railway Engineer, Honorary Professor at the Technical University, Berlin

GENERAL SITUATION

In 1994, Deutsche Bahn began all necessary checks and tests on the PANDROL FASTCLIP system, including a trial installation of 2,018 B-70 FASTCLIP concrete sleepers, with the result that the Federal Railway Office issued a general approval for this system on 30.10.1996.

DB used FASTCLIP FC1501 on a large scale for the first time for the Hasenwechsel 2 track conversion project. This step was negotiated between the DB Netz Board and Pandrol in March 2001 at Frankfurt am Main. The Hanover Line Management Office at the Northern Establishment was responsible for the planning and implementation of the construction work.

CHARACTERISTICS OF THE CONSTRUCTION SITE

The section under construction was the left track (in kilometrage terms) of the Hanover-Hamburg dual track ICE line between the Hasenwechsel junction and Isernhagen Station, from km 31.047 to km 18.527 and at the Isernhagen Station from km 18.416 to km 17.276. Altogether 22,765 B70 P60 concrete sleepers were laid over 13.660 km of track. The track is for the most part straight. In the 2.0 km of bends, the smallest radius is 3,850 m and the largest super-elevation 70 mm. The track loading is around 43,000 tonnes/day, at speeds of 200 km/h.

The section under construction is followed in the direction of Langenhagen by a 5.361 km long

comparative section with permanent way W 14K and W 14K 900 and a section with rail pads of varying stiffness.

PLACING OF ORDER, USER'S DECLARATION AND MANUFACTURER RELATED PRODUCT QUALIFICATION

DB Verkehrsbaulogistik GmbH placed an order on Pandrol for the fastening system and on L. Moll for the sleepers around 100 days before the sleepers were manufactured, which was due to start early in January 2002.

The user declaration for operational trials of the P FC1501 permanent way and the B70 P60 concrete sleeper was implemented by DB Netz on 18.1.2002, in line with the approval obtained from the Federal Railway Office for the B70 P60 concrete sleeper. The user declaration was linked to a reduction in the theoretical gap between the rail base and the side post insulator of 2 x 1.25 mm (PANDROL original) to 2 x 1.0mm. DB Netz also reduced this gap for the W permanent way at the same time, from 2 x 1.1 mm to 2 x 0.6 mm.

Because PANDROL had been graded as a Q 1 supplier to DB in 1996, the fastening components had to be approved and a manufacturer-related product qualification (HPQ) issued. Both tasks were effectively completed by DB Technology, Production means/Track systems Procurement Quality Assurance, on 22.2.2002.

SLEEPER PRODUCTION

When producing the sleepers the tolerance of the shoulder seating could be kept within very tight limits by means of the tensioning mechanism clamping the FASTCLIP shoulders while the concrete cured. In addition, particular care was taken to avoid exposing the sleepers to any kind of vibration until they had hardened. In this event, DB was guaranteed toe loads of between 8 KN and 11.5 KN for each FASTCLIP.

The process of removing the moulds from the concrete while fresh (after it had compressed) proved technically and economically advantageous. A check (but not adjustment) of the shoulder seating was possible immediately after production started and only a few moulds had to be modified to produce the sleepers.

A daily output of 800 sleepers, customary for W sleepers, was achieved during manufacture. The transition from screwing (permanent way W) to a clip driving process (permanent way P) when pre-assembling the clamping components produced two worthwhile means of rationalisation: dispensing with corrosion protection/sealants and the simultaneous driving of all FASTCLIPS to a sleeper by a robot at the pre-assembly stage.


Track Laying Machine VWF2001

TRACK CONVERSION AND TENSION COMPENSATION

The section under construction was laid between 2 March and 7 March 2002 by the Track Laying Machine VFW 2001.

The 180m 60 E 2 rails were laid between the FASTCLIP shoulders at a somewhat reduced distance without any problems; the rails settled on the rail seat pads, assisted by an applied vibrating device.

A PANDROL Mk I or Mk IV clip driving machine followed the track laying machine, travelling at the preset working speed, simultaneously driving all four FASTCLIPS per sleeper and occasionally lifting low sleepers.

To de-stress the continuous rail, all FASTCLIPS were returned to the parked position and driven again after the necessary rail length had been obtained by tensioning or heating.

De-stressing of the 180 m rails is achieved by:

- a rail tensioning device and final welding by resistance flash butt welding (Schlatter


Rail Welding

Pandrol MKIV Clip Driving Machine

welding head) in accordance with a temperature difference of around 20°C

and, only on the continuous main tracks at Isernhagen Station and the Grossburgwedel Halt, for comparative purposes:

- a heating device on a trolley and AT final welding in accordance with a temperature difference of approx. 10°C

Both are standard procedures at DB, the former requiring the double detaching and bracing of anchor lengths 60 m long (corresponding to 20 K), requiring particularly extensive clip switching. Here, too, the rationalisation aspects already described under pre-assembly were evident: the driving of the FASTCLIP fastenings is faster than screwing threaded fastenings, and requires less labour.

The height of certain butt welds was not up to standard and had to be finished with additional grinding work. In the future, FC1501 permanent way with height adjustability of approx. 2 mm will produce more economical solutions.

PANDROL FASTCLIP on the French National Railways

After an extensive evaluation lasting several years involving laboratory testing, track performance trials in curves and high speed lines, and installation performance trials, RFF/SNCF have confirmed their decision to use the Pandrol FASTCLIP system on all concrete sleeper renewals and new line construction projects in France. This will include the construction of TGV Est during 2004-2006.

The evaluation process to compare captive fastening systems against the existing French threaded system, included a rail fastening tender for pre-assembled fastenings, a concrete sleeper tender to compare sleeper and pre-assembly costs of the FASTCLIP and the German threaded system and a tracklaying tender, in which contractors quoted installation costs for the two systems. FASTCLIP won the three way evaluation process.

The contract will run for 5 years from 2003 and represents a major step forward in the growth of FASTCLIP sales in Europe. ■

A Pioneer Experience with PANDROL FASTCLIP in South America

By Henrique da Luz, Permanent Way Technician, Carajás Railway, Brazil

DESCRIPTION OF THE CARAJÁS RAILWAY

The Carajás Railway – EFC, is one of two railways belonging to and directly operated by the CVRD, the world's largest exporter of iron ore. It is part of a compound integrated mine-line-port implemented for the exploration of the Mineral Province of Carajás, located to the south of the State of Pará, that possesses reserves of iron ore in the order of 18 billion tons, being one of the largest reserves of high grade iron ore (66%) in the world. It is important to consider also the significant presence of other minerals in Carajás, such as manganese, copper, nickel and gold.

All the production of Carajás destined for the export market is channelled through the port of "Ponta da Madeira", located in São Luís, capital of the State of Maranhão, an automated port compound with capacity to receive ore carriers up to 360,000 tons and with a storage yard capacity of up to 3.6 million tons of iron ore.

The Carajás Railway was built as a single line, with 47 passing loops, 1.6 metre gauge, axle load 31.5 t, and approximately 892 km in length. The line runs predominantly in flat country requiring little or no embankment and few tunnels or viaducts. The bridges and viaducts account for only 11.2 km of the total track, the most important being the bridge on Tocantins River, with a length of 2,310m. The track is signalled throughout, with all traffic controlled from the Operation Control Centre, located in São Luis.

Three train types operate in the Carajás Railway: ore trains, comprising of 2 locomotives and 206 wagons; cargo trains with about 90 wagons, and passenger trains with approximately 17 cars.

Ore trains transport around 21,630 tons each, reaching more than 2 km in length, characterising the Carajás Railway as a typical heavy haul operator.

EFC is amongst the most modern railways in the world: 73% of its track is tangent, with a minimum radius of curve of 860 metres and a 0.4% gradient for loaded trains.

These are the main characteristics of the Carajás Railway. A modern railway, highly productive, and qualified to carry in the order of 57 million tons of ore per year.

Fig 1: Bridge over the Toncantins River

FASTCLIP TEST

Innovations on the world stage happen very quickly, and the railroads are no exception. Being one of the largest mining companies in the world, and having customers in all continents, CVRD tends to increase its production gradually and it is more and more difficult to find the necessary time to perform satisfactory maintenance. Considering this fact, manufacturers have been looking to develop components that are easy and fast in application, aiming to reduce the time required for installation and maintenance of the track. The Pandrol FASTCLIP is a rail fastening developed to be pre-assembled on the sleeper at the manufacturing plant, and delivered to site with all components captive on the sleeper. This gives the possibility for fast, automated application.


Fig 2: Pre-assembled sleepers at the manufacturing plant

Concrete sleepers pre-assembled with FASTCLIP FC 1601 fastenings were installed on the Carajás Iron Ore Line in January of 2001, between Arari and Victoria do Mearim, approximately $2^{1}/_{2}$ hours drive South West from São Luis. This was the first time FASTCLIP had been installed in South America.

The FASTCLIP track site is predominately tangent track at zero percent grade.

Sleepers were installed using the Gorilla method. The rails were raised on wooden blocks, old timber sleepers fitted with 'K' type cast baseplate and elastic clips were removed in batches of 3 or 4, ballast scooped out, then concrete sleepers with FASTCLIP fastenings re-installed under the rails. Individual sleepers were then held up against the rail foot and clips installed using hand tools.

To date, the fastening system is behaving in a satisfactory way. CVRD is confident that the FASTCLIP fastening will provide an improvement in the execution of the maintenance of several railroads where they will be installed. The results of the tests will be known officially at the end of 2002. ■


Fig 3: Removal of old timber sleepers


Fig 4: Excavation of ballast


Fig 5: FASTCLIP concrete sleepers re-installed under rails


Fig 6: Completed track

PANDROL FASTCLIP application in South Africa

by Arthur Kretzmann, Manager (Perway), COALlink, South Africa

The Sishen-Saldanha iron ore export line (860 track kilometres, 1067 mm gauge) carries 40 mgt annually with 30 tonne axle loads. Approximately 20,000 sleepers are replaced per year on this line owing to alkali-silica reaction problems on the original concrete sleepers. The Broodsnyersplaas-Richards Bay coal export line (1100 track kilometres, 1067 mm gauge) carries 100 mgt annually with 26 ton axle loads. Approximately 15,000 concrete sleepers are replaced per year on this line, mainly owing to derailment damage.

The Fist type rail fastening system in place on these two lines has been problematic owing to the high level of rail maintenance required, such as gauge adjustment and redemption, rail pad replacement, transposing, destressing and rail replacements. In 2000 a decision, in principle, was taken to move towards the use of a rail fastening system mounted on the surface of the sleepers for all new sleeper requirements for the two heavy-haul lines.

In June 2000, test sections of sleepers with Pandrol e-Clip and FASTCLIP fastenings were installed on the coal line to evaluate the performance of these systems in track, as well as to determine the benefits to be gained during rail maintenance activities. At the same time the estimated life cycle maintenance cost of the systems were compared. The FASTCLIP system proved to be the most advantageous and the go-ahead for production was given.

Initially HDPE rail pads will be used, but the FASTCLIP design makes allowance for resilient pads to be introduced if required at a later stage. For the ore line, the design is such that gauge adjustments up to +10mm can be made (in 5mm steps) to improve wheel wear through pummelling. For the coal line, on the other hand, the design is such that gauge redemption of up to 10mm can be achieved (in 5mm steps) to offset gauge widening as a result of side wear on the rails.

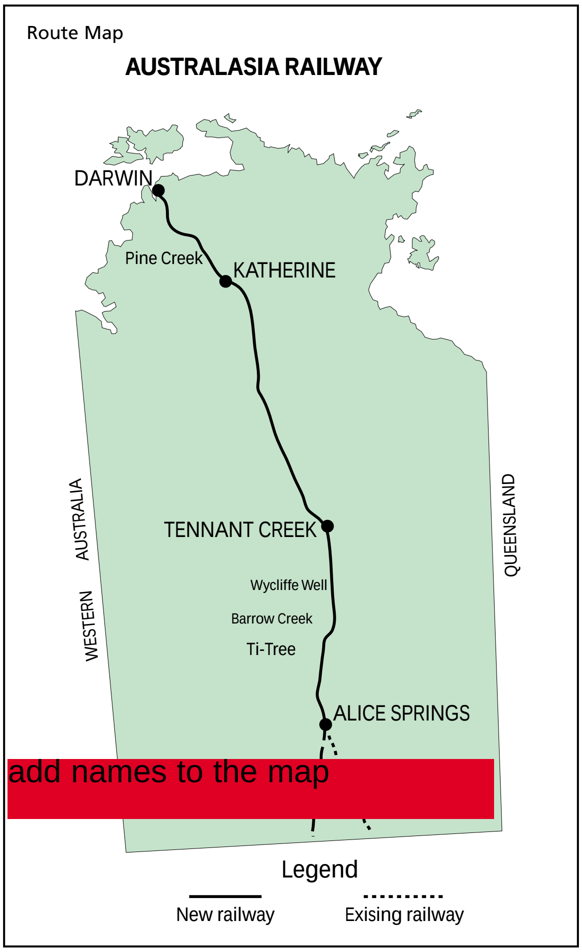
The first production sleepers with FASTCLIP fastenings will be installed during 2002. Immediate benefits are expected through the reduced installation cost of the sleepers with all components pre-assembled in the factory. The main benefits are, however, expected in the longer term through improved performance of the fastening system and reduced resources required for rail maintenance activities. ■

Alice Springs – Darwin Railway Project

The Alice Springs – Darwin Railway is being constructed to connect the deep water Port of Darwin to the National Railway network, creating a new trade route between the north and the economic centre of South Eastern Australia.

This will not only serve to provide a more efficient alternative for reaching Australia's export markets, but will also have significant benefits for regional towns along the route in terms of employment, tourism and agriculture.

The route length from Alice Springs – Darwin is approximately 1420km. Construction depots have been located at Tennant Creek and Katherine, a freight terminal at Berrimah (Darwin) and a siding at the Port of Darwin, 4 passing loops will also be provided, at Katherine, Tennant Creek, Newcastle Waters and Illoquara.



Scale of the Project:

15 million cubic metres of earthworks
1,500 culverts
100 bridges
2 million tonnes of ballast
2 million sleepers
8 million rail fastenings
145,000 tonnes of rail

TRACK DESIGN

The railway is designed and constructed to the standards appropriate to a modern standard-gauge mainline railway in Australia. It will be suitable for operation of rail services with 23 tonne axle loads at a speed of up to 115km/h, and will allow for interchange of rolling stock between the new railway and the existing railway and other parts of the national railway network.

ADrail, an unincorporated Joint Venture comprised of Kellogg Brown and Root, John Holland, Barclay Mowlem and Mamahon, has been contracted by the Asia Pacific Transport Pty Limited and Asia Pacific Contracting Pty Ltd for the design and construction of the new railway.

The Joint Venture is responsible for all phases of the works, including the design, earthworks, trackworks and infrastructure, including signalling and communications.

Track design criteria:

Length	1420kms
Rail	50Kg AS 1085.1
Track Gauge	Standard Gauge (1435mm)
Sleeper	Pre-stressed concrete
Sleeper Spacing	720mm
Maximum Design Speed	115km/h
Axle Load	23 tonnes
Maximum Grade	1.2% but generally a ruling grade of 0.8% applies

CONSTRUCTION SEQUENCE

Construction began in April 2001, tracklaying began in April 2002, and completion is programmed for early 2004.

Earthworks, bridges and culverts needed to be completed sufficiently in advance to enable uninterrupted tracklaying.

Concrete sleeper manufacturing plants have been built at Katherine and Tennant Creek,

capable of producing 1600 and 2400 concrete sleepers per day respectively. As earthworks are completed, tracklaying takes place north and south of the construction depots at Katherine and Tennant Creek, with work trains leaving the depots each morning with enough material to lay 2.0km of track a day in each direction.

Trackwork is initially heading north of Tennant Creek, and south of Katherine, joining up halfway between the 2 centres late in 2002. The teams will then work north from Katherine to Darwin and south from Tennant Creek to Alice Springs.

SLEEPER MANUFACTURE

The Katherine and Tennant Creek sleeper factories, operated by Austrak, will produce more than 860,000 and 1.1 million concrete sleepers respectively, all fully equipped with Pandrol FASTCLIP rail fastenings.

Concrete is poured into moulds laid out on long beds, cut by diamond saws, fitted with FASTCLIP components in the rail ready 'parked' position, inspected to ensure compliance, and stockpiled ready for tracklaying.

RAIL

Rail is loaded onto trains at OneSteel's plant in South Australia for delivery to Roe Creek, which is the transport and logistics centre for the Alice Springs – Darwin Railway, located about 20km south of Alice Springs. From there, it is loaded onto road trains for the trip to either Tennant Creek or Katherine, where the 27.5m lengths are welded into 357.5m lengths, and stockpiled ready for tracklaying.

Once in track, each of these lengths are welded together, creating a continuous rail through from Alice Springs – Darwin. Due to the extreme heat in this region, the rail must be correctly restrained and prestressed, or the steel rails would expand substantially.

RAIL FASTENINGS

The PANDROL FASTCLIP system was selected as the sole fastening for use on the entire length of the line.

As the majority of the line will be non-insulated, Pandrol engineers refined the FASTCLIP design to dispense with insulators, but still retain the fully captive, rail ready features.

By adapting the standard FASTCLIP pad, shoulder and clip, a secure non-insulated assembly

Concrete Sleeper pre-assembled with FASTCLIP fastenings

Plasser and Theurer SVM1000 Track Laying Machine
Inset: Detail of integral clipping head

was developed, which allowed concrete sleepers to be pre-assembled in the factories at Katherine and Tennant Creek, and transported, as required, with no component movement or losses.

BALLAST REQUIREMENTS

About 700,000 tonnes of rock will be crushed at the Katherine Quarry and 1.3 million tonnes at Tennant Creek to supply ballast for the railway. Ballast wagons transport the 3000 tonnes of ballast required for each shift of tracklaying.

TRACKLAYING

Tracklaying is carried out using a Plasser and Theurer SVM1000 tracklayer on the north line to Darwin, and a Harsco Model NTC operating on the Southern half to Alice Springs.

The Track Laying Machines place sleepers and rails, and are equipped with integral clipping units, enabling all operations to be undertaken automatically.

Behind the TLM a ballast 'rake' drops ballast over the skeleton track. A tamper then lifts the track 100mm through the ballast and vibrates and squeezes ballast under the sleepers. Next a 2nd ballast drop is followed by a 50mm lift. A ballast regulator and final tamping run completes the operation.

Fig 5: Harsco Track Laying Machine

PROGRESS TO DATE

At the beginning of August 2002, Earthworks to the north of Tennant Creek were complete to 274km, and 157km to the south. Trackworks to the north of the facility were complete to 152km. The Tennant Creek factory has produced 284,000 sleepers and 573,000 tonnes of ballast.

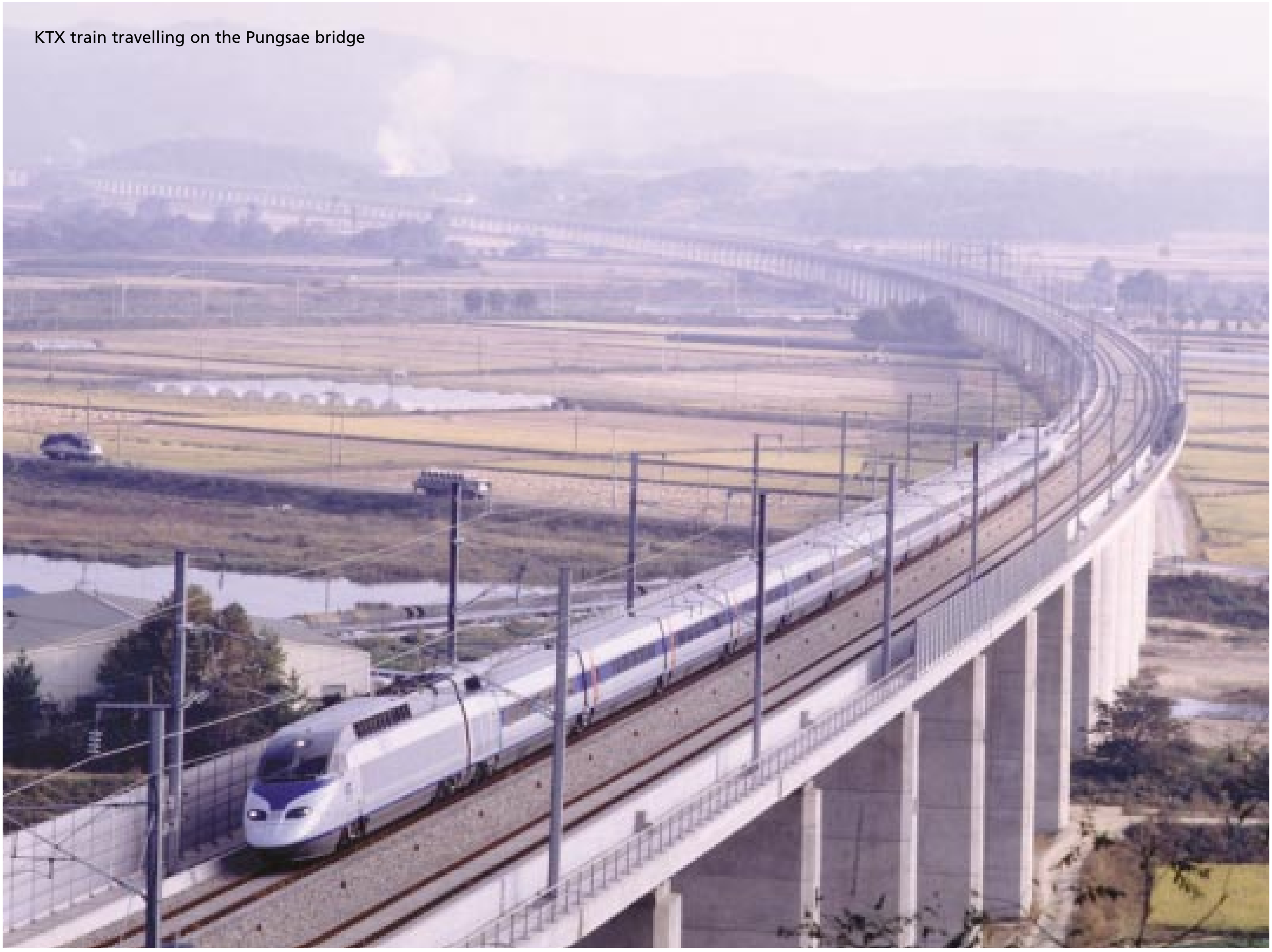
South from Katherine, Earthworks are complete to 214km, and trackwork complete to 152km. The Katherine factory has produced 299,000 sleepers of its 865,000 requirement, and 457,000 tonnes of ballast have been produced.

These achievements have put the project well on target to commence running on the line in 2004. ■

Fig 5: Close-up of Integral Clip Application Unit

Current Status of Korean High-Speed Rail Project

by Dr. K. D. Kang, Executive Director, Quality and Safety Division, KTX, Korea



KTX train travelling on the Pungsae bridge

The Korea High-Speed Rail (KTX) Project has been described in two previous articles in Track Report (1996 and 1999). These articles explain the development and selection of concepts and methodologies for design and installation of track components, as well as implementation of these policies in the Test Track, which has been in operation since late 1999.

This article covers basically two topics, firstly the experiences gained during commissioning and almost 3 years of operation of the Test Track, and secondly it will outline plans and expectations for Phase 2 of the KTX Project.

1) TEST TRACK – COMMISSIONING AND OPERATION

General

Establishment of a Test Track was a basic concept of the KTX Project since its inception more than a decade ago. The objectives for the Test Track were both to develop and test relevant technologies and also to confirm adequate operational quality of all systems, including Korean manufactured elements, such as track components and trains. The philosophy for development of the technologies was to select state-of-the-art designs, based on available experience adapted to the specific project environment in Korea.

Core System

The main elements of the Core System are: Train, Signalling and Power Supply. All technology is either similar or equal to original French solutions, with the most significant deviations being related to the train (KTX) itself. While the overall TGV-concept with Power Cars in each end and intermediate trailers coupled with articulated bogies is maintained, the total length of KTX is double compared to a conventional TGV. Also


Ballasted tracks with Pandrol fastenings – Pyungtaek Bridge

some other features are different from KTX to a French TGV.

The Power Supply system has been adapted to Korean standard 60 Hz frequency, from 50 Hz, as applied in Europe. The signalling system is practically identical in the Korean project compared to what is found on TGV lines in France.

Track Technology

The basic overall technology of KTX Project is derived from French TGV technology, but some different solutions were selected regarding track components. These are mainly elements like sleepers (monobloc) and rail fastening (Pandrol e-Clip) and were the result of both experience and appropriate research and testing for Korean application. After 2 – 3 years of operation, full confidence has now been gained that the choices were adequate and correct, with no significant negative experience related to the above selections – on the contrary, it can be concluded that the track has performed fully to expectations.

As for track installation and other supporting activities, French and other internationally available technologies and methodologies were carefully studied before adopting solutions that best suited Korean conditions. In most cases, these were practically identical solutions to what is conventional French technology and this has also proved to be a success insofar as the results are concerned. Installation rates and overall quality of track geometry and other measurable parameters are comparable or superior to what is achieved in other countries.

Specific measurements have been carried out to determine track elasticity as a function of rolling stock and ambient temperature compared to other countries. The results were encouraging and again confirmed that the selected solutions are performing according to expectations.

Another objective for the project has been to adopt latest technological developments and introduce them to the Korean Railway Industry. One example of such absorption of new technology even after an already successful choice in Test Track, is the recently implemented change of rail fastening system from conventional Pandrol e-Clip (as applied on the entire Test Track)


Concrete sleepers with PANDROL FASTCLIP fastenings


Birds eye view of the new Chonan Station

to Pandrol FASTCLIP. This change was implemented after the Test Track and a part of the next section was installed with e-Clips and will be applied for all remaining ballasted track sections of the project.

This specific change of rail fastening system has been motivated by the simpler and less costly rail-installation and handling of sleepers, which is achieved with the FASTCLIP system compared with the previous system. Similar to the way the 'e'-Clip system was evaluated, the FASTCLIP system was extensively tested in laboratories before being put into service. Also for Pandrol FASTCLIP, all components are manufactured in Korea.

System Integration

As explained already, the main objective with the Test Track has been to confirm relevant quality of all elements – both individually and working in an integrated mode. This objective is extremely important for a huge and technically complex system as a high-speed railway. A few challenges have been experienced during the commissioning, but all teething problems have been resolved and test operation has eventually developed into routine running of newly manufactured trains. Special test-runs with speeds up to 330 km/h have been successfully conducted and all systems are working well together for safe and reliable commercial operation to start in April 2004.

2) PHASE 2. CONCEPTS AND EXPECTATIONS

General

The KTX Project was originally planned for completion in one phase, but the economic crisis in 1997/98 forced the establishment of a phased implementation, with Phase 1 to open in 2004 and Phase 2 in 2010.

Phase 1 would mean operation of KTX trains between Seoul – Pusan, but high-speed infrastructure only for Seoul – Taegu with the exception of some shorter sections in urban areas. (Seoul, Taejon, Taegu). Travel time from Seoul – Pusan will be 2 hours 40 minutes and Phase 1 is estimated to cost $9.8 bn USD.

Phase 2 consists of full high speed standard infrastructure on remaining short sections through Taejon, Taegu and the section Taegu – Pusan. A decision on this phase has been made in order to open for commercial operation in 2008. Travel time will be 1 hour 56 minutes and this phase will cost an additional $4.3 bn USD.

Concepts

All basic design parameters and construction methods will be the same as for Phase 1. The most tangible differences will be in the level of foreign involvement, as Korean companies will take larger responsibility in design, construction and supervision. This development is in line with the project's overall objectives and has already proven to be a success as we can see Korean companies winning contracts in relevant railway projects overseas.

Concerning application of modern track technology, Phase 2 will with all its tunnels include more concrete slab track than Phase 1, while sections in the open will be conventional ballasted track.

SUMMARY

The Korea High-Speed Rail Project has successfully adopted, developed and implemented state-of-the-art technology in all fields of railway engineering. Much of this activity has focused on strengthening Korean resources and ability to take on and manage similar projects in the future – an objective, which already has been achieved.

Timetable:

1992	Start construction
1994	Contract award for Core Contract
1998	Decision for phased project implementation
1999	Opening of Test Track operation
2002	Start work Phase 2
2004	Opening of commercial operation, Phase 1
2008	Opening of commercial operation, Phase 2

Some key data for Korea High-Speed Rail:

Length	411 km
At grade	114 km (28%)
Tunnels	189 km (46%)
Viaduct	109 km (26%)
Max gradient	1.5 – 2.5 %
Max design speed	350 km/h
Operating speed	300 km/h
Track gauge	Standard (1,435 mm)
Min. curve	7,000 m
Track distance	5.0 m
Rail	UIC 60
Electrification	25 kV AC, 60 Hz
Trains	46 sets
Length	388 m (2 power-cars, 2 motor-trailers, 16 trailers)
Weight	841 tonnes
Seats	935
Total costs	14.2 bn USD (Phase 1: 9.8 bn USD)
Government contribution	45% (35% grant, 10% loan)
KHRC contribution	55% (29% bonds, 24% foreign loans, 2% private capital)

Development of the Mineclip Assembly

Concrete sleepers pre-assembled with MINECLIP fastenings

Although the existing Pandrol Brand 'e'1405 clips for 5-ton and Brand 'e'1401 clip for the 10-ton sleeper systems used in the South African mines perform well, the many loose components mean that the systems were not as user-friendly as they could be for underground conditions. Pandrol South Africa realised that it had to develop a new type of fastening for the Mining Industry, to supersede the existing 'e' clip system, which had been in operation for approximately 20 years.

The approach was to give the customer a superior product, reduce the costs and supply a product that was more user-friendly (a captive system, in line with other Pandrol captive systems, such as FASTCLIP).

One problem faced was the substantial cost of converting the Grinaker concrete sleeper moulds to accommodate the new Mineclip shoulders. A pressed steel shoulder to fit into the existing 'e' clip moulds was therefore developed. The design was based on the current CANECLIP system, modified to suit the 5-ton and 10-ton applications used in the SA mining industry.

The Mineclip assembly incorporates an injection-moulded pad with a 6mm upstand initially placed on the field side of both rail seats. When the pads are reversed, this allows up to 12mm of gauge widening in two increments of 6mm in order to assist in the tight curvature common to the underground mining trackwork.

Benefits of the Mineclip assembly over the existing 14mm 'e' clip currently in use include a lower profile, greater resistance to derailment damage, and pre-assembly of the components on the sleeper prior to delivery to site.

When the MINECLIP system was introduced into the mines, senior executives at the Mining Houses as well as the Shaft Managers were approached, to ensure that the system was accepted at all levels.

Extensive tests were carried out in the Spoornet Test Laboratory, which demonstrated the applicability of the product. Many test sections have been installed in the Gold and Platinum Mines, and all have performed above expectations. The MINECLIP assembly has been very successful and demand is now so great, the current facility for the manufacture of 'e' clips for the mine is being upgraded to MINECLIP utilising high output automatic forming equipment.

With the new MINECLIP system, Pandrol believes that it has a system that will cement a mutually beneficial business relationship with the South African Mining Industry. ■

MINECLIP installation tool

Rotor Rail

by Peter Shrubsall, Vortok International

Rotor Rail is an effective upgrade for improving the interface between chair and switch blade for existing switches. It was developed by Construzzioni Meccaniche Angelo Mazzi S.n.c of Verona, Italy for FS (Italian State Railway) and will now be made under licence by Vortok International. The units underwent 1,000,000 cycles on a test rig before track trials. The system is fully approved by FS and some 1000 switches are now fitted in Italy. The oldest has been in service for over 5 years, with no failures. The units are designed to retro fit over existing chairs and are far less expensive to buy and install than other proprietary roller systems.

Versions of the Rotor Rail have now been designed specifically for the UK vertical switch sizes A – G to improve reliability of operation and enable lower maintenance than switches fitted with no roller. They have been approved by Railtrack for use on its infrastructure.

The main benefits of these units are that they are of low initial cost and are extremely quick and easy to install. A two-man team with appropriate possession could easily install a set in less than half an hour on a long switch, half that time on a short switch.

Type 1 unit

Type 2 unit

EQUIPMENT DESCRIPTION

The type 1 comprises a thin plate that straddles the chair attached to the sides of which are two pairs of rollers. The plates have slots through which the two screw spikes used to hold the chair to the sleeper pass and provide adjustment of position. A clamp strip with two clearance holes for the screw spikes with centres matching the centres of the chair holes is placed on top of the plate. The rollers are positioned such that they lift the rail by approximately 3-4mm in the unloaded state. The rail remains in its normal position on the chair when the blade is against the stock rail. This means that no axle load is taken by the unit. The type 1 units are used towards the tip of the blade where the stroke is greatest.

Type 2 units are fitted with just one roller either side of the chair and are used further back along the switch blade.

The production units are made from stainless steel with case hardened steel rollers. The rollers are fitted with Teflon plain bearings and are sealed for life.

Trials in the UK have been very successful, demonstrating that it is no longer necessary to grease any of the chairs. The load on the switch motors is reduced as one blade is on the rollers, reducing friction and drag from that side which comfortably outweighs the slight momentary initial increase in force for the other blade as it climbs onto the rollers. This reduced loading also improves the life of the other working parts.

The load of the train continues to be taken by the chair as the closed blade is off the rollers at this stage. Other than the adjustment to set the rollers against the side of the switch-blade foot there are no other adjustments and therefore an 'out of adjustment' state is eliminated.

There are three secondary benefits of using rollers such as this and they are associated with the greasing of chairs. Apart from the labour saving and the saving on the cost of the grease the classic problems of dust in the grease are avoided. Dust will either form a grinding paste and wear away the chair and the blade or, if there are high levels of mineral or coal dust, the formation of a "cake" which builds up between the stock rail and the blade finally preventing lockout leading to an operational failure.

Grease soaking into the ballast over the years creates an environment problem as well as an eyesore.

Rotor Rail is an effective upgrade for the many switches already in service and versions for inclined switches are being considered, as are versions for other European designs. Eurotunnel is about to test a version widely used by itself and others on the continent. ■

INSTALLATION

1. Remove AS screws and clean off excess grease from baseplate.

2. Place rings over ferrules. If ferrules are damaged, replace as required. Tap ferrules down so as they are flush with the rings.

3. Offer Rotor Rail unit onto baseplate. Slide until rollers just touch switch blade.

4. Place locking plates over holes ensuring serrations are facing down.

5. Replace screws in holes and tighten to correct torque. Note: Longer AS screws or Vortok Coils are recommended to be fitted.

6. Once fitted, the entire site no longer requires greasing.

Ballast Regulator working on the
Alice Springs – Darwin Railway,
Australia