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Permanent Way Institution

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Autumn 2012 Volume 131 Part 3

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PERMANENT WAY INSTITUTION

Journal and Report of Proceedings

Volume 131 Part 3

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Front cover: *Nighttime Working* *(Photo: David Emsley (dremsley@themutual.net) 2012)*

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The editor position is currently vacant. Please contact the Communications Director, Alison Stansfield, with any queries.

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Please note that opinions expressed in this publication are not necessarily those of the Editor or of the Institution as a body.

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Letter from the Chief Executive Officer

David Packer
Chief Executive Officer, Permanent Way Institution
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I was delighted to present the PWI trophy to Network Rail's Track Apprentice of the Year, Katie Tingle, at their awards ceremony at HMS Collingwood, Gosport. Katie has just come to the end of her three-year advanced apprenticeship and is based at Derby. She has agreed to join our Ginger Group, where I'm sure she will be a tremendous asset. It's inspiring to see two hundred infrastructure apprentices, keen to make their mark on the rail industry, and reassuring that Network Rail continues to invest in its engineers for the future.

Steve Whitmore, our newly-elected President, had a similar experience when he presented prizes and certificates at London Underground's 'A' and 'B' classes' graduation event. Over 100 students received their awards, representing a huge investment on the part of the students and London Underground in their future.

At this time of year the rail industry is welcoming its 2012 graduate intake. The PWI is looking forward to their arrival too and we have produced marketing material to promote the benefits of PWI membership at graduate induction events. It's easy to forget how complex the rail industry can seem to new arrivals. Joining the PWI and tapping into a friendly and welcoming group that already 'knows the ropes' is definitely a must for anyone starting a railway career.

As announced at the AGM John Elliott, the PWI's Technical Director, will be stepping down from that role at the 2013 AGM after many years of great service to the PWI. Our aim is to identify John's successor by the end of this year, enabling six months of parallel running before John takes a step back. The new Technical Director will inherit the leading role in a number of significant initiatives. These include considering whether to become an awarding body for professional qualifications, implementing improved technical review procedures, designing and putting in place updating for all our technical publications and broadening the PWI's technical scope to encompass all rail infrastructure. It's an ambitious programme and needs a person with the right balance of technical and business knowledge, flexibility, drive and determination. However, we have many excellent rail engineers in the PWI and I'm looking forward to a strong field of candidates responding to the advert in this Journal, on the website and in the rail press.

Finally, please make sure you read my article on developing the PWI in this Journal. We have come a long way in the two years since I became CEO, leading a re-vitalised team. But there is a lot still to do and my article asks for members to play a part in supporting these developments, which are vital to the PWI and to the rail industry, through their subscriptions.

Non-Executive Directors' Report

Your Board met on July 3rd. The agenda was both detailed and lengthy but was focussed on increasing the membership, sales and the profile of the Institution, as well as improving further electronic communication with members, whilst at the same time containing expenditure. These matters were all discussed in some detail.

A target of increasing membership numbers by 250 this year was agreed. To achieve this, firstly industry employers are to be encouraged to include membership as part of their induction package for people joining the industry. Secondly, it was agreed to re-examine a proposal made a few years ago and introduce corporate membership for organisations working in the industry. It was also agreed that the details now need both revision and updating before a scheme is launched. Thirdly, the benefits of Fellowship of the Institution, both for individuals and their employers are to be publicised to encourage more members at fellowship level.

The Board also resolved to work with the National Skills Academy for Rail Engineering (NSARE) and the Engineering Council to achieve recognition and accreditation of grades of PWI Membership as demonstrating competences in track engineering knowledge and skills.

Arrangements for the 2013 Annual General Meeting in Llandudno were discussed and the Board developed a first draft "Vision" or "Mission Statement" aimed at emphasising as concisely as possible the Institution's unique position in respect of track engineering skills and competences.

The Chief Executive's progress in improving the publication and printing arrangements for future copies of the Journal were agreed as was progress to date in finding a new Journal Editor.

You will find the agreed and signed off minutes on Page 120 of this journal as was agreed at the AGM.

Colin Wheeler, Non-Executive Director, August 2012

cj.wheeler@btinternet.com

Note from Communications Director

It has been a busy six months. One of the key projects has been to integrate all the membership databases that existed into one database that can be easily managed through an administration tool. This has been a huge task. The main work was to validate all the data, ensuring that the membership records were accurate. We started with the existing data, of which there were over 7000 records, going back many years. The work is almost complete but the final part of the process is to ensure we have the latest information on our members, particularly email and mailing addresses. This is where you can assist us. The easiest way is for you to register online and update your details. I do appreciate that some of our members don't have access to the internet. If that is the case and your address details have changed please write to the Secretary with the details and your record will be updated. If you know of a member who has passed away or resigned please inform the Secretary so we can update our records accordingly.

As a result of this work, we now have an accurate picture of our membership numbers and demographics. Through the use of email addresses we will be able to send out notices and information very easily, improve our service to members and, at the same time, reduce our administration costs.

Finally, we are still looking for a Managing Editor for the Journal which means I will be standing in again for Part 4. I am now looking for articles for Part 4. Articles can be between approximately 500 and 3500 words. Any photographs should be of high resolution.

- Have you been involved in an interesting project? Why don't you write it up? Need some help? Just let me know. Articles may count towards your CPD on review by our Technical Director.
- Do you know a longstanding PWI member? I am sure many members would be interested in a short profile of their work in the rail industry or with the PWI. Perhaps an interview of a longstanding professional by a younger member?
- How about an advertorial about a new piece of technology?

I am open to all suggestions; please send me an email to alison.stansfield@permanentwayinstitution.com

From the President

Some of you may know me, some will not, so by way of introduction it seems appropriate to give you a short potted history of my career to date.

I started my railway career 29 years ago as an apprentice electrician in the BR loco works in Crewe. After completing my apprenticeship and following a short spell in the General Office on the drawing boards, I moved to the BR Area Civil Engineers Office in Crewe (a steep learning curve for a 'spark' but aided by day release for a part-time degree in Civil Engineering which I attained from Bolton Institute). I progressed through the technical grades and into management. Through privatisation I joined GTRM for two years as a project manager. I spent the following nine years in consultancy in a mix of technical, management and leadership roles. I joined Network Rail in 2005 and I am now the Engineering Manager for the London Bridge Station Redevelopment as part of the Thameslink Programme.

The level of change in the railway industry I have witnessed since 1994, for me, highlights the need for the PWI to continue its development into a very flexible and responsive organisation. The change from COM to the new CEO structure was a key milestone in the strategy we developed in 2009. I was a member of COM for some years prior to this date and it was, looking back on it, a bold decision to be taken. One thing was evident when COM was asked to vote on the proposal to change; we needed to do something. The bucket of sand strategy – insert one's head – was not an option!

I must thank Phil for his two year stint in steering the Institution into uncharted waters following the restructure in 2010. Phil commented in the June Journal that he wished membership had increased under his Presidency. Whilst this may well be the measure of success going forward, the important work of laying foundations for change has been the prime target over the past two years and it is work that Phil should feel very proud of. Both he and David Packer have worked to prepare ground for what I trust will be a productive two years for me to preside over, and for that I thank them both.

Phil had the bonus of 9 months 'down under' during his term which resulted in me being thrown somewhat into the deep end. This came as a daunting challenge initially, although in hindsight, it has been actually been great opportunity to be involved so closely with the day to day operations whilst still Deputy. Phil has obviously been unable to attend the UK meetings – we can't afford the air fare! This has meant that I have acted on Phil's behalf to chair the Board meetings, attended numerous events and have seen three new Non-Exec's join the Board, bringing their valuable knowledge, experience and support to the table. The use of Skype and email makes a lot of things possible!

During the last two years, the relationship between President and CEO has been developing. The definition in the roles and responsibilities is now more defined with day to day operations being managed by the Executive Directors under David's leadership and the outward facing Institution duties and internal governance function being led by the President.

There is a good amount of effort going into recruiting members, especially young members. You will note from David's report that he presented the Track Apprentice of the year award at Gosport and that I attended the LU graduation event. Both NR and LU are supporting their apprentices with packages which include PWI membership. Our challenge is to keep them interested when they move out into the business and take up a day job.

We are slowly turning a corner with industry credibility. Key players are now approaching the PWI to support them in a number of areas especially staff development. This is good news and will help to create a stronger brand to the PWI. We are actively engaged with NSARE and the development of railway skills within the industry, all of which helps our positioning.

There has been some discussion at the AGM over the past two years regarding our financial position and our trading of consultancy services. Firstly, the Board has set the CEO tough targets to reduce the deficit in 2012 and return a positive trading position for 2013. The Board are expecting to see these targets reported against favourably in October along with a revised strategic plan. On the second point, we are primarily a professional institution set up for the benefit of members. If we are approached for help and we can provide it, we will trade for the income to help the bottom line, but we are not marketing ourselves as a consultancy.

We will, however, need to become more commercial in our outlook and in the way we manage the Institution. We are looking at the other professional institutions and the way they are managed, looking for opportunities to do things better and offer a better service to members. As an Institution we currently have a membership that 'wants' to be here, not one that 'needs' to be here. This is an attribute that sets us aside from the others and we need to build on that aspect. One particular area of keen interest to me is our ability to offer professional registration with the Engineering Council. This subject has been debated previously at COM but the time is now right for another look. Colin Wheeler and John Elliot are both experienced in this area and are looking at our next steps.

The financial gap between improved services, new initiatives and the subsequent increase in membership revenue that they drive is the subject of David's note on 'Developing the PWI'. I would urge you to support the Institution going forward and please contribute any thoughts you have regarding improved services you wish to see. We can't guarantee to deliver everything but we will listen. [The Impossible we will do at once – miracles will take a little longer].

I will be working with the Vice Presidents over the coming year to better define their role and to put some structure around the links to the sections. As a start, the VP's will now receive an invite to the section Secretaries meeting in November this year which I am hoping will be well attended. Invites are expected out shortly from John Linkin.

There is growing enthusiasm for sections organising events. London Section has held numbers of half day seminars over recent years which are well attended and are going strong. A North West technical conference is being hosted in Manchester on 27th February 2013 entitled 'S&C Design and Specification'. The London Section will be holding a half day seminar on the subject of 'Practical Surveying and Gauging' on 15th May at South Bank University. Details of all events will be on the website soon.

Also a quick plug for the 2013 Convention in Llandudno - see the centre pages for more details. I would like to hear from any section (or individual) who is interested in picking up the mantle for 2014. I will offer all the support I can for anyone willing to organise Conventions going forward. One of our key attributes as an organisation is knowledge sharing and social events form an important platform for enabling this.

Before I finish I must apologise for the lack of caption with the photographs in my report of the VDEI visit in the last journal. I inadvertently missed them off the report. The shot of the bridge is Borough High Street Bridge and the other photograph was taken inside London Bridge Signal Box, which will migrate to Three Bridges Signalling Centre by late 2017 as the interlocking is renewed across the layout.

I look forward to a successful two years and to meeting as many of you a possible on my trips around the sections.

Regards,

Steve Whitmore

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Track-Ex: A Tool for Optimising Vehicle/Track Interaction

By Mark A. Dembosky, Vehicle/Track Systems Specialist, Network Rail

Mark Dembosky has 35 years of experience in the railway industry. The first 25 years concentrated on vehicle and track research in the USA at the Transportation Technology Center (TTCI) in Pueblo Colorado, USA. For the last 10 years he has been an employee of Network Rail and has focused on UK wheel/rail interface issues ranging from fundamental investigations of the Rolling Contact Fatigue (RCF) phenomenon to support of VTSIC research projects and software generation.

1.0 A brief History of Track-Ex ©

Rolling Contact Fatigue (RCF) cracks in rails became a critical issue in the UK surface line rail system in 2000 when Railtrack (the predecessor to Network Rail) became aware of a rapid increase in rail crack sites throughout the system. Matters came to a head with the fatal accident at Hatfield on the East Coast Mainline in October 2000.

This accident was caused by the failure of an extensive length of rail in the body of a high speed curve. Such fragmentation was unprecedented and served to launch a comprehensive research effort involving many UK industry stakeholders. Efforts were coordinated at first by the Wheel/Rail Interface System Authority (WRISA) which was later replaced by the Vehicle/Track System Interface Committee (VTSIC). Both served as a central coordinating body and both approved and reviewed RCF investigations, RCF management strategies and anti-RCF tool developments.

The early efforts in the anti-RCF campaign investigated specific curves that had RCF and used existing modelling tools such as Vampire© a sophisticated vehicle dynamics modelling program originally developed by British Rail Research to determine the forces at the Wheel/Rail Interface (WRI). These activities demonstrated that the WRI forces could in fact be correlated with RCF sites on track. Eventually the energy associated with these forces was shown to be a better predictor of RCF and Track-Ex was developed by Network Rail's Systems Engineering Group to exploit this finding.

The first versions of Track-Ex were generated in 2005 and the focus was indeed RCF prediction. Since that time, Track-Ex has been expanded to include generation of exception reports, a rail management cost tool and has served as an experimental test bed for various R&D activities.

2.0 The Root causes of RCF

In the immediate aftermath of the Hatfield accident, a clear and widely accepted explanation of the root causes of rail RCF cracks did not exist within the rail industry. In general RCF was found in curves although isolated patches (dubbed clusters) did occasionally occur on straight track and in S&C.

The fact that RCF was mostly a high rail phenomenon in curves was a significant and clear indicator that WRI forces were the primary cause of RCF. But RCF itself was not always present in curves and, in some cases, seemed to be associated with the kind of vehicles that were present on the route. Often the fleets were dominated by a single vehicle type but sometimes the fleet was mixed. So, the question was: what method could be used to describe the onset of RCF cracks and to explain the change in length, location and orientation of cracks as shown in figure 1?

Figure 1a: RCF on a shallow high speed curve. The cracks are high on the gauge shoulder and crack directions are traversing the rail head.

Figure 1b: RCF on a sharp slow speed curve. The cracks are near the gauge corner and crack directions are more parallel to the running rail.

The first method used to predict RCF employed an estimate of the WRI forces in both the longitudinal (along the rail) and lateral (across the rail head) directions. These forces were summed and divided by the estimated vertical force to give a term called the Traction Coefficient (Tc). The wheel load and the typical WRI contact patch was used to calculate the nominal pressure (Po) which was then normalized by the rail steel yield strength in shear (Po/K). These 2 terms were then projected onto a "Shakedown Diagram" as shown in Figure 2 which is divided into zones of: no damage, squats, cracks and wear. Early use of this method in the rail industry was promoted by Dr Ken Johnson of Cambridge University 1.

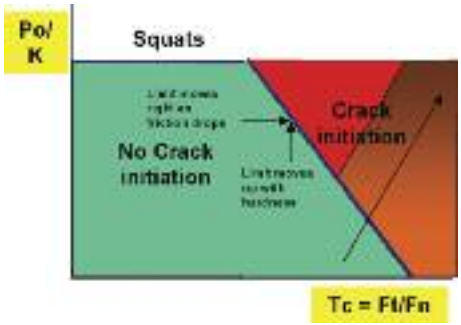

Figure 2: A Shakedown Diagram with forces depicted on the horizontal and pressure on the vertical axis. Since wear is generally a non-linear function of the Tc, cracks eventually give way to wear.
Po: Contact patch peak Hertzian pressure
K: Yield stress in shear
Fn: Contact patch normal force
Ft: Contact patch shear force

This method was successful in associating vehicle performance, track geometry and rail strength to observed locations of RCF cracks. Early reports generated under the auspices of WRISA made extensive use of this method. Once the WRI forces were associated with RCF sites, the research then focused on: what key factors in the vehicle and track system actually give rise to RCF prone conditions?

A review of vehicle curving performance identified curvature, cant deficiency, axle/bogie primary yaw stiffness (PYS), vehicle weight, friction and wheel/rail profiles as the key factors that contribute to the WRI force magnitudes. In general, the fact that WRI steering forces could be as high as the forces associated with full tractive or braking effort was not well known by industry front line staff. Further, PYS was a suspension property known to vehicle designers and research analysts but little known to those with industry operating responsibilities. PYS is the effective stiffness (MNm/rad) between axles in a bogie and controls the ability of the axles to rotate out of parallel to assist negotiation of curves. High PYS is good for maintaining high speed stability but bad for curving since the WRI forces increase as PYS. This is a design conundrum

Figure 3 depicts WRI forces that are typical for bogie curve negotiation. The actual magnitudes of these forces and the subsequent location and orientation of the RCF cracks on rail head are a function of the identified key factors. Management of RCF is then a question of management of the key factors.

The reasons for the increase of rail RCF that occurred in the UK system around 2000 was a substantial change in the wheel profiles used (P1 to P8)

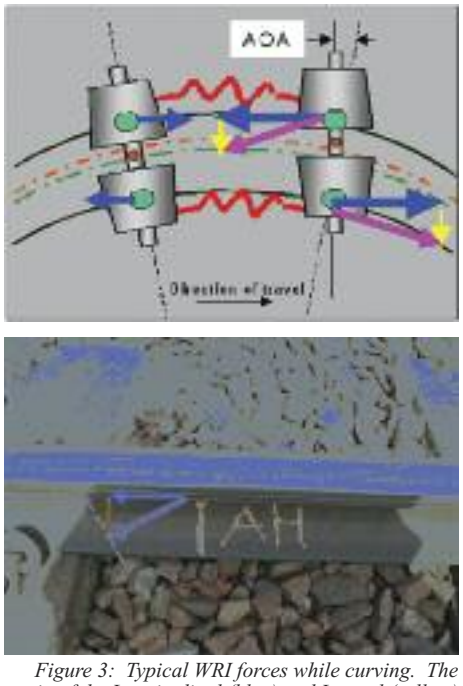

Figure 3: Typical WRI forces while curving. The ratio of the Longitudinal (blue) and Lateral (yellow) forces control the crack angle on the rail

and a rise in the fleet average value of PYS due to new vehicle designs being introduced onto the network. The P8 profile was designed to move the typical curving wheel/rail contact position from gauge face to gauge shoulder and it was successful in doing so. But the coincident increase on PYS, which occurred to increase high speed stability, caused the steering force magnitudes to rise as well, resulting in a higher probability of RCF initiation as system operating points were over the "Shakedown Limit" of figure 2.

After several years of investigation, VTSIC and industry analysts recognized that predictions of RCF at a given location depended not only on the identified key factors as such, but the composition of the fleet and the frequency of traffic. RCF cracks are a "fatigue" phenomenon and are formed as load cycles accumulate. A method was needed that not only described RCF probability but took account of the number and nature of each load cycle the rail experienced. The Whole Life Rail Model (WLRM)2 was developed in the UK under the guidance of VTSIC and used TGamma (Tγ), the Contact Patch Energy which was a concept originally developed by British Rail Research to predict rail wear. WRI forces are a function of the partial slip (creepage) that naturally occurs between wheels and rails. When the forces are plotted as a function of creepage, the area under the curve is an energy term (J/m) and is essentially TGamma. But cracks in materials such as rail steel can be described as a function of the energy absorbed as shown in figure 4.

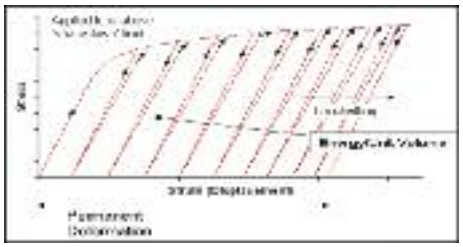

Figure 4: As each wheel traverses a spot on the rail, small dislocations of the surface material will occur if the forces involved cause plastic deformation.

The area under the stress curve is an energy term. When sufficient energy has been absorbed by the rail material, a crack will form

The WLRM therefore uses TGamma as an input and obtains estimates from dynamic simulation tools such as Vampire. It also assumes that RCF crack growth and wear are capable of occurring simultaneously and that they can in fact interact. The onset of RCF growth occurs at a lower TGamma level than Wear. But Wear, once it occurs, grows more rapidly effectively erasing RCF cracks until it exceeds the RCF growth rate. This normally occurs during hard flange contact. The result of the RCF and Wear interaction is a function which has a value of TGamma where RCF growth is maximized as shown in figure 5. For 260 grade steel and the present UK fleet and wheel/rail profiles, the maximum RCF TGamma occurs when the wheels and rails are in gauge shoulder contact.

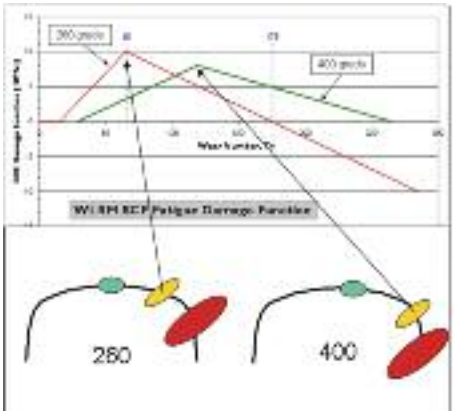

Figure 5: The WLRM damage functions for both 260 and 400 (MHH) grade steel projected upon a curve high rail.
TGamma values are typical for the UK fleet and result in RCF on the gauge shoulder and gauge corner for 260 and 400 grade rail steels respectively

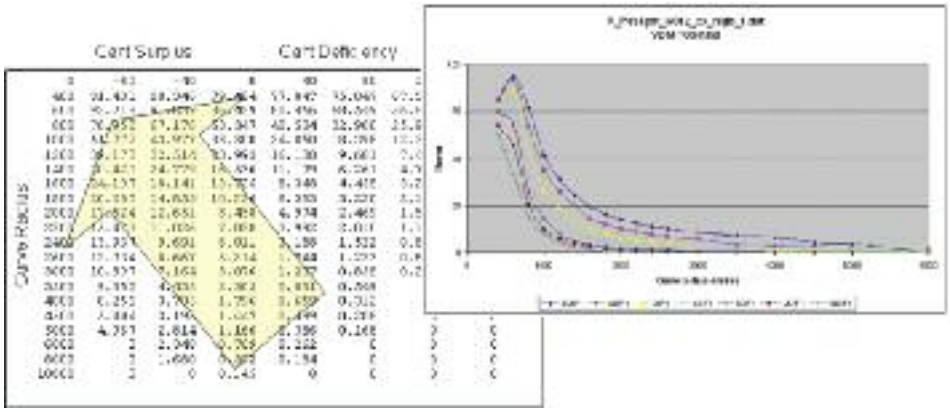

Figure 6: A typical VDM table showing that TGamma increases with curve sharpness and cant surplus.

3.0 Track-Ex Overall Structure

Track-Ex was originally designed to predict RCF on rails by exploiting the knowledge gained during the UK RCF investigations with emphasis on use of the WLRM damage function. To that end, Track-Ex was coded to read the variety of Track Geometry (TRGM) files produced by UK measurement trains as well as the ACTRAFF route traffic database to determine the types and numbers of vehicles operating over each route. In addition, a UK vehicle library was created that contained the PYS weight and wheel profile information needed to describe typical vehicle TGamma performance.

The original intention of Track-Ex was to provide a tool that was relatively easy to use and fast when compared to full vehicle/track simulation programs such as Vampire. Track-Ex therefore does not actually compute TGamma but uses a table of Vampire produced TGamma values which is indexed by a range of curvature and cant deficiencies and is also specific to vehicle PYS, weight, wheel and rail profiles and lubrication state. In other words, each TGamma table (dubbed a Vehicle Damage Matrix or VDM) is associated with the key factors previously identified.

Figure 6 shows a typical VDM and a quick examination shows that the tighter the curve and the smaller the cant deficiency, the higher the TGamma. Prior to the generation of VDMs, the UK industry had some knowledge of the beneficial aspects of high Cant Deficiency (CD) because some older track design handbooks stated that it could aid bogies to steer. Some track engineers had noticed that by reducing installed cant for a curve of fixed speed, rail damage appeared to be reduced. But the VDMs are the first commonly available numeric description of the role of CD and its somewhat counter-intuitive role in reducing rail damage.

Early versions of Track-Ex simply read the TRGM file and used the curvature and CD to interpolate the appropriate VDM table. This resulted in a "quasi-static" estimate of TGamma since the wavelengths in the curve and CD channels are by their measurement nature quite long. No account was made of shorter wavelength track attributes such as Alignment and Gauge. Figure 7 shows the differences between a Vampire produced fully Dynamic TGamma and a Track-Ex quasi-static estimate.

Early versions of Track-Ex made sufficient damage estimates in sharp curves where the quasi-static TGamma dominates but seriously underestimated TGamma in shallow curves where the Dynamic TGamma is predominant. Rather than use a complex system of equations as does Vampire, newer versions of Track-Ex produce a quasi-dynamic estimate by simply adding a scaled version of the AL35 (Alignment with wavelengths less than 35m) to the measured curvature. This "dynamic curvature" is then used to interpolate the VDM and creates "spikes" of TGamma that are approximately of the right magnitude and wavelength as those of Vampire. These estimates are frequently out of phase and in some case, miss important TGamma events entirely. For this reason Track-Ex is described as an "80/20" program i.e. it produces 80% of the correct answer with 20% of the effort needed for 100% accuracy. Track-Ex quasi-dynamic estimates are deemed adequate by most users who use Track-Ex to identify RCF "hot spots" and location errors of 20m or so are not relevant since RCF sites are always verified before rail maintenance.

But recently some users have desired the phase delays common between Vampire and Track-Ex to be removed and overall accuracy improved since Track-Ex outputs are used as inputs to detailed cost models which use damage estimates for every 20m of rail. A significant improvement in accuracy was recently achieved by replacing AL35 with a scaled version of its derivative (the change in AL35 per unit distance) as shown if Figure 8. This increases accuracy for several reasons:

- Modelling has shown that for typical UK bogies, the Dynamic TGamma is composed mostly of changes in Longitudinal rather than Lateral energy
- Longitudinal energy is formed primarily by the Rolling Radius Difference (RRD) which is the effective difference in wheel radius caused by

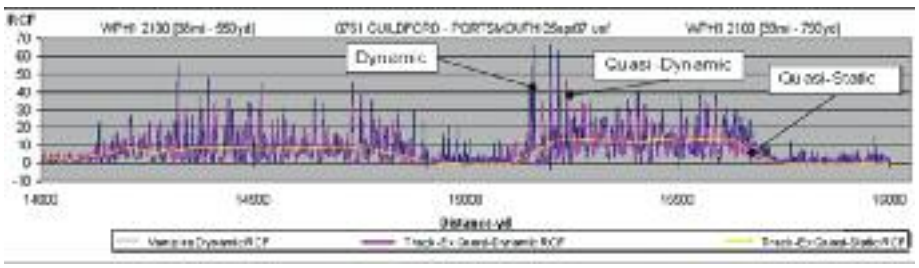

Figure 7: Vampire Dynamic and Track-Ex quasi-static and quasi-dynamic TGamma

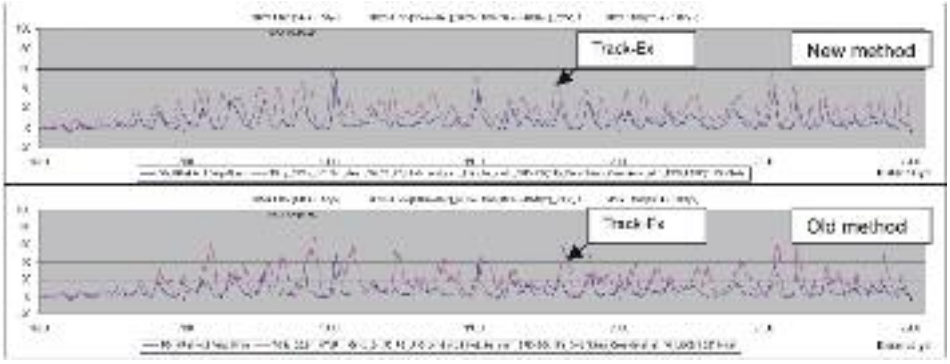

Figure 8: Improved phase relationship of Track-Ex TGamma vs. Vampire

tapered wheels on an axle with no wheel/axle bearings. Typically in curving, the "high rail" wheel is larger than the "low rail" wheel and causes a proportional Longitudinal force and TGamma.

- From the reference frame of an axle moving down the track, AL35 is not a static measurement but rather an oscillating lateral velocity which causes oscillations in RRD
- The derivative of Al35 is therefore an acceleration viewed from the axle reference frame and is roughly proportional to changes in RRD and the subsequent changes in Longitudinal force and its associated energy, the Longitudinal TGamma

The latest versions of Track-Ex actually use the derivative of the rail trajectory i.e. the actual displacement of the rails relative to the track ideal centre line formed by combining AL35 and Gauge. The rail trajectory is a much more realistic depiction of the WRI since variations in RRD are certainly a function of the relative positions in space of the wheel and rail as well as their relative shapes. Efforts are also underway to better scale the derivatives to better match Vampire dynamic and Track-Ex quasi dynamic magnitudes now that phasing has been improved.

4.0 Route/Fleet Analysis

Route Fleet Analysis (RFA) is the most powerful tool in Track-Ex because it calculates the damage on a route for each vehicle type running on that route, scales the damage by the number of such vehicles and aggregates the damage into a "Grand Damage" Index (GDI). (The damage associated with each vehicle type is also available to the user.) The GDI can then be plotted for all locations along the route or summarized as a function of curvature for the entire route. Track-Ex also has available reference values of the GDI that are associated with the standard Network Rail definitions of rail RCF severity: light, medium, heavy and severe. The damage indexes are scaled to represent the RCF that accumulates in 1 year, assuming that all rails are new at the beginning of the analysis.

The user may invoke many options such as the grade of steel, the use of anti-RCF ground profiles and the use of gauge face lubrication. At this time, Top-of-Rail friction modifiers are not available. Similar calculations are available for Wear, the "Grand Wear Index" (GWI) as well as the theoretical loss of anti-RCF ground rail shape, the "Ground Gap Index" or GGI.

Figure 9 shows the input screen for an RCF RFA analysis. The upper portion of the RCF RFA control screen displays the available Curvature, Cant, Speed and Alignment channels. Normally only a single channel of each type is available but facilities do exist to import or generate optional channels. For example, proposed line speed changes can be imported allowing users to estimate any subsequent changes in RCF.

The control screen also lists the ACTRAFF vehicle types for the route analyzed. For each vehicle, Track-Ex consults the built in Car Library and sets the appropriate values for weight, PYS and wheel profile which allow automatic selection of appropriate VDM files. (In general, TGamma increases with PYS).

The lower portion of the screen allows the user to enable/disable anti-RCF grinding, the use of gauge-face lubrication and the steel grade. RCF and Wear can be computed for the High Rail (the most dominant form in the UK system) or the Low rail. Low rail RCF can occur in tight radius curves operating at Cant Excess. Other options exist which are detailed in the Track-Ex users manual. Once all options are defined, the analysis is user friendly and fast as Track-Ex automatically processes all vehicles up to a predetermined percentage of the fleet.

Figure 10 is a plot of GDI for ground and un-ground rail for a portion of a route containing tight curves.

Over a 1 year period, the un-ground rail has "Heavy" RCF while the ground "Light"

Figure 11 depicts the aggregate damage over the entire route analyzed for both the ground and un-ground cases using both 260 and MHH (400) rail. The plots contain relative numbers which indicate the overall damage in each range of curvature, including transitions. The numbers in the upper left corner are the totals of the GDI for the 4 cases and indicate that un-ground 260 grade steel is the worst case while ground MHH has almost no RCF at all.

Figure 11 demonstrates the significant reduction in RCF provided by anti-RCF rail grinding. Likewise, the use of MHH (400) steel causes a significant reduction even when un-ground. A similar analysis of Wear (GWI) would show that MHH greatly reduces gauge face wear as well. But the best combination is that of ground MHH which has only 1.0% of the base case RCF and has essentially eliminated RCF as a problem on this particular route. Generally speaking, the use of MHH and grinding is synergistic in that the performance improvement of MHH and grinding when used together exceeds the individual performance improvement of MHH summed with the individual performance improvement of grinding. This has obvious implications for route strategies.

RFA RCF analysis can also be conducted for segments of track or individual curves of particular interest. This approach is supported by 2 Track-Ex functions which allow the user to select TRGM and ACTRAFF channels for export:

- Comma separated Variable (CSV) export: user selects arbitrary start and end points
- Curve export: automatically locates all curves in a TRGM file and exports each to a unique file

Analysis of individual curves is quite useful to assess the effects of increasing cant deficiency or reducing the magnitude of AL35 or Gauge variations. Present versions of Track-Ex have fundamental arithmetic functions so that cant or AL35 can be scaled by a percentage forming alternative channels for RFA analysis. Track-Ex also allows the user to specify that trains stop at specific locations. This can greatly affect the RCF estimates since any stopping point on or near curves will cause the fleet to run at cant surplus. Figure 6 clearly shows that cant surplus increases TGamma leading to increased RCF or Wear or both. Figure 12 shows the RCF damage at a station

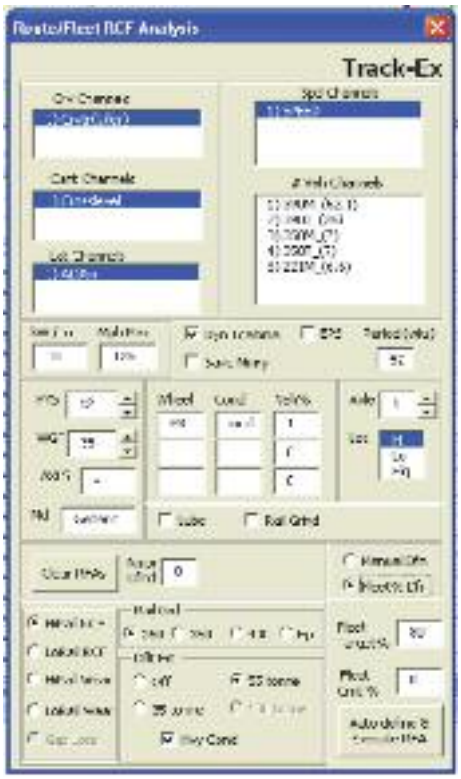

Figure 9: The RCF RFA control screen

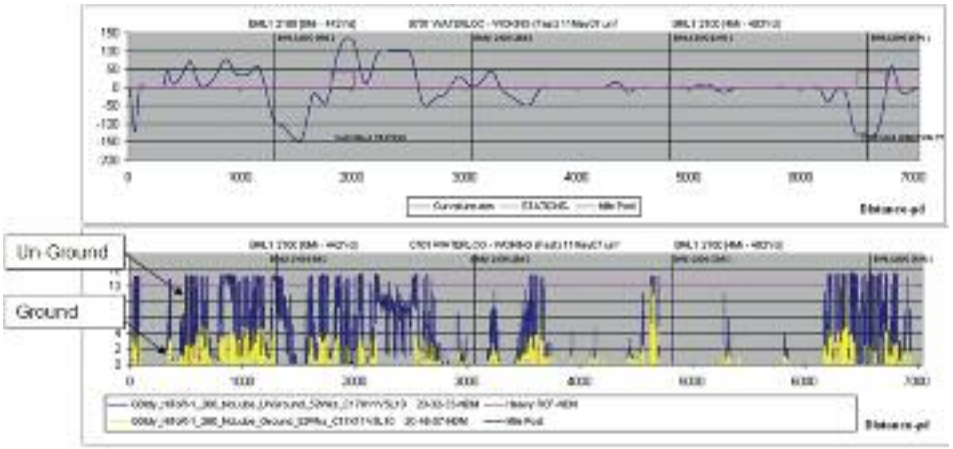

Figure 10 is a plot of GDI for ground and un-ground rail for a portion of a route containing tight curves. Over a 1 year period, the un-ground rail has "Heavy" RCF while the ground "Light"

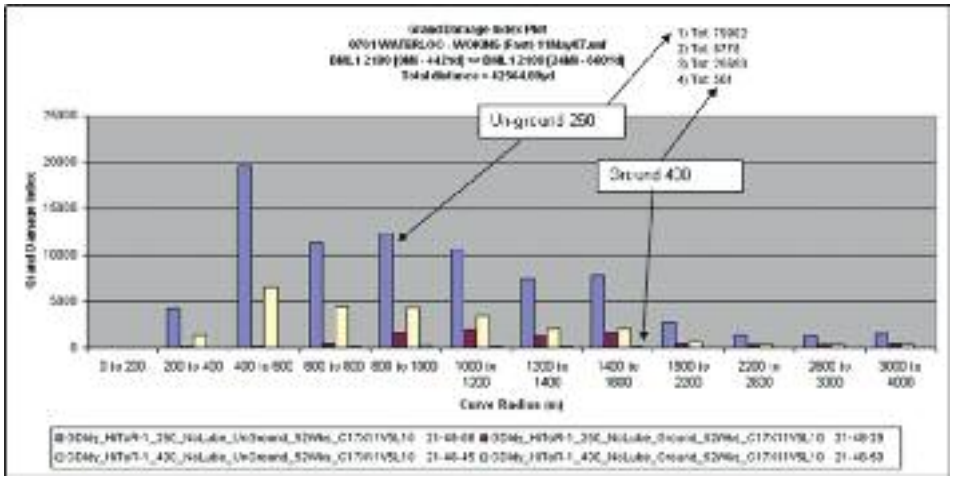

Figure 11: A route comparison of 260/MHH steels with ground/un-ground rails.

on a curve caused by both through and stopping trains. The former are relatively benign and the latter the cause of consistent RCF problems.

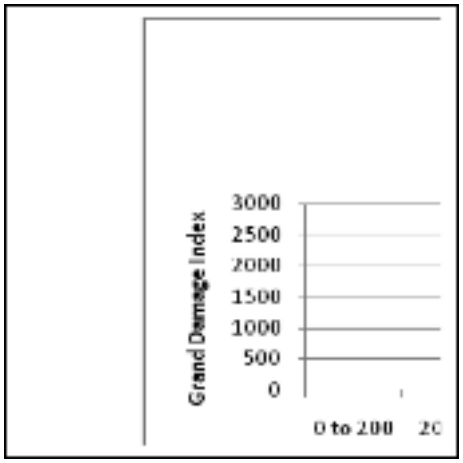

Figure 12: The GDI for stopping and non-stopping trains at a station located on a curve. Stopping trains at cant surplus are predicted to create a chronic RCF problem.

5.0 The Cost Model

The RFA function demonstrates how different tactics can reduce RCF and Wear. But all maintenance or renewals require a business case. For this reason Track-Ex has a Cost Model which allows the user to employee different control tactics and observe projected costs over a multi-year period. At this time the cost estimates should be considered as relative estimates of benefits as some factors are preliminary and because some enhancements to damage projections are required to enhance realism.

The cost model first automatically executes a set of RFA scenarios for the entire route and fleet specified. The set is composed of combinations of various steel grades, lubrication and grinding. The data from the GDI, GWI and GGI from each RFA run is then reduced to the 95th percentile statistic for 50m long segments for the entire route and stored in a single "Cost Data" file.

The Cost Data file may then be imported at any time into the actual Cost Model. Before actually exercising different route tactics, the user may first plot the GDI, GWI or GGI data per segment to get a feel for the most damage prone parts of the route. Figure 13 clearly demonstrates the effectiveness of grinding 260 rail over the route curves.

Some users utilize the Cost Data file on its own without further cost analysis as a quick means of graphically assessing various route level tactics.

After loading a Cost File, the user may invoke the various "rules" for premium rail, grinding and lubrication. At present the rules are deemed useful but are generalized to apply across the entire route. In other words, present versions do not allow the user to specify rail, grinding or lubrication for specific curves. On the one hand, this means that the user may quickly study broad tactics on a route basis but on the other hand can not "tune" each curve for maximum performance. In any case, once a set of rules has been defined, the Cost model then computes the rail life for each segment based upon Severe RCF or excessive Wear. Each segment is thereafter replaced at its computed interval for the duration of the study period (typically 25 years). The costs are then accumulated for all segments in the entire route on a yearly basis. Figure 14 shows the difference in rail costs for 4 tactics for a terminal area route. The most cost effective rule in this case was: MHH in all curves, grinding in curves between 500 and 2000m and lubrication on all curves. This policy reduced period rail costs by about 45%.

Current Cost Model outputs should be considered indicative as improvements are needed to increase realism:

- Ground rail is assumed to retain its anti-RCF shape at all times. Experience indicates this is not always true. In future, the Cost Model will use the computed GGI to revert ground segments to un-ground at the time the GGI predicts.
- All RCF and Wear is assumed to grow linearly with time. Studies have shown that this is not always true. Segments with extremely high wear rates for example (un-lubricated sharp curve) will demonstrate a reduction in Wear rate over time as the rail becomes more conformal with the fleet wheels, thereby spreading the load over a larger contact patch.
- The rail replacement limit for the GDI is well established but the limit for GWI rail replacement needs further calibration
- Network Rail has rail replacement rules which determine if single segments or multiple segments in a curve are replaced. These are not currently implemented.

Changes to the Cost Model will occur as time allows and as user feedback helps set change priorities.

6.0 Non RCF Track-Ex functions

Track-Ex has been taught to over 400 members of the UK surface line system. Requests for new functionality outside the domain of RCF have lead to the development of several practical functions:

- **Trend analysis**. Track-Ex can now read in several files measured at different times for the same route. In most cases, such files have "phase errors" caused by at least 3 factors:
  - Different starting point for recording. This results in a constant offset.
  - Differences in the recording coach "tachos" used to measure elapsed distance. This produces a linear phase error that grows with distance
  - Differences in the partial slip (creepage) of the tacho wheels while the recording coach is in curves. This error is random in nature.

Track-Ex currently has a manual tool to remove the first 2 errors. Results are depicted in figure 15. The existence of the random phase errors means that trend analysis on a point by point basis is misleading. Comparisons of stats (maximums or SDs for example) in a window such as 1/8th mile are reasonable and are supported by an existing Track-Ex function, the "1/x Interval "report where x is a fraction of a mile

- **TRK001 Reports** Track-Ex produces the intervention, alert and immediate action reports contained in the track maintenance standard document TRK001. Official reports used for safety purposes are produced by the Derby Engineering Data Centre (EDC) from track geometry measurement trains. But track engineers require informal reports to assess the impact of speed

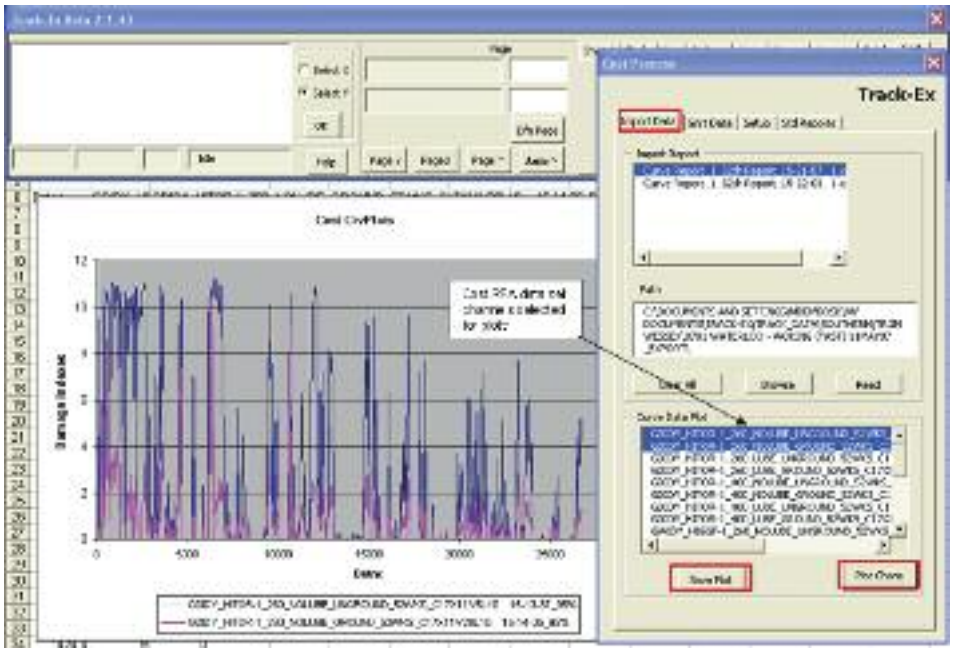

Figure 13: Cost Model 95th percentile data plots for all segments on a route comparing ground and non-ground GDI

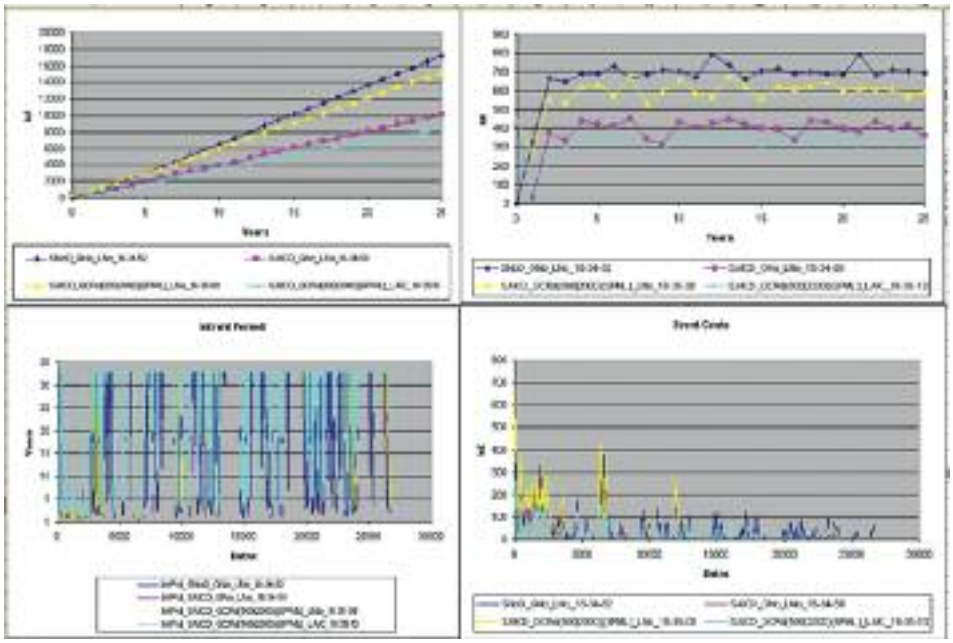

Figure 14: Cost model outputs (preliminary) starting in upper left corner: accumulated total route costs per year, annual total route costs, rail life per segment (default 33 years) and total cost per segment.

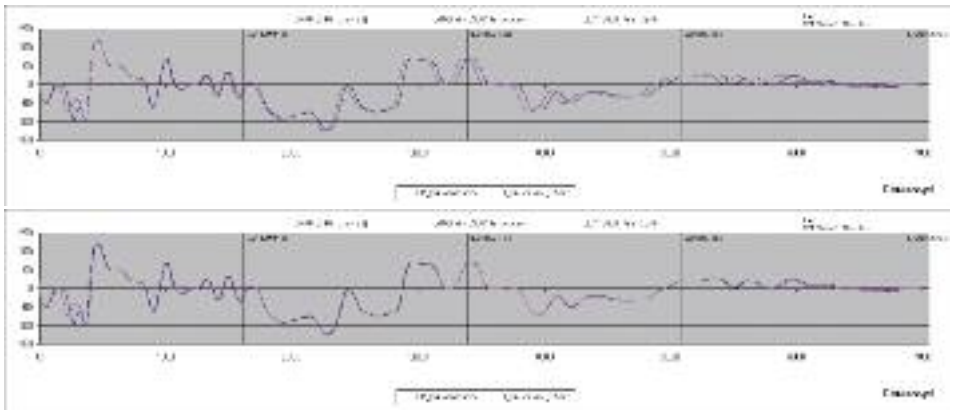

Figure 15: 2 TRGM files before and after phase error removal

changes, explore the potential of reduced TRGM variations and to better plan for maintenance activities. Track-Ex can create plots such as Figure 16 of the exceptions and the thresholds used as well other infrastructure objects such as stations, S&C or bridges. (Track-Ex can read GEOGIS files, the current Network Rail asset data base).

- **049 Channel Generation** The Network Rail track Design handbook (known as 049) specifies various criteria to which curves must comply. As users adjust installed cant or line speed to reduce damage, the Track-Ex 049 function will generate design criteria channels. Figure 17 shows an exception to the nominal 30mm/sec criteria. Such exceptions can be tabulated by Track-Ex using the "Exception Report" function.
- **Other functions.** A host of other functions exist. For example:
  - custom data export functions which support inputs to the Vampire vehicle dynamics simulator and Network Rails design software "The 3rd Way"
  - data import files other than TRGM such as ACTRAFF, GEOGIS and RDMS which are traffic, track asset and track flaw files supported by Network Rail
  - synthetic data such as simple channel based arithmetic, dip angle calculations and artificial ACTRAFF data
  - statistics
  - importation of track design files such as Bentley RailTrack©
  - RFA for rail vertical energy. This facility is experimental but uses the un-sprung mass or P2 force concepts to generate the energy created by a fleet over an entire route. It is intended to support a means of locating non-RCF damage such as excessive ballast degradation. Its control scheme is similar to the RCF RFA.
  - Batch execution. The Track-Ex functions described in this report can be automatically run for a series of input files using a simple batch scripting language

7.0 Developmental Track-Ex features

A variety of improvement schemes are underway to improve Track-Ex accuracy and broaden its scope.

- The VDMs mentioned in section 3 contain the sum of Longitudinal and Lateral TGammas. VDMs will be modified in future into 2 files which contain separate Longitudinal and Lateral TGammas. This improvement will improve quasi-dynamic predictions, assist in the prediction of low rail corrugations and curve squeal and will be of interest to bridge engineers as well.
- The Vertical Energy and Trend Analysis mentioned in section 6.0 are ultimately to be combined to aid research into vertical track degradation. The concept to be explored is simple: if a segment of track has little degradation but very high vertical energy input then it is "strong" while the inverse is "weak". This estimate of vertical track strength could prove to be useful in exploring the impact of future fleets, the efficacy of maintenance plans and to provide a numerical explanation of why some regions of track require more attention than others.
- Cost model calibration and accuracy improvements: As mentioned in section 5, some extrapolations of estimated damage are inherently not linear. Track-Ex therefore needs to accommodate non-linear growth. Better calibration of the GWI and GGI indexes are also needed to better estimate rail life as a function of wear and the loss of anti-RCF ground profile. More robust user "rule" selection is also desirable.
- Quasi-Dynamic TGamma estimates need further improvement as users expect higher accuracy. In the future, Neural Nets (NNs) may be employed. Track-Ex is currently very fast and NNs, once trained properly, are also fast as they are simple arithmetic calculations.

8.0 Who should use Track-Ex and Why

Track-Ex was originally a Network Rail in-house developmental tool. But as its utility grew, VTSIC authorized its use to any participants in the UK surface line system. Over 400 individuals have been trained to date and their duties vary from Track Maintenance Engineers to Route Asset Managers and Track Design Consultants.

Current Network Rail track design guidelines require that an RCF analysis be conducted as part of curve design and many current fleet acquisition specifications contain TGamma limits. Track-Ex is a suitable tool in both of these cases and has already proven itself for route management. Track-Ex output is also used by some budget analysts to forecast future rail expenditures.

The Network Rail's Systems Engineering group believes that tools such as Track-Ex should become an expected part of normal railway business practice. Certainly rail management staff and track designers should consider using Track-Ex as should rolling stock fleet managers since network use charges do now have a curve damage cost component. Budget analysts and safety risk assessment staff should be trained as well. Track-Ex is not limited to UK surface line analysis. In principle, UK underground systems can use it as well as rail systems outside the UK.

9.0 The Future of Track-EX

Since Track-Ex is supported by Network Rail and runs using VBA©, a language contained in Microsoft Excel©, changes are governed by user priorities and

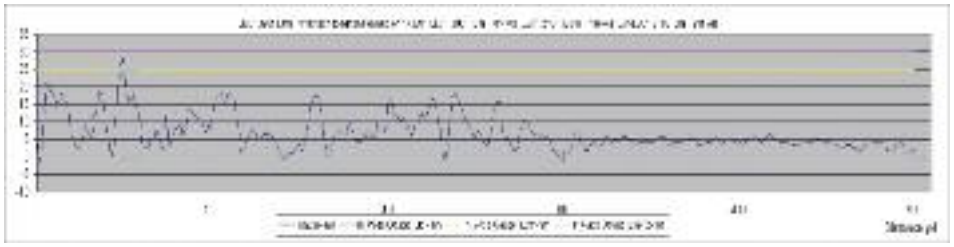

Figure 16: a Wide Gauge exception exceeding a 25mm limit. TRK001 limits are generally a function of speed

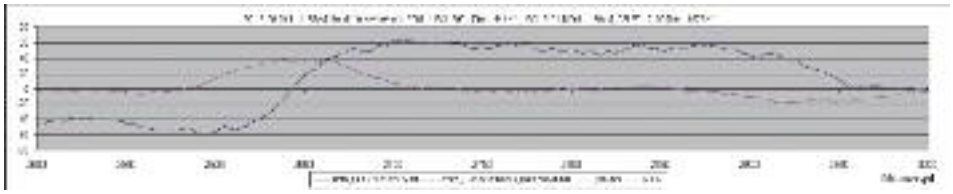

Figure 17: Rate of Cant Deficiency exceeding the nominal 30mm/sec criteria.

the availability of staff. Contracts and licensing are not a constraint on the development process.

Many quick changes are a result of user identified short falls or bugs. User feedback and expectations are also part of the long term plan. Besides the speed, simplicity of code installation and ease of licensing, perhaps the most important feature of Track-Ex is its "80/20" basis. In many practical applications, very high accuracy is not realistic. Programs like Vampire are extremely accurate when compared to field data or vehicle or track test instrumentation. But the acquisition of necessary high quality input data is often not practical or fundable. Besides, front-line personal often need only an approximate answer to identify "hot spots" and do not require highly accurate program output.

In general, Network Rail envisions Track-Ex as a base program for the development of other concepts particularly if they lend themselves to the "80/20" concept. In other words if a complex analysis process is useful to the railway industry and it can be reduced in complexity with a acceptable reduction in accuracy, then it is a candidate for addition to Track-Ex. This strategy is based upon the successful use of the TGamma VDM tables described in section 3 which produce reasonable estimates of TGamma with a fraction of the complexity found in more comprehensive models. Future enhancements of this nature may well be requested by Network Rail itself but, like the VDM concept, may well be conceived by other organizations.

At present 5 individuals spend part of their time as members of the Track-Ex support team. Training, advice, code development and software bug resolution are actively supported. Periodic training courses are run throughout the UK together with "refresher" and "update" courses for existing users. There is also a regular Track-Ex newsletter keeping users up-to-date with developments. For more information contact the Track-Ex Team at:

Track-Ex@NetworkRail.co.uk

References:

1) Plastic flow & shakedown of the rail in repeated wheel-rail contact, A.F.Bower & K.L Johnson, WEAR 1991, Elsevier Sequoia

2) T115 "Whole Life Rail Model application & development for RSSB-continued development of a RCF damage index" RSSB: AEAT, 2004

Developing the PWI
– Subscriptions for 2013 and Beyond

A lot has been done to make the PWI better for its members, and more efficient as a business, since the change of management structure in 2010. A new website has been launched, giving much better access to our excellent range of technical information. With that has come an online forum and links to social media – all of which are proving popular with members and are generating global interest.

Industry links have been strengthened, particularly with TfL and Network Rail but also with the National Skills Academy for Railway Engineering and many consultants and contractors. The PWI's reputation as a source of independent technical support and guidance is growing, supported by the excellent skills of our members. Global interest in the PWI is growing too. We are forging stronger links with the PWI in New South Wales and South Australia, enabling them to join in activity on our UK-based website. We are in early stage discussions on setting up new PWI Sections in Western Australia and Singapore. And we are developing European links, starting with the VDEI in Germany. All these developments will bring benefits to members as our geographical and technical spread grows.

Over the same period the PWI's administration costs have been reduced. The rail industry supports us by providing rooms free for our Board and Executive team meetings. Previously meeting rooms had to be paid for. Postage costs for the Journal have been halved with no effect on the service to members. From next year the cost of producing the Journal will be reduced while improving its look and feel – a real win. The cost of the PWI's storage facilities for books and archive materials has been reduced by 40% and we continue to examine all our spending to make sure that we are getting the best value for money.

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If PWI membership is directly relevant to your employment and you pay your own subscription, you can claim tax relief on that subscription. You can check this out at http://www.hmrc.gov.uk/list3/list3.htm. You must do this for yourself – the PWI cannot do it for you – but it can reduce the cost to you of PWI membership significantly while the PWI still benefits from the full amount.

Members aged 80 years of age or over do not pay subscriptions so please notify the Secretary if you qualify as not all longer serving members' dates of birth are known.

Rates of subscription payable by members of the Overseas Sections are fixed by, and payable to, the Section concerned.

However, as members who have read the Annual Report and Accounts for 2011 will already know, the PWI is currently operating at a loss. Although I expect some improvement in 2012 and 2013 due to cost reductions, these are not sufficient by themselves to turn around the PWI's unsatisfactory financial position and bring it back to balance. But running at a balanced position is not enough. To succeed, the PWI must continue to develop its products and services to members. We know that due to the success of the website, we will have to rebuild it in 2013. We will need to update and print the very popular 'British Railway Track – 6th Edition' in late 2013 or early 2014 due to continuing strong sales. While this is good news, it will cost the PWI £8,000 before we sell a single copy. Meanwhile we will be studying whether the PWI should take steps to being able to award professional accreditation. This would be a significant step, but would also not be easy. We will have to spend money to research it properly before deciding whether or not to proceed.

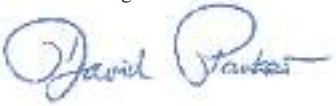
I am asking members to share in supporting these developments through their subscriptions. This is never an easy request to make and is even more challenging given current economic circumstances. However I believe – and I'm confident that members believe – that the PWI can and must play a central role in enabling rail engineers to do a better job and so support and strengthen the rail industry. That cannot be achieved without the funds to do it.

In summary the changes will be:-

- Members' direct debit subscriptions will rise by £7 in 2013 – just two pence per day – and by a similar amount each year until 2017.
- Apprentice and Student subscriptions will rise more slowly – by only £1 in 2013 – and will continue to be very good value to encourage those at the very start of their careers - or considering infrastructure engineering as a career – to join.
- The differential between Member and Fellow subscriptions will be adjusted between 2013 and 2017 to 33%; down from 50% at present. This will bring the PWI more in line with other professional engineering institutions. Our aim is to encourage more people to take up fellowship of the PWI, as a mark of their continuing professional development and contribution to the industry.
- Reduced subscriptions for older members will be adjusted between 2013 and 2017 to be just 40% of the full rate, down from 50% at present, to bring the PWI more in line with other professional engineering institutions.
- Reduced subscriptions will be age-related, a change from the existing 'retired' status. Members who will be 62 or older at 1st January 2013 will be entitled to request the reduced rate, just as retired members request their reduced rate at present. The age threshold will increase by six months each year until it reaches state pension age, 66, in 2021. Members who currently benefit from the reduced rate are not affected by these changes.
- The Board will review the operation of the new arrangements to ensure that the PWI's subscription offering is consistent with that of the other professional engineering institutions.

Don't forget that for UK taxpayers, if PWI membership is directly relevant to your employment and you pay your own subscription, you can claim tax relief on that subscription. You can check this out at http://www.hmrc.gov.uk/list3/list3.htm. You must do this for yourself – the PWI cannot do it for you – but it can reduce the cost to you of PWI membership significantly while the PWI still benefits from the full amount.

I am confident that members will have seen the evidence that the PWI is changing for the better and will support the improvements to come by staying with us. We already benefit from members' support in many practical ways. Your financial support will help us to develop a strong PWI for the benefit of the industry and future generations of rail infrastructure engineers.



David Packer, CEO

PWI – 2013 Annual Subscriptions

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Member	£52.00	£60.32
Fellow	£77.00	£89.44
Member (62 and over)	£26.00	£60.32*
Fellow (62 and over)	£38.50	£89.44*

* We regret that we are unable to offer reduced rate membership to members who pay by payroll deduction. We continue to encourage all members to transfer to direct debit for their subscription payments.

Annual General Meeting of the Permanent Way Institution

Held at the Derby Conference Centre, London Road, Derby on 9th June 2012 at 13.00 hrs

Present:
Ken Aiston, Doug Ayres, Mary Ayres, Norman Bridges, Paul Bull, Philip Bull, John Burdon, Walter Clarke, Colin Cotter, Charles Croft (Finance Director), Brian Counter, Rob Cummings, John Dutton (Non executive Director), John Edwards, Lynne Garner, David Holmes, George Houldsworth, Mark Howells, Philip Johnson, George McMonagle, David Packer (CEO), Malcolm Pearce, Ashley Pettifer, Noel Pitts, Alastair Roberts, Hugh Roper, Alison Stansfield (Communications Director), Martin Summers, Kevin Thurlow, Steve Whitmore (Deputy President), David Williams, Richard Spoors.

Item 1:
The CEO, David Packer opened the meeting as Chairman due to the President being in Australia. He welcomed those present to the AGM, advised the meeting that proxy voting notifications had been received from Gordon Reed, George Bowden and Martin Wooff and read out the following apologies for absence; Mike Barlow, George Bowden, Phil Cave, Mike Chorley, Andy Cooper, Jim Cornell, Colin Cowey, Andy Franklin, John Linkin, Peter Lugg, Phil Ransom, Gordon Reed, Jack Scott, Colin Wheeler, John Elliott and Martin Wooff.

Item 2:
The chairman asked all present to stand and observe one minute's silence to celebrate the lives of PWI members who had passed away during the year. At the start of the silence he read out the names of those whose passing had been advised to the Secretary. These were; Graeme Allan, Leslie Anderson, Kenneth Dampier, Leonard Deakins, John Eggleston, David England, Ted Hamer, Frank Hewlett, Ian Hodgson, David Holt, Keith Jones, William McMorran, Bill Pownall and Robert Sides.

Item 3:
The roll call of the Sections took place. All UK Sections were represented with the exception of Ashford, Glasgow, Solent, Sheffield & Doncaster and Wessex.

Item 4:
The minutes of the 2011 AGM were agreed unanimously with the following minor clarifications;

The word 'died' in the third paragraph to be replaced with 'passed away'.

Item 5:
Steve Whitmore was unanimously elected by the members present to serve as a director and President of the PWI for a 2-year period. Past President Richard Spoors invested the incoming President with his chain of office.

Steve Whitmore, as President, then took over chairmanship of the meeting.

Item 6:
A proposed and B seconded the election of Phil Ransom as Deputy President. The resolution was passed by unanimous vote.

Items 7 & 8:
The recipients of the Arthur Maber Award for the paper Meeting the Challenges of Modern Railway Vegetation Management by Jonathon Callis and Neil Strong and the President's Award for the paper on River Shannon Bridge, Sligo Line by Haidan McAdam and Oliver Doyle were not present.

Item 9:
The Institution Gold Award was presented to Douglas Ayres for his paper on The Stabilisation of Slips in Cuttings and Embankments by Means of Cationic Base Exchange

Item 10:
The Institution Silver Award was presented to Brian Counter on his behalf and on behalf of his co-authors Andy Franklin, Abid Abu-Tair and David Tann for their paper on Life Extension of Railway Track Systems

Item 11:
The immediate Past President gave his report by video presentation to the meeting, the text of which was as follows:

It is tradi*tional for the outgoing President to address the AGM and to report on his time in office. This occasion is somewhat different as I will not be in attendance because, as you know, I am on the other side of the world, in Adelaide South Australia.*

I find it hard to believe that two years have passed since Richard Spoors hung the chain of office around my neck, on behalf of the then outgoing President Bob Cummings. I am still humbled that my fellow professionals saw fit to elect me to the Presidency, something I will cherish forever.

Casting my mind back two years, these were exciting times in the lifetime of the Institution. The changes to the constitution were being implemented and our new Executive, with David Packer as Chief Executive, taking up their positions.

My predecessor Bob was keen that the new President should be a working professional and as such I fitted the bill. What perhaps he and certainly I had not envisaged was that my work would take me to the other side of the world during the latter stages of my Presidency. When it became apparent that a move was on the cards for me, I discussed options with the Executive, who unanimously agreed that I should continue as President from afar. Key to this decision was Steve Whitmore's willingness to step up to deputise for me as President.

I look back on that decision with mixed feelings. I am delighted that the Executive felt they were able to support this arrangement and I have relied very heavily on their support and that too of the wider membership. A benefit has been that I have been able to improve communication with the South Australia and New South Wales sections of the Institution and other railway Societies, particularly the Railway Technical Society of Australasia, the RTSA, which is an important professional body here. I have also gained first-hand experience of the pros and cons of being an 'ethereal' member of an Institution.

The down side has been that I have not been able to offer as much input to the day to day business of the Institution, a function both of being so remote and also of being in full time employment. That said, that's why we introduced a CEO and amended the constitution so that the President no longer needed to be so engaged in the running of the Institution.

On balance I think the decision was the correct one and has demonstrated how we can thrive as an Institution in the industry.

On progress in the last 12 months; at last the website is working and I hope the frustrations and teething problems are receding. The test will be what the members and users have to say. The exciting thing for me remains the ability to allow Members wherever they are and whenever they wish to, to access the site. I hope this becomes the 'font of knowledge' that PW Engineers turn to.

Turning to Journal, I must make mention for the sad loss of our Editor Ted Hamer. Ted's unstinting efforts have kept the Journal in production and it was always a pleasure to be chased by him for my Presidential mutterings. I will miss him. Alison has stepped into the breach and I thank her. The Executive are considering options for the Journal going forward and I await their deliberations with keen interest. Time for some radical thinking I believe.

I am delighted that we staged the two Technical Seminars, and while frustrated at not being able to attend I enjoyed reading the presentations. The full participation by LUL and NR is a most encouraging development, long may this continue. Support by these major industry stakeholders will ensure the Institution's credibility and help encourage new members and the participation of existing members.

I am excited by the Ginger Group concept and the initiative to try and give younger members a voice in the Institution's affairs. I look forward to hearing their ideas on how we can meet their needs and also how we can increase engagement by members in the PWI's affairs.

Lastly membership; the numbers will speak for themselves. If I had one wish it would have been that membership increased under my Presidency, not due to any personal effect but as a result of the radical changes that we have embraced; we will await the reckoning. I am advised that the numbers of members joining the Institution has increased over the last two years, so I take this a very positive sign that we are turning the corner.

Before I close I would also like to mention Bill Pownall, who too has tragically passed away very recently. While no longer active in the Institution, Bill had for many years played a very active role and was a good friend to the PWI. He will be sorely missed by all who knew him.

So to close, thank you to all for supporting my Presidency over the last two years. I look forward to continuing to serve the PWI as Deputy President and I wish Steve every success in his time as President.

G'day from down under, Phil Ransom

Item 12:
David Packer, the CEO, firstly acknowledged the PWI's loss at the recent deaths of Ted Hamer and Bill Pownall. They had both given generously of their time and enthusiasm to the work of the Institution and would be sadly missed. He summarised his report for the year, which had been previously published in the Journal. He gave information on the attendance of directors at Board meetings and then went on to discuss the PWI's textbooks and their future. With all the new options for publishing material now open to us, the PWI will be looking at the best way of making technical information available to members. This is particularly relevant to the S&C Maintenance textbook where limited stocks remain and the information contained in it needs to be updated prior to re-publication. This prompted some discussion from the floor on the availability of suitable technical material and the challenges of getting it published.

He then moved on to outline the significant progress that had been made with the PWI's website during the year and some of the challenges that had been overcome. He explained that Alison Stansfield is very keen to have feedback on the website and its operation as this is the best way to improve service to the PWI's members. This prompted a request from the floor that past Section meetings should be included in an archive section of the website as it was felt that this would help to demonstrate the PWI's range of activities. A discussion then took place on the publication of Board minutes in the members' area of the website as a way of improving the information that members had available. David Holmes proposed and Richard Spoors seconded that the Board be instructed to publish minutes to the PWI's members. The motion was passed unanimously. Kevin Thurlow asked if the PWI knows what volume of business is generated by the website. Alison Stansfield replied that we are just starting to get usable statistics on website traffic and are keen to develop our understanding in this area.

Item 13:
David Packer gave a PowerPoint presentation summarising the PWI's Annual Report and Accounts for 2011, which had been made available to members and which were available at the meeting in hard copy. He noted that income had increased slightly in the year with trading revenue more than offsetting reductions in subscription and other income. The rate of new members joining had continued to hold up well, with leavers reducing, giving a small decrease in UK membership for the year. Journal advertising revenue had fallen in line with the general economic picture and book sales continued to decline. However, expertise contracting was proving to be an area where the PWI could offer opportunities to its members and value to the industry. Annual costs rose as a full-year effect of the new management arrangements was reflected in the accounts, confirming the decision to invest some of the PWI's reserves in improving the institution. The value in the accounts of the PWI's stock of textbooks had been significantly reduced, reflecting poor sales and high stocks of a few volumes. The cumulative effect of these individual changes was an operating loss of £91,414.

David Packer responded to questions submitted in advance by George Bowden, clarifying that the accounts are signed by the Company Secretary, Charles Croft in accordance with the requirements of Companies' House. Details of payments to individuals and companies were set out in David's presentation. These are all agreed by the Board's Remuneration Committee which is comprised of non-executive Board members, in line with corporate good governance.

Richard Spoors asked if the Board had set a level below which the PWI's reserves should not fall, as part of its 5-year plan. David responded that original strategic plan had a figure for the lowest reserves of £65,290 a lower figure than he, personally, would be comfortable with. The Board was very concerned at the PWI's financial position and has instructed the CEO to prepare a revised 5-year plan for discussion in the autumn. This revised plan will include the planned minimum reserves for the PWI.

David Packer then proposed and Steve Whitmore seconded adoption of the PWI's Annual Report and Accounts for 2011. This was carried unanimously.

Item 14:
Andy Cooper was unanimously elected to serve as a non-executive director of the PWI for two years.

Item 15:
Colin Wheeler was unanimously elected to serve as a non-executive director of the PWI for two years.

Item 16:
The proposal to elect John Dutton as a non-executive director was withdrawn when it was realised that his election would exceed the maximum number of three specified in clause 4 (1)d of the Articles of Association.

Item 17:
Alison Stansfield was elected as an executive director of the PWI for two years, the votes being thirty for and two against.

Item 18:
Paul Bull was unanimously elected to serve as Vice-President for England.

Item 19:
Jill Coleman was unanimously elected to serve as Vice-President for Scotland.

Item 20:
David Williams was unanimously elected to serve as Vice-President for Wales

Item 21:
Seamus Kenny was unanimously elected to serve as Vice-President for Ireland.

Item 22:
The date and location of the 2013 AGM was agreed as Saturday 15th June 2013 in Llandudno, North Wales, subject to ratification by the Board.

How YOU can help us reduce our administration costs

From the start of 2012 the Direct Debit system for collecting subscriptions has been changed for new Members. All new members will have their annual fees collected at the end of January, April, July or October in the nearest quarter to when they joined. This spreads the subscription income over the whole year instead of a single influx at the start of the year and will have an increasing effect over the years as new members join thereby improving our cash flow. Everyone who joined before 2012 will continue to have their fees collected around the end of January each year.

Can I appeal to all members who pay by credit card, cheque or banks transfer to pay their subscriptions on time **and please send them (or notification of payment) to the Registered Office**. I am now instituting a six month notice period when I shall stop sending Journals followed by removal from the database after 12 months. I understand that it is easy to put the reminder to one side and then forget but the administrative effort in identifying and sending out of further reminders is extremely costly to the Institution at a time when we are counting every penny. Even better sign up for Direct Debit and there is then nothing more to do. I can send forms by email or post upon request.

I also make an appeal for you to keep your postal and other contact details up to date. Adding an email address helps considerably with communication and makes a considerable reduction in the amount we spend on post. Unless you update your information on the website or tell me or your local Section Secretary I do not have any indication that things have changed until a Journal is returned to me. This also is very costly with the administration, re-packing and posting meaning that each Journal Part can cost as much as £7.50 when the original printing, packing and posting is taken into account.

Finally an apology. I have allowed a large backlog up of membership certificates to develop. This started when our past President moved to Adelaide making personal sign offs of certificates rather difficult. The situation is now resolved with Steve Whitmore being much more accessible. I am working hard to clear the pile and ask for your patience in this matter.

John Linkin FPWI FRSA MIoD

PWI Secretary

Permanent Way Construction on the Gautrain Project

by Jan van Tonder (jvantonder@hatch.co.za)

Abstract

Initial planning of the mammoth Gautrain project started in 2000. It went through many stages and from a perway perspective the first track was laid in March 2008 in the Midrand Depot. The last section of track was constructed in March 2011, 3 years later. This was quite an achievement from a technical viewpoint.

The project was split into two phases, OCD 1 and OCD 2 (Operational Completion Date). OCD 1 was completion of the Oliver Tambo Airport to Sandton section and OCD 2 the rest of the system. OCD 1 was focused on completing this section to be operational for the 2010 Soccer World Cup which was hosted by South Africa. Initially, the two biggest constraints on track construction were the N3 crossing at Marlboro station (OCD 1) and the 5 km long viaduct from the N1 at the John Vorster ramp passing Centurion station to the M1 at the Jean Avenue ramp in the north (OCD 2). The civil and earthworks were behind schedule and this resulted in an enormous reduction of construction time for track work to still meet promised completion dates for the project. During construction another two constraining sections were added to the project, Dale Road just south of Midrand station where the initial test track ended as well as the section between Pretoria and Hatfield (OCD 2).

Content

Introduction

The Gautrain trackwork system (Standard Gauge: 1437mm) consists of slab track in the tunnels (± 21 km) and ballasted track everywhere else (± 70 km) double track bringing the total system to ± 160 km. Three types of rails were used namely:

- UIC60 E2 Carbon Rail - Depot Track (Imported from Corus in France)
- UIC60 E2 HT - Main Line Track (Imported from Corus in France)
- UIC60 E2 HH - Turnouts (Imported by VAE, South Africa, from Voest Alpine. VAE, South Africa manufactured the turnouts)

There are a total of twenty four (24) 1:9 (0 inclination, rail bound crossing) turnouts in the Depot, two (2) 1:18.5 (1:20 inclination, movable V crossing) and fifty eight (58) 1:12 (1:20 inclination, movable V crossing) turnouts on the main line. The Low Vibration Track system (LVT) Sonneville block was used on the track slab in the tunnels.

Two types of sleepers were used namely:

- B70F Concrete sleeper with no inclination on the rail seat (Used in the Depot where short distances occurred between turnouts)
- B70 Concrete sleeper with 1:20 inclination on the rail seat

The sleepers were manufactured by Infraset at their factory in Brakpan, South Africa. Infraset also manufactured the sleepers for the turnouts.

The Pandrol Fast Clip fastening system was used except for the maintenance workshop and the train wash bay where the Pandrol E Clip were used. The fastening systems were manufactured by Pandrol in South Africa.

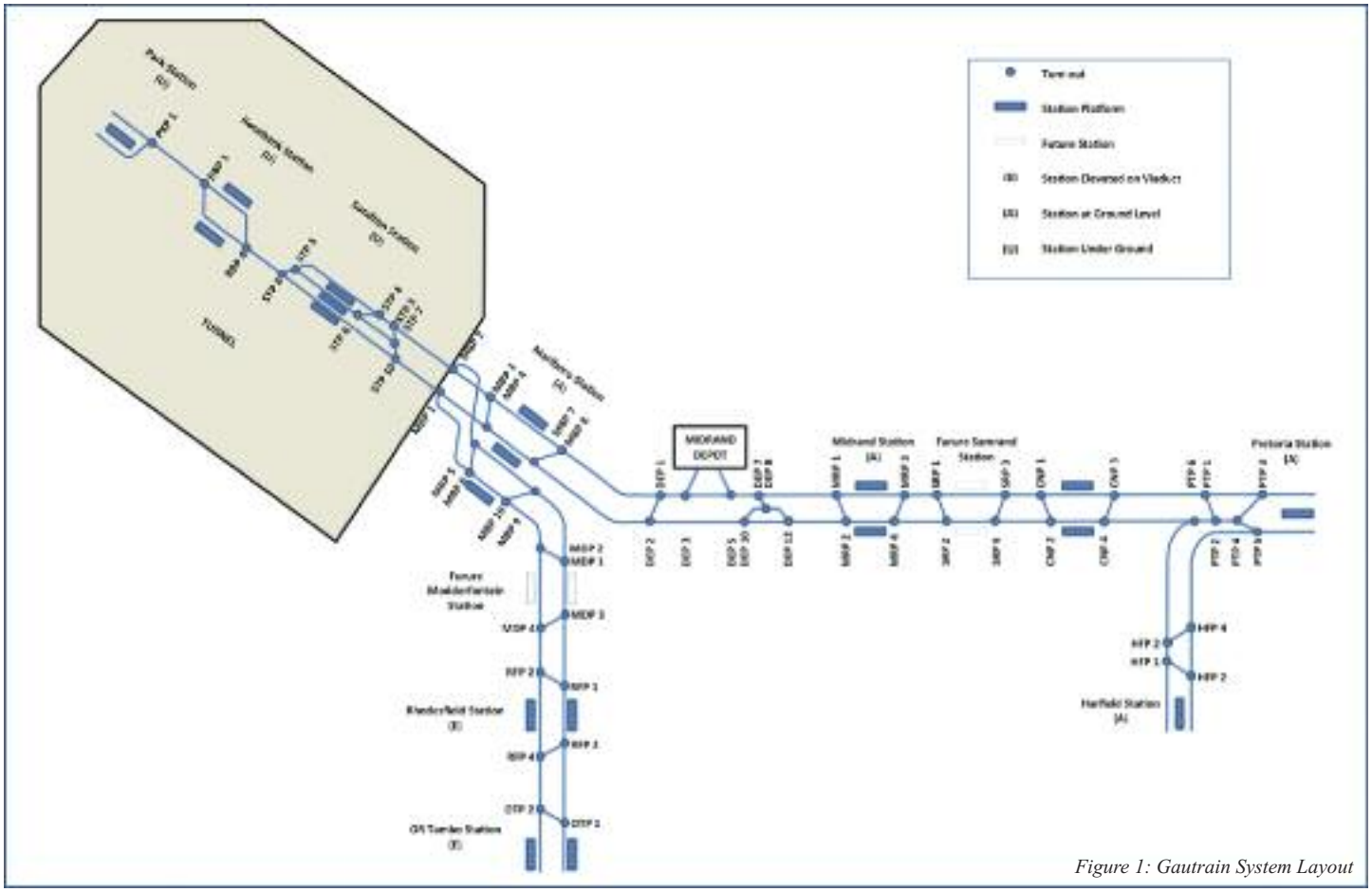


Figure 1: Gautrain System Layout

The System

Figure 1 shows the layout of the total Gautrain system.

The Construction Plan

The basic construction plan was:

- Build the Depot Yard which included the main workshop lines
- From the Depot build the rest of the system concentrating on OCD 1

To execute this basic plan the following had to be in place at the Depot from a track laying perspective:

- Build a temporary workshop to maintain construction vehicles and equipment
- Build a flash butt facility to weld 18m rails into 216m strings for track laying
- Above had to be constructed with sufficient temporary railway lines (yard) on which on-track equipment could be off-loaded

The physical execution of this plan started in November 2007 when the construction of the flash butt yard started followed shortly by the temporary workshop.

Construction Methods

The system consists of track slab and ballasted track therefore two basic methods were used.

Ballasted track:

The basic method was placing bottom ballast using a ballast box pulled by a truck tipping the ballast in the box while moving forward. This resulted in an even layer of ballast being placed on the formation. This layer was then compacted using a roller.

The sleepers were then placed by machine (Vaia Car, Hi-rail excavator fitted with a sleeper layer) from the stacks placed on the formation. The machine spaced the sleepers 700mm before placing them onto the bottom ballast. The rails were placed on the sleepers and clipped up in the 216m panels.

Temporary fishplates were used to join the panels to allow ballast wagons and tamping machines to bring the track to its final alignment and level.

The mobile flash butt welder was then used to weld the panels into 432m panels which were destressed and thermit welded during destressing to complete the ballasted track construction.

Figure 2: Placing bottom ballast

Figure 2 shows placing of bottom ballast using a ballast box pulled by a tipper truck.

Due to program constraints the placing of bottom ballast was later abolished and sleepers were placed directly on the formation (bottom up). The tamping machines had the capability to be set that with the initial lift of the track the tamping tines only goes have the full capable distance down into the ballast, thus not damaging the formation with the initial lift. This saved time on track construction.

Figure 3: Sleepers being placed

Figure 3 shows the sleepers being placed on the bottom ballast.

Figure 4 shows the rail train being pushed to the next position for off-loading.

Figure 5 shows a rail string pulled from the rail train onto the sleepers.

Figure 6 shows tamping being done.

Figure 4: Rail train on its way to be off-loaded

Destressing was done mostly (70%) by means of tensioning working with a Stress Free Rail temperature (SFT) of 35 °C. 30% destressing was done by the conventional method working with a SFT range of 25 – 42 °C.

Figure 5: Rail string pulled from rail train onto the sleepers

Figure 6: Tamping

Figure 7 shows the rail tensioner kept in place until the thermit weld cooled down before it was removed. Tensioners were kept in position for at least 45 minutes after the thermit weld was stripped.

Figure 7: Tensioner kept in place after destressing waiting for the thermit weld to cool down

Slab Track:

The basic construction method was to place the rail strings on the invert slab and using temporary braces consisting of flat bar, space the rails to keep gauge while the construction trains and machines move on the rails. Using flat wagons the Sonneville blocks were distributed on pallets along this temporary braced track. A rail threader (Figure 8) was then used to lift the temporary braced track into position over the Sonneville blocks. The temporary braced track was then lowered onto the Sonneville blocks and clipped.

Figure 8: Rail threader

A Gauge Set Frame (GSF) was then fitted to the rail @ 3m intervals. These frames inclined the rails to

1:20 and allowed adjustment for gauge, cant and vertical level. The GSF's were anchored to the walk way via an adjustable buckle allowing setting of the horizontal alignment of the track. The position of the track was initially given by the surveyors using theodelites on one leg of the track. From this leg the gauge and cant was set using normal track gauges. A length of 220m sections was set up for a concrete pour at a time. The track was then checked by the surveyors again and finally checked for alignment, gauge, cant and twist using a hand pushed geometry trolley before the GSF's, rails and fasteners were covered with plastic for the concrete pour.

Figure 9: Slab track ready to be covered prior to concrete pouring

Concrete was moved into the tunnel using an 15 m3 agitator mounted on a flat wagon. The concrete was discharged into a rail bound concrete pump, pumping the concrete at a starting distance 220m away from the pump towards the concrete pump. This allowed for dismantling the pipes and cleaning them at the same time as the slab track was poured working towards the concrete pump. The plastic covering was removed the next day. The mobile flash butt welder was then used to butt weld the rail panels completing the track construction. No destressing is necessary in the tunnels.

Flash Butt Yard

The mobile flash butt welder was delivered in December 2007 and the first test weld for setting up the machine was done in January 2008.

The first rail (Carbon) arrived on the 8 th of January 2008.

The first rail string consisting of 11 butt welds (216m long) was butt welded on the 17 th of January 2008. Figure 10 shows a picture of the mobile flash butt welder in the flash butt yard at the Depot.

Figure 10: Mobile Flash Butt Welder

The production rate for the welder started at ± 18 welds per shift (8 hours) and increased to an average of 42 welds per shift as the crew became familiar with the process and equipment.

All the welds were tested using the ultrasonic testing method for certification. Figure 11 shows a butt weld in a rail string being tested.

Figure 11: Ultrasonic Testing

Executing the Construction Plan

As mentioned before it was a known fact that by the time track construction reached the N3 crossing from the Depot, the civil and earthworks will not be finished and will not be ready for track construction. The plan from an OCD 1 perspective was an Electrostar running on the Airport line in December 2009. This had to be achieved to allow sufficient time for testing of the system before opening the Sandton – ORTIA line (OCD 1) in June 2010 to the public in time for the Soccer World Cup.

The first section of tunnel (± 5km) was available in May 2009 and to be able to start the track construction in the tunnel a temporary flash butt facility was setup at the entrance to the tunnel (Marlboro Portal) to continue track construction into the tunnel to Sandton. By this time sufficient rail strings were welded to construct the ballasted track of OCD 1. The flash butt welder was moved to Marlboro Portal to start welding the strings for the tunnel until the N3 crossing was finished and rail strings from the Depot could be used.

Earthworks were completed and formation was available for track construction east of the N3 crossing towards ORTIA. To be able to continue with track construction and finish track construction in time the decision was made to build a temporary construction line (Goat Track) from north of the N3 crossing linking the Pretoria main line (Part of Test Track) with the Sandton – ORTIA line. This enabled delivery of track components and material for construction to ORTIA from the east of the N3 crossing via rail from the Depot.

To work around the Dale road cut and cover being late a temporary flash butt facility was build at the future Samrand station to continue with track construction towards Viaduct 5. It was therefore possible to build track from already constructed track as this method suited all the construction equipment better as delivering of track components and material for construction was done by rail.

Temporary flash butt facilities were also constructed between Centurion and Pretoria and Hatfield and Pretoria for the same reason as above.

Another factor that resulted in a huge constraint on track construction was the opening of the line on OCD 1 while the tunnel section beyond Sandton still had to be completed. Concrete for the slab track was delivered and loaded at Marlboro Portal. This could no longer be done and to solve the problem tremmie pipes for concrete delivery were installed at Mushroom Farm Park, Emergency Shaft # 6 and Emergency Shaft #3. Material were taken into the tunnel during the engineering hours at night (Between 22H00 – 04H00) when the passenger services were shut down.

Isithimela Rail Services finished Track construction in March 2011.

Some Statistics

Here are some approximate quantities of materials used for the perway portion of the Gautrain Project:

- 19 320 Tons of rail
- 60 000 Sonneville Blocks
- 200 000 sleepers
- 16 200 m3 of concrete
- 453 600 Tons of ballast stone
- 17 889 Butt welds were completed
- 2 150 Thermit welds were casted

Conclusion

Due to the mechanized component of track construction on the Gautrain project the work was done with a labour force of ± 200 people. This included management, foremen, machine operators and labourers.

The Gautrain system was a major project that will definitely have an enormous positive influence on the public transport sector in the Gauteng Province.

High Output Evaluation Review: Introducing HOVAR

By Eur Ing Dave Brooks
BEng CEng MICE MPWI

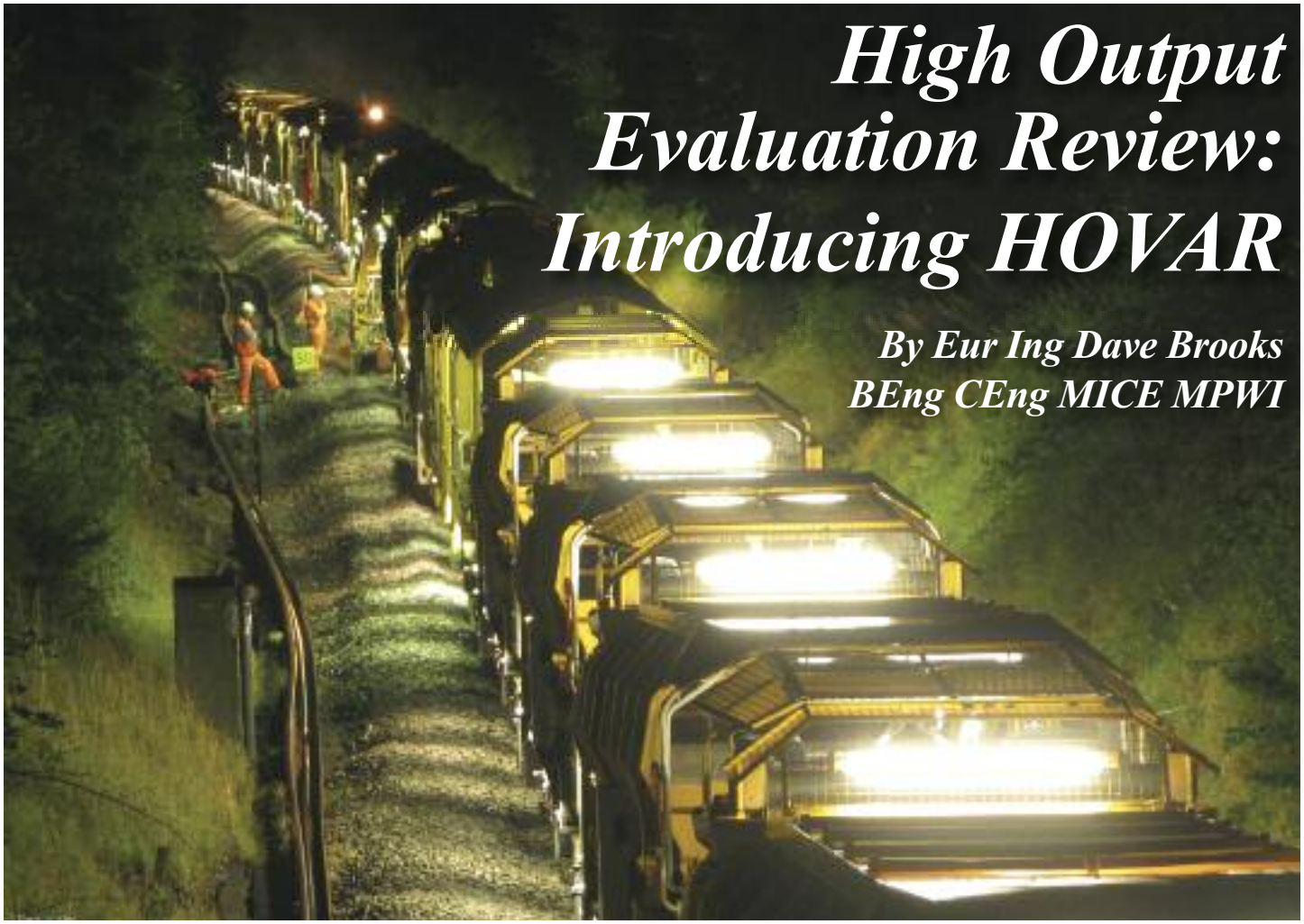


Plate Two - Nighttime Working *David Emsley (dremsley@themutual.net) 2012*

Introduction

A review of the Track Asset Policy for Control Period (CP) 5 highlights an increase, wherever possible, in the use of the High Output machinery currently available within the UK. In particular, this refers to the High and Medium Output Ballast Cleaners (HOBC and MOBC, respectively) and the Track Renewal Train (TRT). [1]

The aspiration of CP5 is to maximise the utilisation of the High Output machinery in places where 'conventional' renewals would have normally be undertaken.

The challenge presented to the London North Western [North] (LNW-N) track Route Asset Management (RAM) team was how to establish a simple method of determining where the High Output machinery could be utilised and when – could they be effectively used during mid-week or weekend working.

Once this had been determined, and then combined with the TRS (Track Renewals System) workbank, a robust programme of High Output works could be established for CP5. [2]

To achieve this, the LNW-N track RAM team utilised the new process known as HOVAR: High Output Evaluation Review. This paper aims to set out the background to HOVAR.

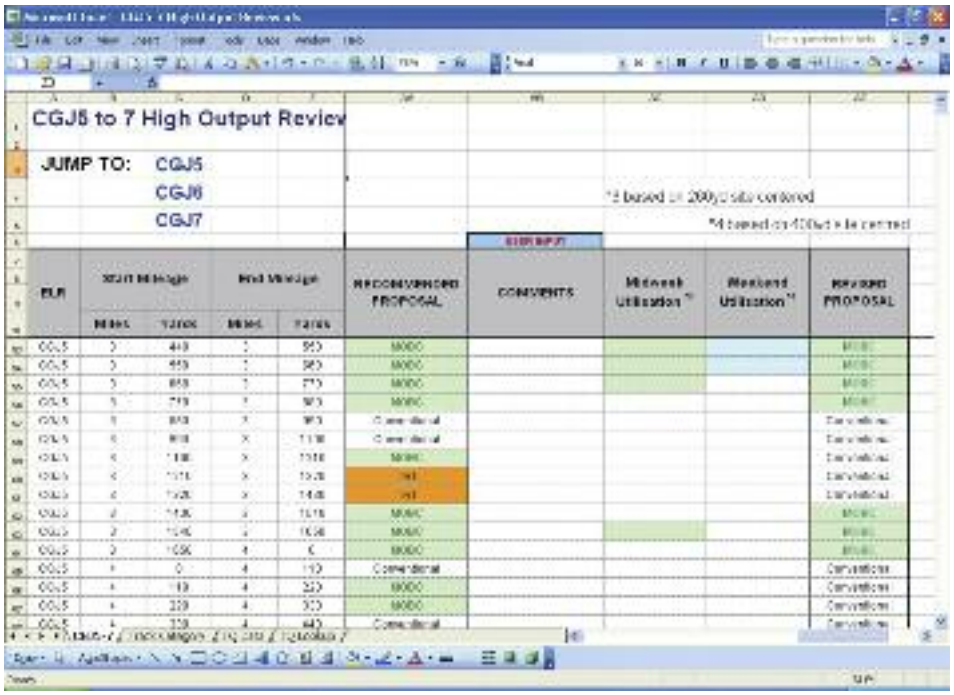
Plate One shows a High Output Ballast Cleaner in daytime working. [3]

What is HOVAR?

HOVAR is the assessment of a route section, in 1/16th mile segments, to determine whether High Output machinery can be utilised.

ANY SITE CONSTRAINTS?							
Platform	SSC	Tunnel / Underbridge	Steel Sleepers	Clearance <700mm (RE-Structure)	Excessive Lower Required >250mm	Level Crossing	Wooden Sleepers

HOVAR Constraints *Dave Brooks*



HOVAR Screenshot *Dave Brooks*

HOVAR works in four steps:

STEP ONE:	**Environ Constraints**
STEP TWO:	**Machinery Selection**
STEP THREE:	**Recommendation**
STEP FOUR:	**Utilisation**

How Does HOVAR Work?

STEP ONE: ENVIRON CONSTRAINTS

HOVAR is a culmination of environ data for a given 1/16th of a mile route section. This data is referred to as "Constraints" (Figure One). Any 1/16th of route mile location with one or more of these constraints would immediately preclude it from being accessible to the High Output machinery. [4]

The constraints are:

Platforms and Clearances:

Is there insufficient lateral space (<700mm) to allow passage of the machinery (Plate Two illustrates the need for lateral space); [5]

Switches and Crossings (S&C):

The machinery currently can not deal with S&C and any renewal or refurbishment work must be undertaken using traditional methods;

Tunnels and Underbridges:

This is a combination of limited space both laterally and vertically, as well as load/vibration risks;

Level Crossings:

These are either an obstruction and/or too large and time consuming to lift and reposition after completion of the works;

Steel Sleepers:

There is some debate as to whether it is possible to ballast clean a route section consisting of steel sleepers. The premise being that steel sleepers may twist when lifted and would not obtain sufficient compaction stability when relayed on the trackbed.

There is currently verification testing being undertaken by the LNW route;

Wooden Sleepers:

The presence of wooden sleepers is not a precluding factor but the quality of the wooden sleepers needs to be determined to establish whether they are in a suitable condition to with stand the passing of the High Output machinery; and

Excessive Lower:

Excessive lower applies to any proposed track lower greater than 250mm, where the required trackbed depth is also taken into account in accordance with that route Track Category. Any lowers that exceed 500mm (including trackbed depth) are rejected for use of the High Output renewal method.

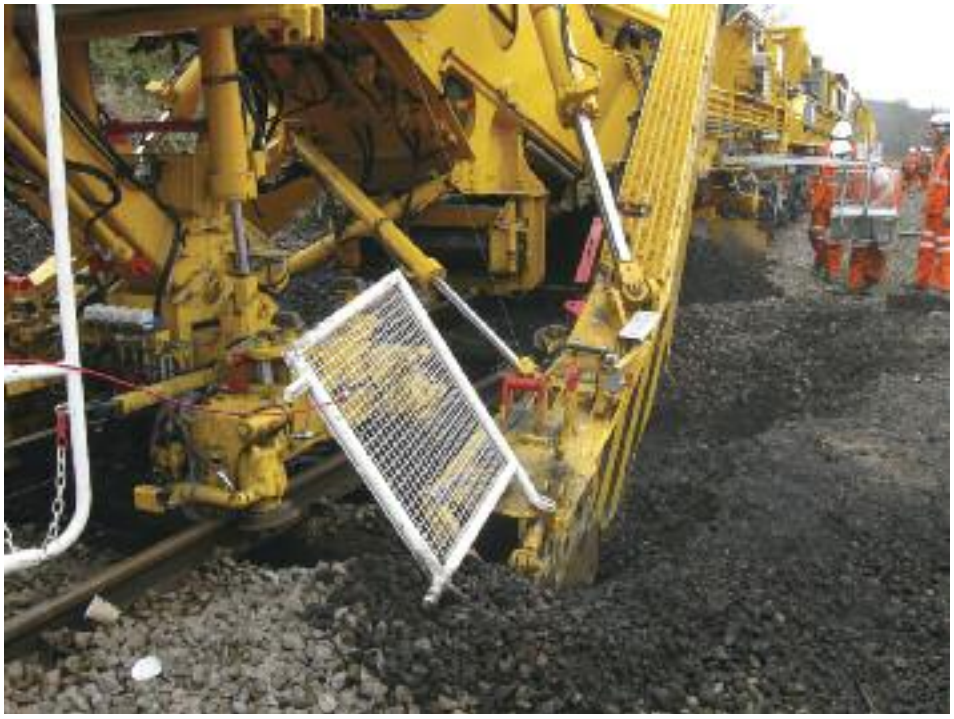


Plate One - Daytime Working *Matthew Benson, Network Rail 2010*

HOVAR assigns an arbitrary value (1) to each constraint and depending upon the sub-total of the constraints summation will determine whether any High Output machinery can be utilised on that 1/16th of route mile section.

The exception being wooden sleepers; this value is given a value of 0.25, as the presence of wooden sleepers doesn't totally preclude the use of any High Output machinery, but rather the integrity of the wooden sleepers needs to be assessed.

Anywhere with a resultant summation of greater than 0.5 is highlighted as being '*constrained*'. Less than 0.5 is flagged for '*assessment*' and would require a site visit to verify the integrity of the wooden sleepers.

Anywhere flagged for assessment does not change throughout the next steps.

Using GEOGIS the track category for that route can be obtained, and in accordance with the track design and construction standard (NR/L2/TRK/2102) the required trackbed depth can be obtained. [6, 7]

If there is a known lower for a 1/16th route mile section HOVAR calculates the overall construction depth and anything exceeding 500mm will be rejected for High Output machinery.

It is now known for a given 1/16th route section if it is possible to use High Output machinery.

HOVAR then moves to Step Two.

STEP TWO: MACHINERY SELECTION

Inputting the TRS specifications for the route allows HOVAR to determine which High Output machine to recommend.

The initial recommendation default, if no constraints are present, is HOBC/MOBC as the end

Plate Three - Cutterbar in Action *Matthew Benson, Network Rail 2010*

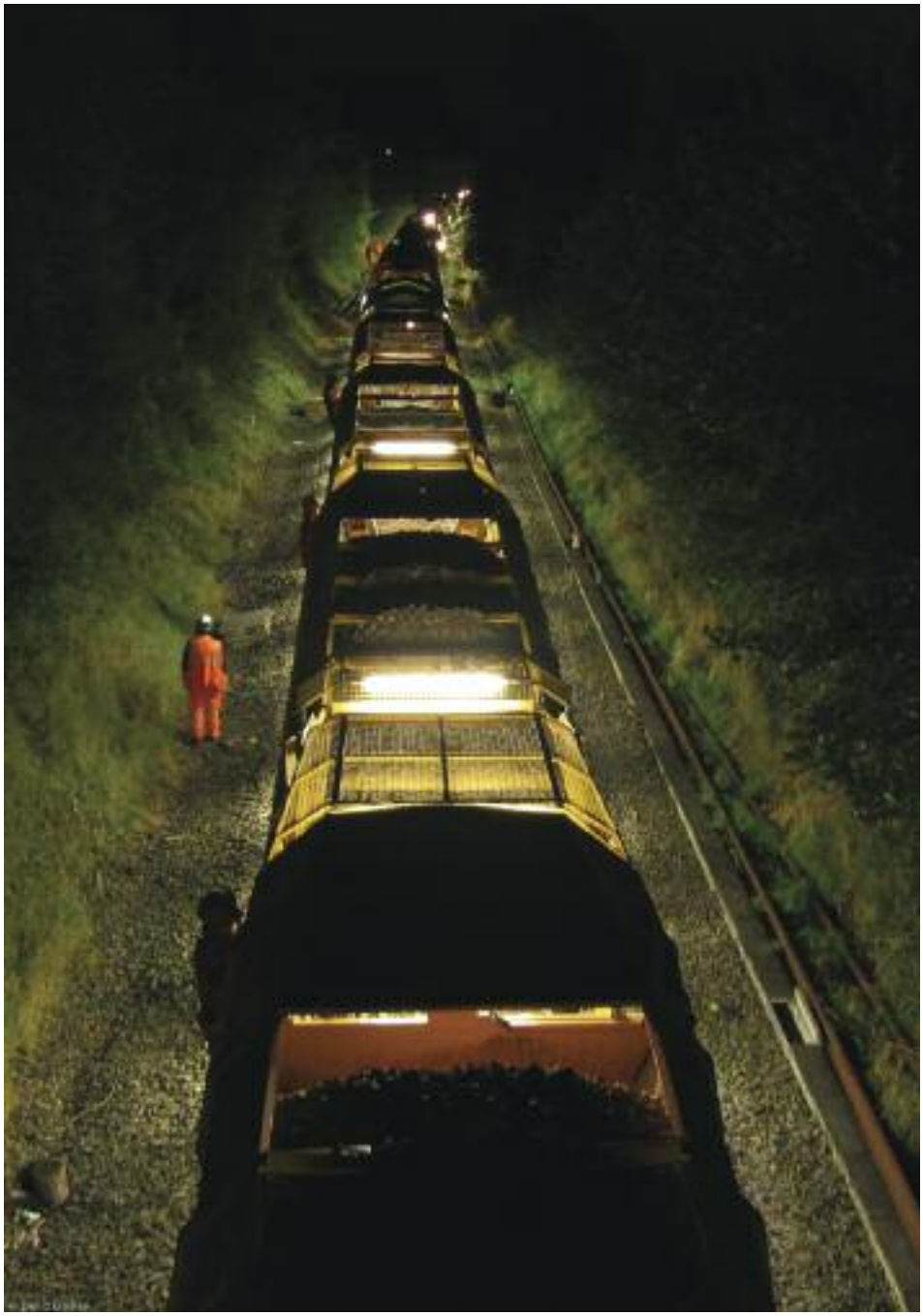


Plate Four - Ballast by Night *David Emsley (dremsley@themutual.net) 2012*

result is the same. If TRS has a 1/16th for proposed ballast replacement, then the recommendation remains at HOBC/MOBC. Should TRS require ballast, rails and/or sleepers then the recommendation can be changed to TRT.

If TRS has any formation work requirements then the recommendation is changed back to '*conventional*'.

If there is no TRS specification the default recommendation of HOBC/MOBC (if no constraints are present) is selected. If there are constraints and no TRS specification then the selection is '*conventional*'.

HOVAR then moves to Step Three.

STEP THREE: RECOMMENDATION

HOVAR determines the current rate of deterioration for that 1/16th route mile section, based on the current and past Standard Deviation (SD) track quality values (for example, over a min. of six months or any run/set of data available). This result is then used to determine the likelihood of a formation issue present.

The rate of deterioration is determined using mean deviation and is referred to as the Maintenance Index (MI).

$$\mathbf{MI = [(SD_W - SD_B) / (SD_T - SD_A)]}$$

Where: SD_W = Worst SD value in sample

SD_B = Best SD value in sample

SD_T = SD Tolerance Limit (*)

SD_A = Average SD for sample

Any 1/16th section with a MI > 1.9 is deemed to probably have formation issues, and so the recommendation is reverted back to 'conventional'.

Note: HOVAR is now an additional and integral part of the TARQUIN process. [8, 9]

* This is the corresponding "Q" Band value from Table A.3 in NR/L2/TRK.2102 within the Band 2 WT35 section for the route section linespeed. [7]

HOVAR then moves to Step Four.

STEP FOUR: UTILISATION

Having established where High Output machinery can be recommended, HOVAR then determines the efficiency of using the equipment during mid-week and weekend-possessions, given the amount of High Output work available.

Using centred lengths of 260yards for mid-week working and 400yards for weekend working, HOVAR establishes which 1/16th sections would be best approached midweek or at weekends for greatest efficiency.

Plates Two and Four show High Output machinery working night shift on 25th August 2012 near Kenilworth.

Where Has HOVAR Been Used?

To date, HOVAR has been used to determine solutions successfully on the following Network Rail projects:

- Preston to Blackpool Route Upgrade;
- West Coast Mainline (LEC4 to WCM1, inclusive) CP5 workbank;
- Settle – Carlisle future workbank;
- National Electrification Project:
  - Cardiff Valley Lines;
  - Midland Mainline Electrification (Paddington to Sheffield); and
  - North West Electrification Phases 5 (Manchester Victoria to Stalybridge)

Further Information

If you require further information or assistance in reviewing a project area for the use of High Output machinery, please feel free to contact the author:

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Email Address: David.brooks3@networkrail.co.uk

The author would like to thank Matt Benson and David Emsley for the kind use of their photographs.

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South & West Wales PWI Technical Visits 2012

Wednesday, 13th June.

Five PWI members travelled to Bishops Lydeard on the West Somerset Railway where the group were met by host Mr Ian Aldridge for a short car trip to Norton Fitzwarren triangle. Although the installation has been widely publicised, the enormity of the site could not be appreciated without setting foot at the locâle.

The group walked over one chord of the layout to inspect the permanent way and turnouts and was able to see the entrance line to the site from the mainline connection and a section which is re-laid on part of the former Barnstaple Branch.

Whilst there, a spent ballast train entered the northern chord and reversed onto the north-south chord before running around via the south chord and again, the sheer train length of the special wagons could not be appreciated until witnessing a typical spent ballast train arrival.

The party then returned to Bishops Lydeard for a relaxing return journey by steam-hauled train to Minehead.

We are indebted to Ian Aldridge for his in-depth information on the triangle's installation and appreciate the enormous effort put in by volunteer permanent way staff in achieving the laying of this massive project.

Wednesday 18th – Friday 20th July.

Following Jeremy Reece's excellent technical paper on the Isle of Man Steam and Tram Railways, presented to the section at a Newport meeting in February, where he invited members to visit the Isle of Man Railway system, nine members and ladies journeyed to the island for a 3-or 4-night's stay at Douglas.

Jeremy had very kindly arranged a two-morning's itinerary, the first of which was a visit to the Derby Castle tram depôt. Most of the group travelled on a horse-drawn tram for the short run from their hotels to the Derby Castle terminus, to meet up with Jeremy. It was a short walk to the electric tram depôt where the workshops and trams in various states were seen and the fitting shop was visited where surprisingly, most of the workshop machinery was driven via an overhead lineshaft. The group was able to see wheels

being hydraulically pressed onto an axle. Outside, the intricate permanent way, all 3ft gauge, with sharp radii into the depôt, contained a number of tandem turnouts and at the esplanade section where the horse-drawn 3ft-gauge trams terminate, the permanent way is interlinked and again an intricate system of 3-way turnouts and curved diamonds are laid flush with the road surface into the horse-drawn tram shed.

Following a very detailed insight to the IOM electric tram systems operation and history given by Jeremy, he accompanied us on a tram journey to Laxey power station where a special stop was authorised to de-train and visit the power supply building and additional tram storage shed.

Inside the immaculately clean building, transformers were housed and surprisingly, working mercury arc rectifiers which supply 550 volts dc to the OLE and these are apparently two of the last remaining working units in the world. We were able to see the ammeters on the output circuits, swinging to and fro as trams powered from the overhead lines were applying or reducing power on their journeys.

The sharpness of some of the curves in the PW was amazing and the modern automated level crossing control system is excellent.

A short walk to Laxey tram station was then made and our party split up, for a free afternoon but rejoined at Derby Castle at 18.40 for a tram journey back to Laxey and connection to the 3ft-6in gauge Snaefell Mountain Railway to ascend to the summit just over 3000ft above sea level, for a pre-arranged dinner (above the clouds).

The following day we met up with Jeremy at Douglas railway station where once again, he gave us a very detailed account of the Manx Railway's history and we toured the workshops which cater for all aspects of steam engine maintenance and what we witnessed is a credit to the corporation. Again machinery was driven via a lineshaft and a steam engine which used to power it, was still workable but now driven by compressed air for demonstration purposes.

Steam locomotives in various states of repair were seen.

Following this part of the morning's itinerary, we thanked Jeremy sincerely for giving up his time to escort us for the first two mornings and for the wealth of information given us and so our party boarded a steam-hauled train for the 16-mile run to Port Erin and this was indeed an experience, the 2-4-0 Beyer Peacock steam loco performing excellently! It was intriguing to note that some of the semaphore signals at passing places on the single line were still of the old split post type with single red spectacle which swung clear of the lamp to show a white light for "All clear"! Much of the recently renewed FB rail sections were seen.

The remaining time was taken up by individuals "doing their own thing" and everyone agreed that this was one of the best PWI visits that they had been on and the weather had been favourable too.

Thursday 2nd August.

Ten PWI members and two guests assembled at the Airport Security Office for a pre-arranged visit to Cardiff Air Traffic Control tower, kindly authorised by NATS Administrator, Ms Sue Holly.

After protocol briefing and photo-ID checking, members were split into two groups and introduced to other ATC staff prior to being introduced to controllers manning the ATC tower, where on-screen mimic panels of the ground taxiways and their lighting systems were monitored. The command of view from the tower is amazing and because of the flatness of the Vale of Glamorgan, a 360° view is possible and on most days the Somerset and Devon north coasts are visible from the tower right down to Bull Point in Devon.

Following this, the Cardiff control area section below the highest section of the tower was visited. Here ATC controllers were monitoring and controlling the flightpaths of aircraft over a wide radar control area and a mass of data was seen to be displayed on monitors. Cardiff ATC is a control zone and controllers cover all aircraft transiting the area between the Severn estuary and south-west Wales, up to altitude of 16,500 ft. This includes military aircraft carrying out routine exercises at approach and overshoot procedures and beacon approach. Although RAF St. Athan aerodrome is just 1½ miles west of Cardiff airport, all traffic to or from St.Athan must contact Cardiff ATC for clearance and this also applies to aircraft inbound and outbound to Bristol-Lulsgate, Filton, Exeter, Gloucester, Newquay, Swansea and Cardiff heliport and obviously to all police or emergency services helicopter flights or aircraft wishing to pass through the flight control zone.

The radio link between controllers and aircraft is unique and almost all aircraft carry transponders which are set to a "Squawk" numerical identity by tower radar controllers which, once established, the aircraft can be followed on the radar screen. London ATC play a significant rôle in handover of all flights from and to Cardiff and flight paths from Cardiff are authorised by direct 'phone link prior to being cleared.

The PWI is extremely grateful to Cardiff ATC for their co-operation and welcome extended to members for this enlightening visit.

Following this visit, members travelled to the 13th Century "Blue Anchor" Inn at East Aberthaw village for lunch.

Note: all three visits were arranged by Brian Mills and some members of the Bristol & West of England Section were included. All photography is by Brian Mills.

The PWI is online

We encourage all members to register on the website and update their details.

www.permanentwayinstitution.com

www.facebook.com/PermanentWayInstitution

www.twitter.com/PermWayInstit

Permanent Way Institution forum on LinkedIn

PWI Publications and Sales

BRITISH RAILWAY TRACK - 7th EDITION
The following volumes of the 7th edition of the Permanent Way Institution textbook are now available:

Volume 1 - Design Part 2 Switches & Crossings, by John Morgan, with contributions from Martin Curno and Chris Preston. This volume provides guidelines on good practice in the design of switches and crossings in flat bottom rail. Within its 500 pages there is data for all of the British Rail and Network Rail standard designs.
Prices for PWI members £28.00 in the United Kingdom, or £34.00 outside the UK. For non-members the prices are £58.00 (UK), or £64.00 outside the UK.

Volume 1 - Design Part 3 Bull Head, by John Morgan. This is the moist comprehensive treatment of this important subject ever attempted, comprising 282 pages with more than 90 photographs.
Prices for PWI members £16.00 in the United Kingdom, or £20.00 (overseas). For non-members the prices are £36.00 (UK), or £40.00 (overseas).

Volume 4 - Plain Line Maintenance by Dr D L Cope and J B Ellis gives an in-depth treatment of all aspects of this important subject. By providing frequent cross-reference to Network Rail standards it gives a comprehensive and up-to-the minute resource of best practice.
Prices for a recent reprint for PWI members £26.00 in the United Kingdom, or £30.00 (overseas). For non-members the prices are £52.50 (UK), or £56.50 (overseas).

Volume 5 - Switch and Crossing Maintenance by Dr D L Cope and J B Ellis sets out the Network Rail preferred methods of carrying out maintenance of switches and crossings, including RT60 layouts. An essential document for those involved in switch and crossing maintenance.
Prices for PWI members £23.50 in the UK, or £27.50 (overseas). For non-members the prices are £50.00 (UK), or £54.00 (overseas).

Volume 9 - Track Terminology by I W Ellis with contributions by Dr C S Gaillard and P J F Gous.
Gives a comprehensive description of trackwork features with many commonly used track terms in the French, German, Italian, Spanish and Afrikaans languages.
Prices for PWI members in the UK £16.00, or £20.00 (overseas). For non-members the prices are £36.00 (UK), or £40.00 each (overseas).

BRITISH RAILWAY TRACK - 6th EDITION
Copies of ***British Railway Track - Design, Construction and Maintenance*** are available at £20.00 in the United Kingdom, or £26.00 (overseas). For non-members it is £30.00, or £36.00 (overseas).

TRACKS TO THE CITIES - LIGHT RAIL SUPPLEMENT
This book by David L Bateman describes the design, construction and maintenance of Light Railways and Tramways.
Prices for PWI members in the United Kingdom £7.00, or £10.00 (overseas). For non-members the prices are £10.00, or £13.00 (overseas).

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A 64-page booklet. The text of the paper given by Charles E Lee to the London Section of the Institution on 8 March 1937.
Price £4.00 in the United Kingdom, or £6.00 (overseas).

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PERMANENT WAY INSTITUTION
AGM and Summer Convention
Llandudno June 14th – 17th 2013
Organised by North Wales Section
Provisional Convention Programme

Venue & Accommodation	St. Georges Hotel, The Promenade, Llandudno, Conwy. LL30 2LG. 01492 877544 http://www.stgeorgeswales.co.uk/ email: reservations@stgeorgeswales.co.uk Quoted rates for a standard room are; Twin/Double room - £60 per person per night for B&B. Single room supp £30 per room. Upgrades are available. All bookings for accommodation should be made direct with the hotel, quoting Permanent Way Institution and contract number 926450 Llandudno has a number of hotels, guest house and bed & breakfast accommodation. Please visit contact the tourist information centre - Library Building, Mostyn St, Llandudno, Gwynedd LL30 2RP, website http://www.visitllandudno.org.uk/ Tel. 01492 577577
How to Book -	Return booking forms and payment to: Steve Whitmore, 7 Chilworth Close, Wistaston, Crewe, Cheshire, CW2 6UN. Cheques payable to 'PWI North Wales Section' Mobile: 07786 224561 steve.whitmore@permanentwayinstitution.com
Friday 14th June CEMEX	A Golf Day is being arranged and supported by CEMEX at North Wales Golf Club, 72 Bryniau Road, West Shore, Llandudno, LL30 2DZ. Details will be available from Tony Darroch in the New Year.
13:00 – 17:00	**Technical Visit to Hanson Penmaenmawr Quarry** Members only and sorry, no children. This is a working quarry therefore uneven surfaces and stairs/gradients will be present.
19:30 onwards	**Welcome Evening** – 2 course hot and cold buffet with entertainment. Children welcome.
Saturday 15th 10:30 – 13:00	**Vintage Coach Tour to Marine Drive (Great Orme) and Conwy** Lunch included on the trip. Children welcome.
14:00 – 16:00	**Annual General Meeting** – St Georges Hotel
19:30 – onwards	**Convention Dinner** accompanied by entertainment. 3 course dinner followed with coffee/mints. Wine and water provided on the tables. Children welcome
Sunday 16th 09:30 – 18:15	**Five Valleys Tour – Welsh Highland Railway and Ffestiniog Railway** • Depart Llandudno by coach to Caernarfon to undertake an anti-clockwise trip on Welsh Highland Railway and Ffestiniog Railway. • Ploughmans Lunch will be served on the Welsh Highland section of the trip. • There will be free time in Porthmadog along with the ability to take a tour of Boston Lodge Works, prior to a 16:00 departure from Porthmadog on Ffestiniog Railway trough to Blaenau Ffestiniog • Return coach travel from Blaenau Ffestiniog will complete the trip.
19:30 onwards	**Evening Dinner** – 3 course dinner in private dining room (subject to numbers)
Monday 17th 09:30 – 16:30	**Llangollen Railway** • Depart Llandudno for Llangollen • Workshop tour and Presentation on the current developments followed by trip on the railway with lunch included onboard, • Free time in Llangollen before return to Llandudno

Timings and trip details are being developed and this programme is still subject to some changes. Costs include group rates and Priv travel where available. This event is not for profit.

Permanent Way Institution AGM and Summer Convention
Llandudno 14th – 17th June 2013

Booking Form

Party Name:	
Contact Name:	
Contact Address:	
Contact Telephone:	
Contact Email:	
Names of people in Party (for name badges): (include ages of children) (Please list all delegates)	
Special Dietary Requirements or other requirements we need to consider:	

Ref	Description	Comments	Cost per Person	Number of People	Total Cost
1	Golf Day	To be booked direct with Tony Darroch – CEMEX Booking form will be available in the New Year			
2	Technical Visit to Quarry (Sorry, no children)	Fri 13:00 – 17:00	£12.00		
3	Welcome Evening (Children 4-13yrs)	Fri 19:30	Adult £28.00 Children £12.00		
4	Vintage Coach Trip (Children 3-13yrs)	Sat 10:00 – 12:00	Adults £14.00 Children £10.00		
5	Annual Dinner (Children 4-13yrs)	Sat 19:30 onwards	Adults £38.00 Children £14.00		
6	5 Valleys Trip (Children 3-13yrs)	Sun 09:30 – 18:30	Adults £36.00 Children £26.00		
7	Sunday Evening Dinner (Children 4-13yrs)	Sun 19:30 onwards	Adults £29.00 Children £14.00		
8	Llangollen Railway (Group booking rates) (Children 3-13yrs)	Mon 09:00 – 16:15	Adults £38.00 Children £19.00		
				Total Payment	

Children under 4 have no cost for events at the hotel. However, due to seats on coaches/trains, we need to charge for the trips for children over 3. Children age 14 and over count as an adult for most venues and so this pricing applies throughout.

Cheques should be made payable to 'PWI North Wales Section' and sent to: Steve Whitmore, 7 Chilworth Close, Wistaston, Crewe, Cheshire, CW2 6UN.
BACS transfer is available to account 60-06-23, 31610781, but please remember to send this form.

London Section:

Half-Day Technical Seminar on Practical Rail Stress Management, Held at South Bank University on Wednesday 25th April 2012

The overall theme of the Seminar was to answer an important question:

Why is it important to manage the stress in rails and how do we prevent track buckles from happening?

To address these fundamental points, the seminar took the form of a series of papers on the practical aspects of rail stress management and the prevention of track buckling. It dealt with the theory and the methods, tools and equipment used in order to maintain rails in a safe stress condition.

Welcome by Chairman – Andy Franklin, Network Rail opened the HDS by welcoming attendees and setting out the programme for the day. He was particularly pleased that the PWI had taken the opportunity to cover this subject and stressed (sorry for the pun) the importance of Managing Rail Stress.

Key Note address – Andy Jones, Network Rail Built on the key points raised by Andy Franklin in his welcome, with again raising the importance to the audience of the need for effective Rail Stress Management and the critical factor this plays in maintaining a safe and reliable service.

Paper 1 – What is the theory? – Brian Whitney, Network Rail

'Theory' – why do we have to do it?

Brian gave an easy to follow introduction into the world of Rail Stress management, plus showing several effective slides depicting the result of inadequate rail stress and their basic causes. This set the scene for Paul Butler to cover the practical application of Rail Stressing.

Paper 2 – How is it done? – Paul Butler, London Underground

How do we stress the rail? What are the practical considerations?

Why does it catch us out so often?

Paul gave a detailed presentation on the process of rail stressing, drawing from his own practical experience of undertaking stressing on both London Underground and Network Rail, highlighting some of the differences, which were mainly terminology and the effect of lower operating speeds on London Underground. The presentation was well received by all and brought out some interesting questions from the audience.

Paper 3 – The Art of Stressing S&C – Sean Ring Practical illustrations of how it is done.

This presentation looked at the requirements and application of stressing S&C, through various examples including the new installation of S&C at Paddington. The presentation took the form of a discussion covering the requirements from design through to installation.

After the break the session looked at current equipment, methods and developments. This was covered by two suppliers to the Rail Industry.

Paper 4a – Sersa rail heating – George Thompson, Sersa:

The presentation covered the heating of rails to induce thermal expansion the required length. This gave alternative approach to the conventional stressing through the use of tensors.

Paper 4b - .Railscan stress monitoring - Dr Wegner, Elektro-Thermit

Dr Wegner's presentation concentrated on an alternative method for measuring rail stress without disturbing the rails. The rail stress is obtained by use of the Railscan equipment.

Q&A session – Speakers' Panel.

The Speakers, with PWI London Chair Shazma Shakoor and Vice-Chair Mike Allen

The seminar concluded following a lively Q&A session, with Shazma Shakoor thanking all the Presenters and the audience for their participation in the day.

The audience showed their appreciation of the speakers in the usual way, and departed with much to consider.

Relating Vehicle and Infrastructure Effects

By Peter Doran of the ORR who originally wrote this paper for a pan European R&D group.

Synopsis:

Until the derivation of the surface damage charging model by ORR and then Network Rail in 2005, to account for the cost of rolling contact fatigue and similar rail effects, previous ORR and industry cost models had not directly linked vehicle behaviour to infrastructure performance in determining their inter-linked effects and the correct allocation of wear and tear costs to traffic using the railway. This approach could be further developed so that linking known engineering behaviours and operating experience, vertical stiffness can be used to connect vehicle behaviour to track maintenance costs and hence to determine both the charges vehicles should pay for the deterioration they cause to the track and the quality of ride they can expect from it.

1. INTRODUCTION

Early work on freight usage charging showed that end users were often concerned that they saw no linkage between costs derived from the usage model that they were paying and the quality of track performance they could expect to get for the money. Freight operators had similar views generally, but passenger operators had a wider range of opinions, based on their different fleets and their technical characteristics. This implies that the question of linking payment to results may well arise again in the future, requiring more detail to be provided linking charges to the cost of repair of the permanent way. This paper reviews recent advances in engineering knowledge that could be useful to help show the linkage exists, how it can be measured and charges derived to put into the model(s) that are produced.

2. WHEEL / TRACK INTERACTION

2.1 Interactions

For the purposes of modelling usage charges, the following elements of vehicle behaviour have been identified so far (between 1999 and 2010) as being the prime drivers of varying track repair costs:

- Average speed
- Axle load (static)
- Un-sprung mass
- Coal spillage
- Lateral forces
- Track friendly suspensions
- Rolling contact forces

These have been partly related or mapped to track maintenance, operation and renewal costs by regression analysis. The present day grouping of cost drivers and Operating, Maintenance and Renewal (OMR) categories can be represented as the following table.

Table 1 - Cost drivers grouped by effects on vehicle or track

2.2 Relative Contribution to Costs

The previous weighting of cost causation approximates to:

Vertical stiffness	70%
Contact Surface Effects	15%
Vehicle structural contribution	15%

2.3 Costs reported in 2003 Access Charges Review

The foundation of today's usage charging regime dates largely from work done in 2003 - 5. This would need updating by examination of OMR cost reports to check if the above weighting remained correct, which could be done by looking at the track renewal and maintenance costs using Network Rail's 16 categories of cost recording for renewal and the 34 used for maintenance.

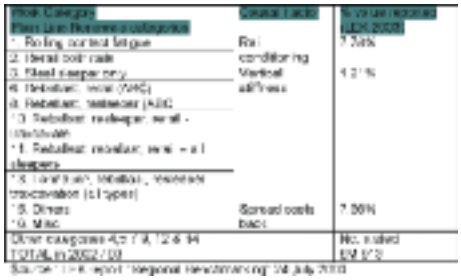


Table 2 - Value of work 2002 / 03 by renewal category

Thus at the time 83% of costs were really not well attributed by track element or function.

By 2008 a much better understanding was available, with close to 100% coverage:

Plain Line renewal cost proportions

3. SETTLEMENT OF THE BALLAST LAYER

3.1 Theory [1], [2], [3]

Over a number of years, it has become accepted that on track with an adequately resistant infrastructure, the total settlement of the track is basically due to settlement of the ballast. Settlement of the ballast layer, δ, is a function of the pressure acting on its surface, σb, and of the acceleration experienced, γ, thus,

Settlement = constant x pressure x acceleration

$$\ldots\delta = \beta\sigma b\gamma$$

The stress received by the ballast σb can be related to;

- Load per wheel acting on the rail, Q
- Distance between sleepers, d
- Support area of the sleeper under a rail, F
- Ballast coefficient (an indirect measurement of vertical stiffness of the track), c
- EI – the vertical stiffness of the rail

Using Zimmermann's formula, as above and linking this to Prud'Homme's work, the static load per wheel and dynamic overload can be linked to the:

- Geometric quality of the track and wheels
- Vehicle's running speed
- Un-sprung mass per vehicle wheel
- Vertical stiffness of the track

This thus links speed to vehicle mass and vertical track stiffness, the general considerations of which are two contrasting effects:

(a) there are greater dynamic overloads on the rail for tracks of high vertical stiffness

(b) more energy is dissipated by vehicles on excessively flexible tracks

There is also the research carried out by DB [7] that shows that levels of vibration generated by traffic in the track superstructure and the ballast layer should be limited to avoid rapid deterioration of the material.

The conclusions that can be reached are that there is a trade-off between the vertical stiffness of the track and the effects on vehicles running over it, because a reduction in the vertical stiffness of the track (which includes the base plates and their contribution) would help limit the vertical dynamic stresses exerted on the track by the un-sprung masses of vehicles and also reduces the vibration speed of the ballast particles and their reaction and deterioration to running speed of vehicles. The flip side being the less vertically stiff track leads to a greater dissipation of train energy in the track at higher operating speeds and hence higher operating and maintenance costs.

3.2 The contribution from base plates

Recent research [5] has shown that pad and ballast stiffness is effectively non-linear, load dependent and that it increases with the load. Due to the non-linearity of the track, the foundation near the wheel load is stiffened, but only a few supports are influenced. The impact forces between the wheel and rail and in the track foundation increase with increasing pad stiffness. Impact forces rise dramatically when stiff rail pads are used. Thus using soft pads can reduce impact forces significantly. On the other hand, however, soft pads increase the rail vibration level and thus the impact noise radiation away from the rail. The overall stiffness combining the contribution of base plates and ballast layers can be determined by using the ORE formula [10].

$$Ks = \frac{Kplate.\ Kbp}{Kplate + Kbp}$$

Where:

Ks = vertical stiffness of the rail's support consisting of the base plate plus the layers of the ballast – platform system. (platform = supporting sub-grade)

Kplate = vertical stiffness of the base plate

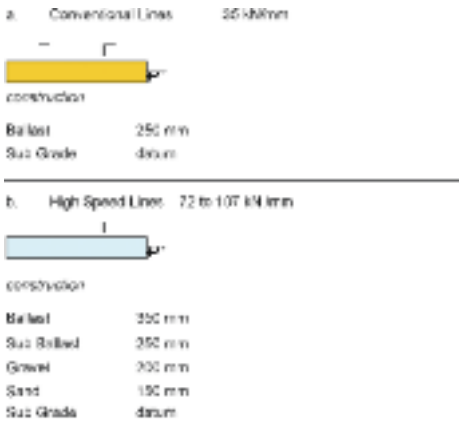
Kbp = vertical stiffness of the ballast platform system

4. VERTICAL STIFFNESS OF TRACK

4.1 Experience in Europe

Construction of high speed lines in France and Germany between 1974 and 1997 taught some useful lessons in how track needed to stiffened to be between 2 and 3 times stiffer than conventional lines to accommodate the new traffic, but that over-stiffening caused premature deterioration of the geometric quality of the high speed lines.

Characteristic values of the vertical stiffness of the ballast sub-grade system were reported by Lopez Pita [9]



4.2 Optimum Stiffness

As mentioned already, there is an optimum value for the vertical stiffness of track. Ballast coefficient, which is an indirect measurement of vertical stiffness of the track, can be compared, for example:

Old & Improved line	Poor resistant capacity	0.66
	Good quality	0.15
New construction		
Hannover - Würzburg	Subsoil & others	0.30 – 0.40
Mannheim - Stuttgart	Bridges and tunnels	0.40 – 0.50

Table 3 Ballast coefficients of some German lines [7]

4.3 Vertical stiffness of the baseplate

There are considerable variations in stiffness of base plates used on French and German lines, leading to significant differences in the rail's support

Type of Route	Base plate stiffness (kN/mm)
On conventional lines	
French national railways	150
German national railways	500
On high speed lines	
Paris – Lyon line	90
Hannover – Würzburg line	500
Mannheim – Stuttgart line	500
Hannover – Berlin line	60
Around the town of Sherdal	27
On the Hannover – Berlin line	

Table 4 Vertical stiffness of the base plate [10]

4.4 Desirable Vertical Stiffness

Overall the vertical stiffness of the ballast – platform system on high speed lines is about 98 kN/mm. Given the optimum vertical stiffness of the track (as a whole system) is about 75 kN/mm this requires base plates to have a stiffness of approximately 30 – 50 kN/mm.

5. ENERGY & MAINTENANCE COSTS

5.1 Track Quality & Performance

The D-117 Committee of ORE [10] found there was a direct relationship between settlement of the track and track defects:

$$\text{Settlement of the ballast layer} = \lambda\, Q^{a}$$

Where λ is a constant, Q is axle load and exponent a has a value between 1 and 2 to reflect the influence of axle load on deterioration of rise and fall levelling of the track. Thus it is possible to relate:

- Degree of deterioration of geometric track quality with maintenance costs
- Maintenance costs with known vertical stiffness
- Dissipated train energy with track stiffness

Hence for a particular stiffness it is possible to relate stiffness to cost at optimum energy dissipation and hence to aim for minimum energy and maintenance cost performance for a particular piece of track based on its known vertical stiffness for a particular axle load and speed of train passing over it, using all the equations listed in this paper.

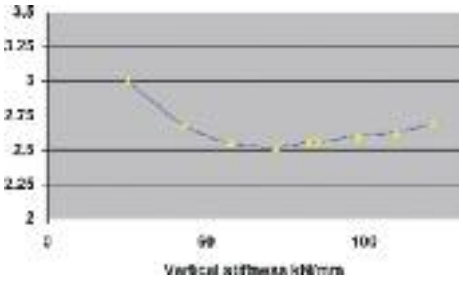


Fig 1 Track stiffness (kN/mm) vs. total costs (Euro K / year / km)

NOTE: Costs here are SNCF costs for tamping and alignment, not full track maintenance costs + overheads

5.2 Energy Costs

Spanish research has looked at energy consumed by AVE trains travelling at 300 km/h, 23 trains a day between Madrid and Seville [12] with 8.15 ton wheel loads

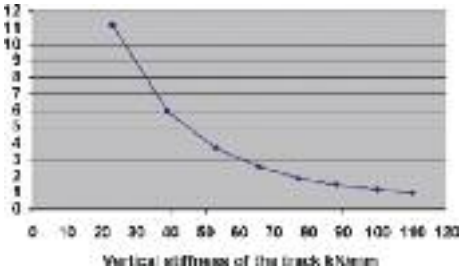


Fig 2 The influence of track stiffness (kN/mm) on power dissipated (kW)

For 8.15 ton wheel at 300 km/h for UIC 60 rail

6. LINKING TRACK STIFFNESS TO TOTAL COSTS

6.1 Refining Parameters in Use

The previous work on the Freight Usage Charge model by Booz Allen & Hamilton [8] and work done within ORR derived cost allocations based on the factors listed in 2.1. However the consideration of passenger vehicles suggests that the factors might be simplified due to the variation in suspension behaviour being less marked across the passenger fleet, the influence of un-sprung mass being less and the fact that dynamic impacts are considered in the formulae mentioned in 3.1. Accordingly the vehicle cost drivers might be reduced to:

- Average speed
- Axle load
- Surface contact forces

This would require co-relation with the freight model, if only to explain why suspension type and un-sprung mass were retained as factors for freight and not for passenger vehicles.

6.2 Surface Contact Forces

Considerable effort has been put into this topic. The ORR has engaged in joint working with Network Rail on the Structure of Charges and the industry standing committee, the Vehicle / Track Systems Interface Committee (SIC) also lead research into the wheel – rail area with its own "whole life rail model".

7. DERIVING USAGE CHARGE MODELS

The outcome of the above linking of engineering and economic relationships could be to produce a usage charge matrix based on:

- Category of track
- Track performance expressed as vertical stiffness (by track band)
- Cost of maintenance (by track band)
- Energy requirements (demand by vehicle by route section)
- Vehicle speed
- Vehicle sprung and un-sprung masses incorporating axle load

8. CONCLUSION

The means exist to link railway vehicle behaviour to infrastructure performance, there are still many complexities involved and actual measurement may be unjustified purely to advance cost attribution exercises, however the ORR could ask the industry what it prefers to do, to go for more complex, more accurate linkage of cause and effect or stay with the high level, aggregated figures based on national averages for track quality and maintenance costs used previously. Getting the Vehicle Track SIC to validate any new research of surface contact effects and cost modelling would be useful in its own right.

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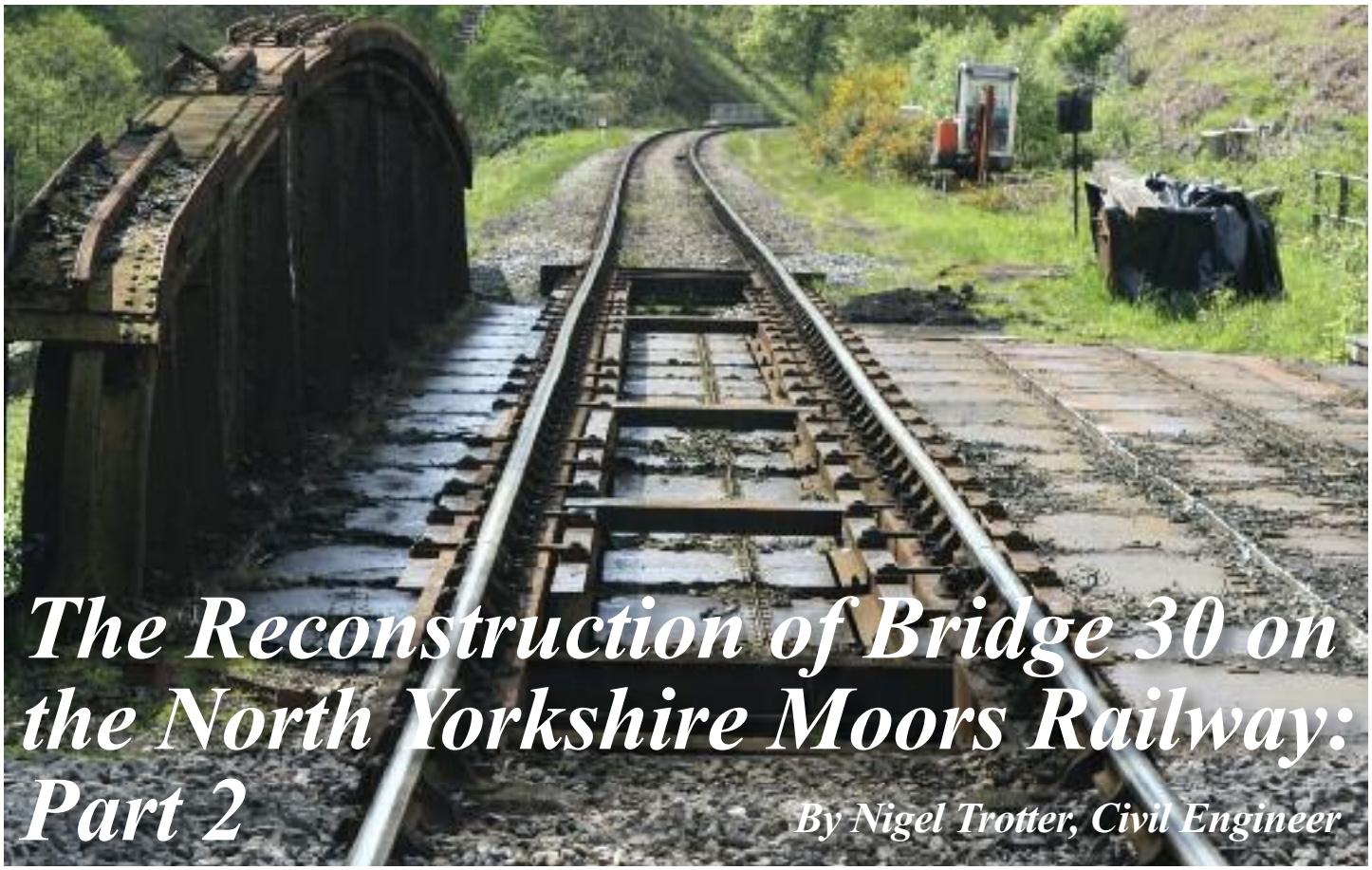
This article carries on from Part 1 which appeared in the Spring 2012, Volume 130, Part1 journal. In this part Nigel describes the construction of the Old Bridge 30.



The Reconstruction of Bridge 30 on the North Yorkshire Moors Railway: Part 2

By Nigel Trotter, Civil Engineer

On the old bridge, the curved top flanges of the main girders were made from individually shaped cast iron segments bolted together. The webs and bottom flanges were riveted wrought iron plates and sections thus forming a "composite" girder. As is well known now, cast iron is good in compression but very poor in tension. It is also susceptible to live, or dynamic loads, from trains crossing the bridge. Wrought iron of that era has a reasonable corrosion resistance, but can laminate and is also not as strong as modern mild steel.

In addition, the main girder webs were too thin for the span and loads being carried. This is thought to be the reason the girders were slightly twisted. Whether this occurred before or after the 1906 strengthening is not known for certain, but is most likely to have been before. Measurements showed that the outer main girder webs varied in thickness between 7mm and 15mm. Once the main girders have distorted, their long-term strength may be compromised.

The cross girders, spaced at 6ft or 1.83m intervals, were slung underneath the two main girders. This is a poor design as the cross girders were only carried by the rivets being in tension. This is the most unsuitable load path for a rivet and is not even allowed by today's design codes.

The two tracks were in turn carried on longitudinal timber waybeams spanning between the cross girders. These timber waybeams therefore had to act as longitudinal beams spanning the cross girders as there were no rail bearers to support them.

Due to the 47 degree skew of the bridge, of the 17 cross girders only 9 actually spanned all the way from main girder to main girder. The remaining ones were curtailed and founded with one end on top of the masonry abutments. This heavy skew was a major factor in the various assessments and options for any repairs or reconstruction.

There were two types of cross girder, both of which were originally assumed to be wrought iron. Those near the ends – the trimmed cross girders - were "fish bellied" whilst those in the centre section had parallel flanges. There was no apparent reason for this and it was not known whether both types were original or not. It was suspected that the parallel flange ones were 1908 replacements. In the event, when cut for demolition they were a random mixture of early steel and wrought iron.

The abutments still are the original masonry with the rail level in the order of 10m above the Eller Beck river level. With some of the individual stones weighing 2 tonnes, these are substantial constructions in their own right. It is believed some at least came out of the adjacent cutting where massive rock outcrops can be seen.

How the original 1864 bridge was built is not recorded, presumably it would have been erected on a substantial timber trestle built across the river. This would have supported the bridge deck while it was being riveted together from the small plates and sections brought to site along the railway formation. The supplier being Head Ashby & Co on Teesside.

Prior to purchase of the line from British Rail in 1968 the line was singled with the track on the south or Down side of the bridge being used.

Bridge 30 had several design features that were commonly used in railway bridges at that time. But they are now considered to be a poor design or are even prohibited in railway bridges altogether. Problems with the carrying capacity of the bridge led to substantial strengthening works being carried out in 1906 and again in 1908, as described in some detail later.

It is interesting to note that there are still four other bridges of similar design remaining on the Network Rail Esk Valley Line at Danby and Glaisdale. These bridges, which were built at the same time as bridge 30, and by the same contractor, were also strengthened in 1908 in an almost identical manner. These have now been replaced by Network Rail in 2012

It is important to remember that early bridge design was based on small loads, which until the turn of the century were for axle loads of 10 to 15 tons with speeds of 5 to 60mph. The live loads from trains were often underestimated with the dynamic effects not being understood. Material properties were also of variable quality but the design and analysis methods were usually very conservative. This helps explain why many of these same bridges are today carrying 25tonne axle load freight and 125mph passenger trains.

However by today's standards and certainly in the early 1860's when the Deviation was built, bridge design was very much a one-off activity. Some designers were up to date with current thinking; others not. For 1863 the design of bridge 30 was outdated. At that time, many railway engineers would not have opted for a composite cast and wrought iron form of construction. Unless an arch was to be built, the very first railway bridges used cast iron because there was very little else available, other than timber as used on the original Whitby & Pickering Railway. However, wrought iron, albeit in relatively small plate sizes, soon came along.

The first problems with cast iron came to light in 1847 with the failure of the River Dee Bridge on the Chester to Holyhead line. The bridge collapsed whilst a train was crossing it, leading to the death of 5 people. The subsequent enquiry nearly ruined the career and reputation of the designer Robert

View looking towards Grosmont in June 2009. Note the substantial masonry wing walls supporting the railway on either side of the bridge in addition to the substantial abutments.

The Goathland end of the Up side main girder showing the steel strengthening added in 1906. Note the uneven lines of rivets are not parallel due to the distortion in the original main girder.

The North or Up side of the bridge showing the centre girder and the skew. The space between the abutments and under the bridge appears excessive for the size of the Eller Beck River flowing through!

Stephenson. River Dee was a composite cast iron and wrought iron structure and, unusually, it was a cast iron compression member that failed. It was basically an unsound form of construction.

The result of the Board of Trade Inquiry was to lead to the recommendation that composite construction was not to be used in railway bridges. Furthermore, after 1850, wrought iron virtually superseded cast iron (except for arches), coinciding with a more scientific attitude by designers. Nevertheless cast iron lingered on in some quarters for compression members, in spite of occasional failures, until almost the end of the 19th century. The catastrophic failure of the Tay Bridge cast iron piers in 1879 finally led to a complete ban on the use of any cast iron in new railway bridges.

But there continued to be occasional failures of existing cast iron girder bridges. However, the collapse of a bridge carrying the Brighton line at Norwood Junction in 1891 changed everything. From then on, the use of cast iron .in the superstructure of existing railway bridges, other than for arches in total compression was finally banned. Sir John Fowler, of Forth Bridge fame, conducted the inquiry into the collapse of the Norwood Junction Bridge. He reviewed similar bridges elsewhere on the railways and recommended their reconstruction. So, by the turn of the century most cast iron bridges on main lines, again other than arch types, had been replaced.

With all the unknowns relating to early metal railway bridges it was, and still is, often very difficult to assess when a structure has reached the end of its useful life. In other words when is it no longer cost effective to keep maintaining it in a safe and reliable condition to carry trains? This task becomes even more onerous when the original drawings are sparse or even non-existent.

Only very limited original documentation was available for bridge 30. The NYMR has an original 1865 drawing showing the abutments and wing walls. However, the source and accuracy of the information shown is not known. Is it a proposed design or an as built? Before the main works started, trial excavations and coring established that it is generally correct and sufficient for design purposes. During the construction work for the new bridge, the deeper excavations proved that the internal buttressing was indeed as shown.

By 1906 the North Eastern Railway had finally got round to upgrading the bridge stock on its secondary lines. This was to eliminate the risk from any remaining cast iron or composite girder bridges but also to accommodate heavier axle loads and locomotives. Various bridges were strengthened or reconstructed on the Esk Valley line and on the Whitby to Pickering Branch, part of which is now the NYMR.

Had it been on a main line there is no doubt that bridge 30 would have been reconstructed. But, with the volume and speed of rail traffic at a maximum of 35mph a strengthening option must have been considered adequate. In order to strengthen the two main girders additional steelwork was riveted to their cast iron top flanges. This is shown in drawings dated 1906.

Four other drawings dated 1906 and 1908 are also held by the NYMR. These show the general strengthening details, which included the addition of the substantial riveted steel main girder added in 1908. These drawings partly help to explain the present form of the bridge but do not explain why the unusual folding wedge supports were permanently adopted. They also do not refer to the two different types of cross girders present in the bridge.

It is believed that the new centre girder was brought to the site by rail in small sections. It was then assembled, using rivets, on a timber trestle before being slid into two notches cut into the abutments, one of which is deeper than the other. This was possible due to the skew of the bridge but how the contractor, Samuel Butler of Stanningley near Leeds, did it is not clear. It is doubtful that modern health, safety and environment requirements would have been met! As with the four similar bridges on the Esk Valley Line strengthened at the same time, the large stone blocks cut out of the abutments for the new centre girder were simply left in the river.

Inspection summary records for the few years just prior to the line purchase are held by the NYMR. Subsequent inspections by the NYMR are also all documented. Unfortunately when the line was sold to the NYMR in 1968 only the limited documentation referred to was obtained from British Rail, the rest presumably destroyed.

After the strengthening works carried out in 1906 and 1908, the timber waybeams were still left spanning between the cross girders. In turn these remained with their outer ends suspended by rivets underneath the main girder bottom flanges.

The Goathland end of the Down side outer main girder showing the underslung cross girders and the centre girder added in 1908. Note also the steel strengthening fitted to the cast iron top flange in 1906.

Tributes and Obituaries

Leonard Henry Deakins 1933 - 2012

With great sadness, the family have announced the death of 'Len' after a prolonged illness at the age of 78.

Len's career on the railways started straight from school when in 1949 he joined the Traffic Department at Kemble station, the village where he latterly lived for 29 years. In doing so he was following in the footsteps of his grandfather, his father and three of his uncles. Len's brothers Les and Frank also worked on the railways and all together the family clocked up an impressive 375 years of service on 'God's Wonderful Railway'.

Len worked diligently and in 1950 was promoted to the post of Goods Agent / Signalman at Coates Goods Yard. In 1951 Len was called up for National Service and served with the 1st battalion Wiltshire Regiment in the New Territories of Hong Kong at the time of the Malaya and Korean conflicts. However, the railways were never far from Len's thoughts and he returned to civilian life as a Signalman at Sapperton Sidings, controlling train movements through Sapperton Tunnel.

Technological advances led to the replacement of all manual signal boxes on the GWR and so in 1970 Len transferred to the Civil Engineering Department. Once again Len's hard working attitude and love of the railways helped him to move up through the grades working on track maintenance and renewals. Equipped with the necessary certificates he eventually took charge of supervising major projects to ensure the safety of trains travelling at 125mph running Challow-Swindon-Bathampton, through Box Tunnel, Wootton Bassett Junction and Badminton. This was a total in excess of 50 miles of double track, bridges, sidings, loops, branch lines and boundaries.

Working day and night, in all weathers Len served on the front line of the railways for a total of 44 years. He finally retired in 1993 from the post of British Rail Civil Engineering High Speed Line Section Manager at Swindon.

In retirement Len continued his love of the railways, helping as a part-time consultant on a local private railway in Wiltshire. He combined this with a remarkable talent for gardening, skilful drawing/painting and enjoying the countryside he had spent so long working in.

Sadly a congenital heart condition slowed Len down in the last few years of his retirement and for an active man this came hard. However, through regular railway publications and DVDs he maintained his interest in the industry that he had devoted his life to. Len was driven by a strong sense of service on the railways and took his responsibilities for passenger safety extremely seriously. At the same time he also found his work very enjoyable. Len was a countryman at heart and working in the outdoors kept him close to nature through all the seasons. It even provided his family with a much loved pet, 'Mr Nobody', when one day miles from any houses Len found a tortoise on the track!!

Len leaves a devoted wife, Iris, to whom he was very happily married for 52 years. He also leaves 2 children and 4 grandchildren. He will be much missed by all who knew him. He was a gentle and understated man who dedicated his life to his love of the railways and to his family.

Leslie Mathew Anderson 1928 - 2012

Les was born and grew up in the Midlands. During the war years he attended Handsworth Grammar School in Birmingham where he excelled in art. At the end of the war he studied at Birmingham College of Art, leaving in 1951 as a fully qualified art teacher. However he did not take up teaching until 1959 spending the intervening years with the National Coal Board in the local mining industry. He then taught Art at various schools within the Birmingham Education Committee Area.

Les's father was heavily involved in narrow gauge railways (15" gauge) and Les joined him with the installation and operation at various locations. Attractions were operated at Severn Beach (around the lake), Dudley Zoo, Longleat, Flamingoland (near Malton in Yorkshire) and Birnbeck Island at Weston Super Mare. Les was also involved in a project to create the Axe and Lyme Railway but this never reached completion.

Unfortunately, Les's company ran into financial difficulties after one of his projects failed and Les joined British Railways as a Trackman in the Highbridge gang. His immaculate handwriting and background railway knowledge soon saw him promoted to Timekeeper in the new Renewals organisation set up under the Divisional Civil Engineer at Bristol and Les stayed in that post until his retirement in 1993.

Les joined the PWI in 1981 and regularly attended meetings and visits until suffering ill health over the last few years.

Les was a very private man with no living relations or family but will be remembered by the legacy of the various railways he was involved with that still run today, giving great enjoyment to young and old.

William Peter Alexander 1928 - 2012

Peter was born in East London on 2nd January 1928. He developed an interest in railways at an early stage in his childhood, living within sight of the Great Eastern Mainline.

His family moved to Harpenden during his childhood.

In 1994 when Peter was sixteen years old he started his employment with the London Midland and Scottish Railway at the Grove in Watford. Part of his National Service was spent stationed at Longmoor Military Railway.

Peter joined the Permanent Way Institution in 1945 as a student Member, transferred to Associate Member in 1950, to Associate Fellow in 1952, Fellow in 1965 and Honorary Life Member in 1996.

Peter was a regular attender at the Nottingham and Derby Section where he served as Section Chairman, Committee Member and Council of Management Member. Peter and his wife were participants at PWI Conventions for many years. Peter was also a regular attender of the National Annual General Meetings.

In the early 1950's he moved to Derby where he met Shirley who became his wife, they have spent 55 years together.

He held a number of posts in the Derby/Nottingham area. During the 1960's he headed up the team responsible for the permanent way works for the Trent and Derby Power Signal Box schemes covering the area from Loughborough to Chesterfield via Nottingham and Derby and Nottingham to Elford west of Burton on Trent.

On completion and commissioning of both power signal boxes he became Renewals Assistant at Nottingham Division. He held this post until he retired in July 1989

During his career on the railway he was a methodical and knowledgeable manager making many friends all over the system.

When he retired he set himself the objective of travelling on all the open passenger lines on the system, he achieved this objective in a few years. He spent the first year of retirement covering 26,000 miles of Railway. He would devote at least one day a week to travelling on the railway. It was his last trip on July 10th 2012 when he collapsed on Reading Station and died in hospital shortly afterwards.

He will be missed by his family and his many friends.

Comment & Feedback

The Editor

Permanent Way Institution Journal

Sir,

Tony Phillips' article about inspection coaches brought back many memories of such trips, especially those during my time as District Engineer at Shrewsbury from 1960 to 1966.

Shrewsbury and Oswestry Districts had been amalgamated into one, making a large District covering, in addition to part of the Didcot to Chester and Hereford to Shrewsbury main lines, much of the branch line network in Central Wales.

Coach inspections to Llandovery over the central Wales line and to Three Cocks Junction could be done in a long day, but the Cambrian Coast lines between Aberystwyth and Pwllheli required two days.

The first day usually covered Shrewsbury to Aberwystwyth and Dovey Junction to Barmouth, where we spent the night. The coach was stabled in the down bay line at Barmouth and the engine crew and coach attendant slept in the coach. The second day covered Barmouth to Pwllheli, then returning to Morfa Mawddach Junction and proceeding over the Ruabon to Barmouth line.

As well as the normal track and bridge work, the line along the coast had a number of wooden viaducts (and still does today), the most notable being Barmouth Viaduct across the Mawddach estuary between Morfa Mawddach and Barmouth.

I have no knowledge of Network Rail's maintenance arrangements for this area, but doubtless they have many of the same problems to face, except for the proposed new viaduct at Penrhyndeudraeth replacing the existing timber structure.

Yours faithfully,

Philip Rees

(C.C.E. W.R. 1975 – 83)

Sir,

It is not correct to state, as mentioned by Robert Hall in his article on embedded rail (Journal, Summer 2012), that Joseph Locke introduced the bullhead rail. Locke's achievement, on the Grand Junction Railway, was to introduce the double-headed rail, which was symmetrical in section, and which could be reversed to obtain a second life. This idea met with mixed success, largely dependent upon when the reversal was done in the life of the rail, and whether or not the chairs incorporated a wood seat to prevent galling of the foot of the rail.

The heavier head of the rail was introduced in later years, but it was not known formally as the bullhead rail until the 1870s, when the Midland Railway used it on the Settle & Carlisle line. The double-headed rail continued to be used by many companies until Edwardian days.

There are competing claims for the invention of the flat-bottom rail, but primacy almost certainly belongs to Robert Stevens, who first laid it on the Camden & Amboy as soon as he had some lengths rolled by John Guest after a visit to the Liverpool & Manchester in 1830. Charles Vignoles also claimed to have invented the flat bottom rail in 1830, but it is probable that his form of the rail was not used until a few years later. While the original Stevens rail took a profile substantially similar to that which we know today, the Vignoles flat-bottom rail was squat and of less height. They were probably first used on the Dublin & Kingstown Railway.

It should also be noted that in Great Britain the 1 in 20 inward cant of flat bottom rails was sometimes achieved with baseplates, but also often by adzing an inclined seat on the sleeper. In America, baseplates were not used until late in the 19th Century, and 1 in 20 baseplates not until early in the 20th Century.

Lastly, perhaps I may add that samples of step rail in the National Collection are dated from about 1830, and thus may predate their use in 1835 in America. In any case, the step rails used in America were almost certainly rolled in this country.

Yours faithfully,

Andrew Dow

Fellow

Dear Editor

Readers may be interested to note that there are outlets for collections of Journals. I have recently donated my entire collection of Journals from over 55 years of membership of the Institution to the Railway Studies Collection, Devon County Council, Passmore Edwards Centre, Market Street, Newton Abbot, TQ12 2RJ. In addition, for the steam buffs amongst members, I also donated a 'History of the Halls' which were the names given to the 329 steam locomotives of the GWR. A project carried out by John Carter (deceased) and myself after our active retirement from active service.

In both cases the contents will, I'm sure, be of use and interest to railwaymen of the present and future.

Yours faithfully

PJ Hunt

Thames Valley Section

Dear Editor

This is a response to an item in "Comments and Feedback" where a gentlemen asked about "Belsize Tunnels – A Change of Use".

I can confirm that the change of use took place during electrification. By that stage, use of the Goods Lines was minimal, as both goods depots in the St Pancras area and the newer depot near Kentish Town had closed. The work was carried out during a long blockade, lasting several weeks. The track layout at Carlton Road Junction and between Finchley Road and West Hampstead, i.e., either end of the tunnel, was also significantly remodelled as part of the electrification works. West Hampstead PSB initially took over control of the central section of the "Bedpan" route; it took control of the London end in later stages.

I was part of the DCEO Watford Projects team at the time. This note is based on personal recollection, rather than any documentary evidence.

Kind regards

Eur Ing John Dolan

Technical Head - Infrastructure

Interfleet Technology Ltd

dolan.j@interfleet.co.uk

Dear Alison,

The answer to your question in respect of the photo on page 37 of Part 1 journal is: this is a holding down device for a type of springclips used in the Netherlands called NEFIT. The two spikes are driven into hardwood sleepers. The rails are positioned on a rubber path, direct on the wooden sleepers. A special type of spring is inserted in the steel insert. This Nefit track was a lot cheaper than traditional (see Vossloh or Pandrol) track but lasted only 25 years. Most of the mainlines in the Netherlands were fitted with this type. However after a number of years it became clear that track stiffness was over time reduced and in a number of cases trackbuckling occurred. Over 2006 to 2008 all the remaining kilometers of Nefit track have been replaced.

I have attached a page of a report on trackbuckling which clearly shows the Nefit fastening pointed with a red arrow.

I hope this clarifies your question.

Kind Regards,

Ing. N.J.A. (Nick) van den Hurk
nickvandenhurk@spocior.com

Dear Editor,

It was with some interest that I read the article by Jeremy Reece in the latest issue of the Journal, largely since this illustrated technology that I had first become intimately involved with when I became the Engineer for Tramtrack Croydon Ltd, in 1997. With the exception of the depot, the switches on this system, both off-street and on-street were operated by Hanning & Kahl mechanisms with stretcher bars that were pin jointed to the switch rails. The depot points, which were even shorter than the Isle of Man examples, used conventional British flexible type stretcher bars and were a continual source of minor problems, ranging from high operating forces to loosening of fasteners. The use of pin jointed stretcher bars is common practice in the rest of Europe, and is ideally suited to the shallow depth switch rails that are now normal.

Whereas the Manx examples require a connecting bracket to be bolted to the web of the switch rail, with shallow depth switches, the clevis is attached directly to the foot of the rail, eliminating the vertical bolted joints that are a source of weakness in both the Manx and the traditional British design. Given the near universality of pin jointed stretcher bars across the world, it remains something of a mystery as to why British railway engineers have never adopted them.

Regards,

Jim Snowdon

Book Reviews

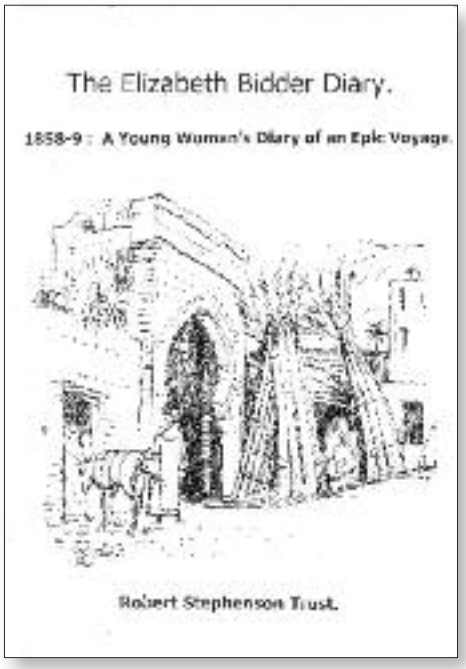
A SURPRISE-ELIZABETH HARBY BIDDER'S DIARY

I never thought I would not only read but enjoy the diary of a young unmarried woman written in 1858/9. She was the daughter of George Parker Bidder who worked with George and Robert Stephenson as a civil engineer; indeed George was her Godfather.

In 1858, aged just 18 she sailed to Egypt with Robert Stephenson and others on his 84.7 feet long schooner "Titania". She kept a meticulous diary of her journey revealing the character of arguably the greatest railway engineer this country has ever produced.

They sailed for Gibraltar on October 14th 1858 at 6 am. Daily diary entries begin with their latitude, longitude and course of sailing, sometimes explained by footnotes giving daily mileage. Writing about the camaraderie on board she comments that, "the puns that fly about are alarmingly real, ones sides quite ache with laughing". Descriptions of small cabin trauma caused by rough seas are graphic and amusing.

As they approached Malta Robert's concern to ensure maximum time for his railway project work in Egypt was challenged by the yacht's lack of fresh meat. The decision made was to visit Malta rather than dine throughout their passage to Alexandria on salted provisions. She described Malta harbour, plants, landscape and buildings including the Governor's House and the haggling that went on before a price of 35/- was agreed for the services of a tug boat. She has a cutting turn of phrase when describing locals she did not like. One she describes as coming from "a species of parasitical vampire that attaches themselves to all yacht travellers in "furrin parts" making friends with the men and cheating the masters, the present specimen is the best of his kind, speaks a most indescribable jargon, weighs 17 or 18 stone and is altogether very original".



Their arrival at Alexandria on November 30th indicates of the time needed to visit Robert Stephenson's railway projects. Here she visited the local Princess whose home was entered past two guards "Eunuchs about 8-feet high, the tallest I ever saw"; where she was served coffee in a china cup ("the outer being of gold set with diamonds"). Then by train to Cairo and with Robert in his carriage to their hotel. She describes her sight-seeing trips, early morning shore walks beside the Red Sea with Robert, and how on December 20th Robert met with Brunel back in Alexandria as Brunel was "too ill to come to Cairo". Christmas was celebrated at the "Hotel D'Orient" Cairo where they stayed until January 6th before travelling by train back to Alexandria and boarding the steam ship "Euxine" for their return journey.

She describes fellow passengers including "a ridiculous old gentleman, three small children and two babies, nearly all next door to me." Having come from Alexandria they had to spend 8-days in Marseilles' Quarantine Harbour two and a half miles out before taking down their yellow warning flag and landing at the port on January 20th. After sight-seeing, including a trip to Notre Dame de la Garde with Robert they travelled by train to Nimes where she describes the Hotel's Table d'hote as "detestable". Then via Avignon to Paris where she was re-united with her parents early on January 28th 1859. Robert Stephenson died later that year but the book includes shorter entries from December 1859 covering her return visit with her new husband John Stanton who worked for Robert. These entries conclude on February 11th and nothing more has so far been found.

Published by the Robert Stephenson Trust and available In Kindle form from Amazon I recommend it- to my surprise!!

Colin Wheeler September 2012 ©

Overseas member Ilgaz Candemir offers his paper on his experience of wheel/rail management on the Izmir light rail system. I have edited the language in this paper to facilitate easier understanding. However given that english is the writers second language I have decided to leave in a lot of 'turkish english'. Communications Director

Critical Rail Failures after 11 year traffic on the LRT System and how we combat the problems for Improved Passenger Comfort

By Ilgaz CANDEMIR M.Sc. Civil Engineer

1. Introduction

May 22, 2000 was a milestone of the inauguration of Izmir Light Rail Transit (in the heart of the city centre); the present network is 11,6 km length only now and despite the financial crisis it grew in a few months to 18.6 km, the total plan cover up in a number of expansion projects totalling 41km as result of Greater City Municipality light rail strategy. This year marks the 11th anniversary of IZMIR light rail line and it brings more responsibility at our shoulders for better service in all the segments.

Izmir LRT had been operating for 11 years at the city's most congested corridor from eastbound (Bornova) to westbound (Konak-Ucyol-Hatay-Balcova-Narlıdere). Ucyol station behaves as a bottleneck to collecting high demand on especially morning rush hour and asymmetrically Bornova is the same in the late afternoon through Ucyol direction. An average passenger in a day is 140,000 at 11,6 km track.(13,39 km after extension opened, March 2012)

As construction and track department our ultimate goal is to always give comfort on the track to our passengers at every second of their journey. Urban Rail systems have a lot of benefits for the public beside some bad effects, especially corrugation and rolling contact fatigues (RCF) are very important for all of urban and commuter systems. At Izmir LRT we have continuous periodical checks against RCF's which are caused by rail-wheel interaction and contact stress. This article has studied a lot of rail surface failures that we call head checks, corrugations, squats which appears at IZMIR and combating strategies and tracking grinding methodology.

2. History 1st Grinding Project

Izmir Metro has been using rail grinding as a part of its rail maintenance schedule since 2006. We know we're the first operator who implemented and achieved best practice in Turkey. Construction specifications didn't include new rail grinding item that's why we start up 0-1 against our maintenance of way. As every new company, we struggled in the first years but then we closely followed up our rails after 2002, we have had experience step by step then our first grinding project was performed in mid-2006. The important thing is before the job we did a lot of site survey and office job called pre-grind inspection.

Rails were reviewed, photographed, transverse and longitudinal measure was taken, categorized the defects and finally archived at pre-grind session.

For best practice of grinding the operators must control:

- **Carry out tamping job for the entire track**
- **Corrugation and RCF analysis on track, clarify types, categorize failures**
- **Determine noise map, 1/3 octave band analysis**
- **Creating permanent plates for obtaining measuring points for Transverse and longitudinal measurements (blocking the track)**
- **Decision for Plant type**

First we need to mention the current disabilities and wearing out and need to put forward the issues. Studies have been put together under one topic for the collection of rail head defects in the UIC catalogues and comprehensive reports have been prepared on the subject of whether 6 different authorities given 6 different similar defect names are in Izmir or not.

Ilgaz Candemir

Ilgaz Candemir has worked as Fıxed Installations Deputy Manager of permanent of way and civil works at Izmir Metro A.Ş. between 2002 to 2012. He now working at one of the biggest Consultancy organization. He holds a Master Degree in Civil Engineering -Transportation /Rail Division from 9 Eylül University-İzmir. He has been also been a Member of Board of Chamber of Civil Engineers-Izmir.

After many hours of site and office team work, the available data was compared with the literature samples. Out of 15 important rail head defects, 8-10 were detected to start or progress on the track after. All of these have been screened and archived. Later a map was made for these corrugations and RCF defects and it was an important data recovery before the plant arrived. Thus, while the machines productivity increased it provided a training

opportunity for the entire track group. In general; EN 13231-3 is the leading document for who will implement grinding works. Now to give details on some of these strategic topics is important for the issue not to remain on the air.

3.NOISE

A noise analysis at the level of EN was performed before the project. Along with these RCF defects a map was also made of the main track on the noise issues. This map was compared with the second noise measurement taken after grinding. The target is very sensitive in the noise measurements made with B&K 5 channel acoustic analyzer and sensitive microphones that can take continuous measurements to make 1/3 octave recording analysis. As a result of this analysis we were going to get ideas on noise and frequency issues. Just before the job a detailed measurement was performed with a test train with or without passengers, running 5 full journeys at 5 different time periods during the day, and a recording was taken at 5 second intervals.

Figure 1 : Scenes from realtime measuring and a cockpit survey.

The microphones were stabilized on a tripod 120cm from the ground and 2 sound collectors were used. These were deployed in the cockpit and wagon in compliance with the standards. The same exercise was performed after grinding and a dB(A) type difference was obtained. Dominant frequencies are 500Hz and 160Hz at passenger wagon, driver cockpit noise is concentrated in the range observed in the 200-400Hz. Noise in the 500Hz frequency of carriage, especially around the concentration of speech, also a negative effect on passenger's speech intelligibility.

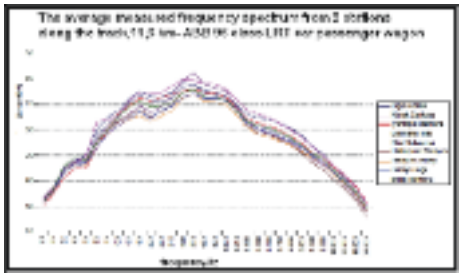


Figure 2 : Noise analysis recording, IZMIR LRT Archive 2006

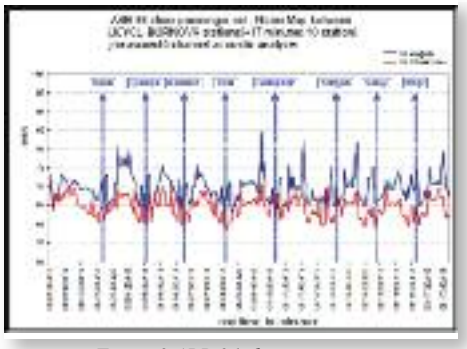


Figure 3 ABB 96 class passenger set noise measuring; one tour/1 direction after grinding.

After grinding noise in high places shown above in figure 3 peaks refers to turnout or crossings. 1ST grinding project did not cover turnouts. We planned turnouts are to grind after 50-60 million gross tones accumulated load .

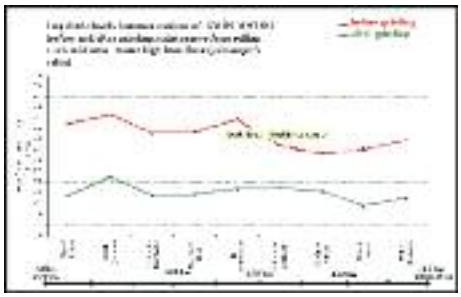


Figure 4 ; Before and after rail grinding results

After grinding; noise level measured in the outcomes that appear to be seriously reduced. Especially in wagon noise, recorded an average drop of around 7 to 13 dB(A) were observed as shown in figure 4 . The biggest treatment was in the range of 100-1000 Hz voice frequency spectrum. Another issue is vibration caused by bad running band.

4. CORRUGATION, HEAD CHECKS and OTHERS

First of all we have been recording all the inner or outer Common Rail faults at Rail Head. Since mid 2003; after long-term research and inspection of the track we addressed there are many defect types besides the famous headchecks, spalling squats and undoubtedly corrugations .We found many average, heavy and severe headchecks .There is no doubt grinding is confidently the best and practical solution to remove rail head surface defects and bringing a smoother ride and passenger comfort.

Track Engineers have been mostly recognized below faults at the surface!

- 1. Corrugations
- 2. Head Checks
- 3. Spalling or flakings
- 4. Squats
- 5. Wheel burns or engine burns (blueing)
- 6. Shelling
- 7. Surface batter or crushed head
- 8. Weld irregularities
- 9. Battered joints
- 10. Plastic flow (flowed rail, lips)
- 11. Manufacturing defects; mill defects, seams, mill scale
- 12. Roughness on the surface
- 13. Corrosion

We were given numbers and a total of 140 transverse measurement stations were allocated at the track and depot in these regions. A total of 1056 transverse measurements were recorded for 4 different rail groups (RR, RL, LR, LL)at the track before and after grinding. Furthermore track was measured and recorded with portable trolley before and after grinding and separated 4 different classes 10-300 mm to 300-1000 mm wavelength band. Below you will find samples of grinding results from RMF and DQM.

Table1 presents the estimated average wear before 1st and 2nd grinding maintenance conditions at rail gauge. This shows that it would be 14 years or a little bit more before the R<600 rails' replacement.

The 900 grade rail, S49E1 had severe headchecks some of them more than 18-20mm if you leave the rail their spontaneous condition without any maintenance .These headchecks may cause dangerous incidents or you have to be change your rails before technical life end at least.2 grinding heavy maintenance we understand very well from our surveillance photos; cracks will grow up light form -3mm to severe form over 20mm after average 35 MGT track load cycles. This level is our milestone.

Figure 5 .High stresses initiation at the gauge corner and growth headchecks also spalling appearance it meant material break up between Konak-Çankaya stations, curve ; 80km/h, cant=130 mm, r=300 m .Daily traffic is so hectic, more than 180 -195 trains a day in the last last 3 years against demand. Photos Izmir Metro archive 2010.

Rail squats look like surface stains, local plastic deformation of the mostly running band appearance of the rail head. In Izmir we found different diameter squats especially R≥3000 curves or tangent track.

Figure 6: below: on viaduct R=3000 curve, above: a squat with a wave at tangent track, Photos Izmir Metro archive 2010.

Figure 6 shows these kinds of rail top irregularities and all squats are suspicious points engineering groups have to have a log book, make an ultrasonic inspection and follow up all of them.

MONITORING

Monitoring by numbers and tables is the easy way for pre-grind period before plant has arrived. Rail geometry will be inspected and monitored curve by curve with electronic equipments. This will increase cost efficiency of grinding maintenance.

After many years we have been realized still researching at Izmir about rail behavior for crack initiation ; Wear of rails depends on a lot of parameters, rolling stocks, rail quality, axle loads, track design and geometry, maintenance level, wheel-rail interaction is just some of them. Experience collected and gained has shown us we have only one way to combat rolling contact fatigues and that is with grinding. Well-organized maintenance, right lubrication indicator and programme and continuous patrol and periodical ultrasonic inspection for flaw detecting. Joining welding is also brings some efficiency especially

	S49E1,R260	June 2006			March 2011		
No:	Curvature (m)	Max.Wear (mm)	1 m Headchecks group /100 m	Squat detected	Max.Wear (mm)	1 m Headchecks group /100 m	Squat detected
01	R<300, 70- 80 km/h	2,40	44	0	4,00	38	0
02	300≤R≤600, 80 km/h	1,80	33	0	2,85	32	0
03	600≤R≤1500,80km/h	1,40	22	1	1,90	20	1
04	1500R<3000,80 km/h	1,00	18	3	1,00	19	4
05	R>3000, 80 km/h	1,00	6	4	1,00	11	8

Table 1. Before grinding maintenance; some essential data for better understanding propagation of wear and RCF from main track

Headchecks are most recognized surface fault ; which occurred gauge corner or top of the rail located consecutive, 1-5 mm intervals. Classification method of headchecks by 1 meter units as shown in table 1 .

Same process is also works at corrugation and short-long pitch waves shown at table 2 .

	S49E1,R260	June 2006			March 2011		
No:	Curvature (m)	Corrugation depth * (mm)	% corrugation /100 m	Dominant wave length (mm)	Corrugation depth* (mm)	%corrugation /100 m	Dominant wave length (mm)
01	R<300, 70- 80 km/h	0,16	%61,34	70	0,18	%60,53	65
02	300≤R≤600, 80 km/h	0,14	%39,23	75	0,16	%40,93	80
03	600≤R≤1500,80km/h	0,13	%23,42	75	0,15	%29,10	80
04	1500R<3000,80 km/h	0,12	%32,22	50	0,13	%30,78	60
05	R>3000, 80 km/h	0,06	%18,10	45	0,08	%20,46	43
06	Tangent track-Station	0,05	n/a	27	0,05	%32,55	27

Table 2. Site survey for additional data for corrugation grow map, before grinding

*:Maximum depth, engineering office will be consider max value of deeper corrugations, for example eliminate 0,12 mm amplitude wave, plant will be cut 0,15 mm or might be deeper.

No:	Kilometer	track/rail	radius	length	cant	structure	dqm2004	dqm2006	mf/w	final	where
1	0+700	RR	500	496,67	30	natm	0.42	0,53	w	0.31	cu
2	0+700	RL	500	496,67	30	natm	0.51	0,80	mf	0.28	cu
3	0+700	LR	500	496,67	30	natm	0.77	0,89	w	0.21	cu
4	0+700	LL	500	496,67	30	natm	0.53	0,54	mf	0.17	cu
5	2+220	RR	300	93,73	140	epbm	0.44	0,48	mf	0.19	cu
6	2+220	RL	300	93,73	140	epbm	0.43	0,87	w	0.22	cu
7	2+220	LR	250	198,63	140	epbm	0.65	0,64	mf	0.30	cl
8	2+220	LL	250	198,63	140	epbm	0.69	0,73	mf	0.28	cl
9	2+452	RR	450	166,14	110	epbm	0,88*	0,80	mf	0.29	cl
10	2+452	RL	450	166,14	110	epbm	0,51*	0,29	mf	0.19	cl
11	2+453	LR	250	198,63	140	epbm	0,86*	0,81	mf	0.23	cu
12	2+453	LL	250	198,63	140	epbm	0,42*	0,57	w	0.32	cu
13	2+540	RR	450	166,14	110	epbm	0,82*	0,84	mf	0.21	cu
14	2+540	RL	450	166,14	110	epbm	0.26	0,46	w	0.14	cu
15	2+540	LR	250	198,63	140	epbm	0.52	0,59	mf	0.25	cl
16	2+540	LL	250	198,63	140	epbm	0.37	0,53	w	0.24	cl

Table 3. Rail geometry related wear tracking roster, Izmir LRT

Abbreviations for Table 3 are; mf:metal flow, w:wear, final:after grinding result, cu:curve, cl:clotoid Table 3's dqm2004 and dqm2006 and final is given mm.

turnouts and sharp curves if don't want to replacement of your rails before rail technical life.

This is the most inclined curve in the system, r=500 m, L= 496 m, clotoid length= 75 m inclination ‰48, cant=30 mm ;RMF 2.3E portable trolley used at measuring.5% was used as the limit of length tolerance in the longitudinal measurements.

CALCULATING GRINDING INTERVALS

Obtaining grinding intervals is right and preventive reaction for light grinding sessions between corrective or re-profiling cycles. Famous magic wear rate refers also mentioned to us on-time and sufficient grinding period remedies cracks, fatigued layers and deep corrugations. The idea of this behaviors is prolong rail life and cutting costs.

Summing up;Some Institutions and Operators have been preparing appropriate tables for better describing grinding intervals but no one has covered every criteria or condition of different geography railways. This study creates some results are shown in at below for light rail or metros depending some facts of daily traffic on track. Turkey Metros usually use standart S49E1, UIC54 / 900 grade. HSH rails calculation is so

Figure7. 100 mm short waves where on clotoid to curve, r=400 m, cant=50 mm before grinding monitoring

Figure 8: Figure 7 curve end; after grinding with 7 passes; desired profile done. Figure 7-8 photos are belonging to Izmir Metro archive.

different.Here is the best optimization for rail grinding study for LRT systems who is using 900 grade rail.

Turkish Assumptions for R260 class rails for **"preventive grinding": (STANDART RAIL)**

8-12 MGT for R<350-400

17-20 MGT for 400<R<150

25-30 MGT for 1500<R<5000

40-50 MGT for tangent

Turkish Assumptions for R260 class rails for **" cyclical grinding ":(STANDART RAIL)**

17-20 MGT for R<350-400

20-25 MGT for 400<R<1500

30-35 MGT for 1500<R<5000

45-55 MGT for tangent

CONCLUSION

Some heavy rail maintenance titles is widely accepted from railway engineering which are tamping, rail welding, grinding, ballast cleaning are common. Rail Grinding have a portion of %~20-25 of global rail maintenance.The engineering and environmental need to push us to determine a solution for track maintenance ; we couldn't find rail grinding treatment but we develop ourselves for sensitive reactions about rails. Rail Grinding is still the number one engineering solution and the leading environmental indicator against rail borned noise. These study results illustrate that monitoring and scheduled maintenance is very important against headchecks, squats and RCF cracks, and corrugation. Grinding offers intensive care and prolonged rail life but not enough. Lubrication, wheel grinding, right tamping periods, weld treatments, experienced staff are also necessary and part of maintenance of way.

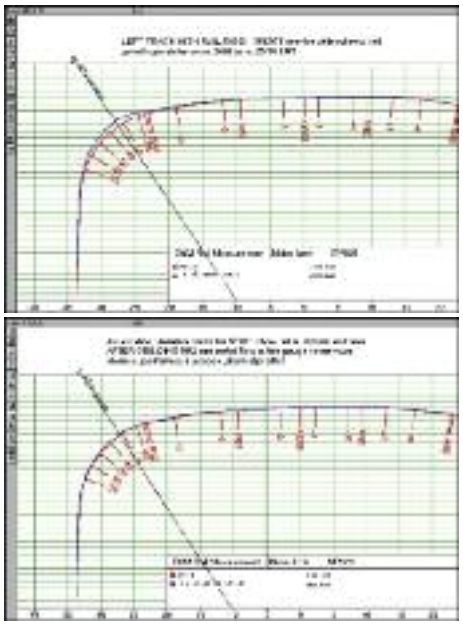


Figure 9. Between Konak-Çankaya stations; there is a sharp curve (r=250 m and r=300m) and speed 70-80 km/h, top:0,92 mm metal removal was cleaned and bottom: final profile at above.

Cyclical rail inspection and on-time maintenance is the most important criteria to get significant results a guarantee for the longer technical service life for rails, optimum load distribution, optimum rail geometry, reducing noise level inside and outside of the train and cutting energy costs and tamping intervals .We keep learning continuously and results order to us 30-40 MGT is our cyclical maintenance period for corrective; we must find more elastic solutions for preventive grinding .It also brings to us better tamping intervals as well. Optimal grinding intervals are depending directly on calculation of life cycle costs.

Our experience shows us ; every 36-40 months is our cycle for grinding and also tamping.

Another significant result to assist grinding is extend tamping intervals, in principle we'll keep our maintenance programme for the following years "first tamping then grinding following 1-3 month" . Tamping and grinding maintenance plan must be sequential and costs will decrease and will be a win-win for all parties. Optimization is very essential for trams, light rails, metros that's why bigger is better;

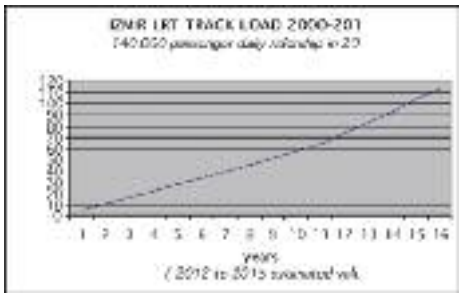


Figure 11. Track loads: "2000 to 2011" and estimated future

Regarding calculate own maintenance cycles and optimization:

Maintenance No	grinding intervals (month)	Accumulated load (MGT)	date
1.grinding	72	59.219	2006 june
2.grinding	64	35.426	est. 2011
3.grinding	42	55.057	est. 2015
4.grinding	40	36.276	est 2018
5.grinding	36	59.029	est. 2021

Table 3. Existence experience and estimated grinding jobs for next decade at Izmir LRT System.

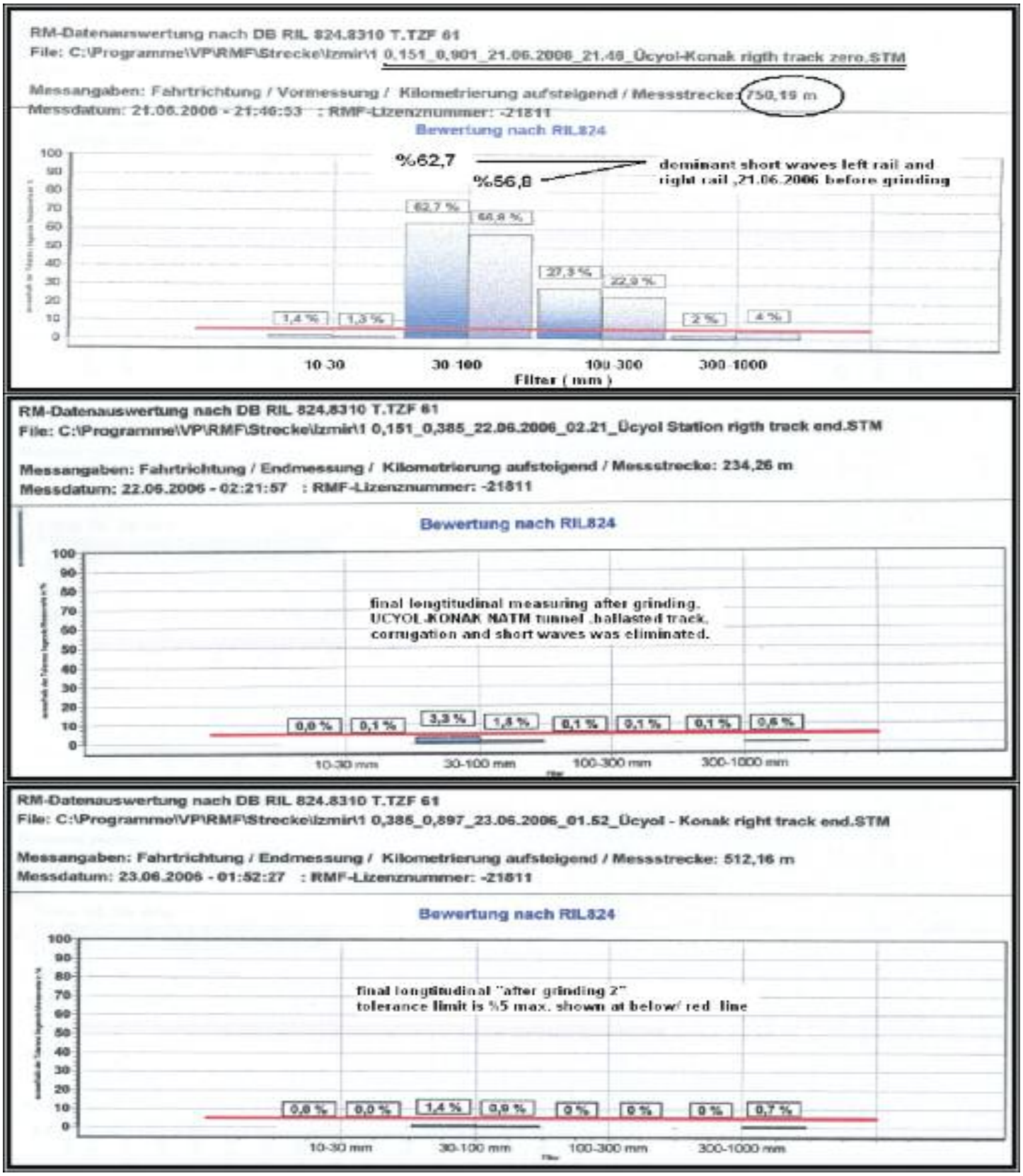


Figure 10 .top: zero measurement ; middle and bottom: final measurement.

16-20 stone capacity systems is in use on certain tracks for urban systems. That's why proper planning and scheduling of rail heavy maintenance activities is to be first order of importance. Studies have shown next decade maintenance software's will be developed and assist engineering teams to rotate their reaction mechanisms.

Author hopes that this article will open a way for new urban rail companies or who didn't execute the rail grinding till that moment. Special thanks to Izmir LRT (Metro A.S.) construction and track department labor group who did help author for measure and continous support.

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Home Section Activities

ASHFORD SECTION
Chairman: Steve Everest
Secretary: Phil Reynolds, 56a Burley road, Sittingbourne, ME10 1JH
E-mail: phil.reynolds@networkrail.co.uk
Meeting Venue – The Elwick Club, Church Road, Ashford (10 minutes from Ashford Station) at 1830

BIRMINGHAM SECTION
Co-Chairman: David Holmes/Bob Langford
Secretary: Ashley Pettifer, 5 Shottery Road, Stratford-upon-Avon, Warwickshire CV37 9QA
Tel: 01789 293578.
Email: arp5@btinternet.com
Meeting Venue – The Comfort Inn Hotel, Station Street, Birmingham 1730 for an 1800 start
The Gateway Centre in Shrewsbury at 18.00

Thursday 10th May 2012 – In Birmingham - It was our pleasure to welcome **Paul Griffiths**, the Metro Programme Executive, from Centro, who gave his presentation **Midland Metro - Birmingham Extension**. Paul set the scene of his presentation by reminding us of the currently operating Line 1 from Wolverhampton to Birmingham, before showing a map of the network which was envisaged. Due to various constraints the original plans did not get fully funded. The first extension now planned is to connect Snow Hill Station to New Street Station. This will increase the accessibility of the Metro in Central Birmingham to the public. The extension is 1500 metres long but will cost about £120M due to the challenges of building in the city centre. One major change will see buses removed from Corporation Street on 22nd July 2012. These will now operate to five bus hubs, connected by a circular bus route. As part of the works, a new design of bus stop is planned. Paul continued by explaining the current metro depot in Wednesbury, is being changed and upgraded for a new fleet of between 20 to 25 trams which will be 33M long. These will replace the current fleet of 16 trams which are 24M long. As part of the upgrade the platform edges on Line 1 will need to be cut back to accept the new design of vehicles, which are being built to a different structure gauge.

City centre works, have been going on for the last 6 to 9 months and concentrate on relocating utilities with side entry manholes. Paul showed details of the underground services maps available, which proved to be not very accurate. One additional challenge was recent site clearances which revealed the remains of previous buildings. As a result ground penetrating radar is in use. Paul also offered to come back at a later date to update us on the progress of the works. Bob Langford gave a Vote of Thanks to Paul. 19M,1V.

Thursday 14th June 2012 – In Shrewsbury - David Holmes opened the meeting and welcomed members. We were delighted to welcome our speaker for the evening **Adrian Bocking**, the Systems Integration Manager for North England, from Network Rail, who gave his presentation **Northern Hub**. Adrian firstly outlined the scope of the scheme, which is to improve train services in the North West area. Adrian showed a map which detailed all the services using the Manchester area. The Regional Development Agency commissioned a report which identified delays to trains caused by conflicting movements of trains from North to South and East to West, particularly around Piccadilly Station. The report identified the need for construction of a flyover at Ardwick, although this would be difficult to construct as well as being costly, since the railway is on a viaduct in the area. An alternative scheme, which has now been adopted as part of the Northern Hub Project is to change the route of East to West trains away from Piccadilly to Victoria Station. This increases the number of trains through its four platforms from 11/hour to 22/hour. A new chord line will be constructed at Ordsall Lane. This is in itself a challenge since there are a number of listed bridges on the original Liverpool to Manchester Railway and the nearby canal which is also in the way of the proposed route. When completed the number of trains from Sheffield and Leeds to Manchester and Liverpool will be increased.

Adrian also gave us details of some of the other schemes in the project, which will improve journey times by providing more loops and four tracking schemes, as well as electrification. Manchester Piccadilly would have two additional through platforms to improve capacity. An electric substation needs to be moved. The junction at Miles Platting also will be changed as well as an additional platform at Manchester Airport. In the Greater Manchester area, the Hope Valley route would be given a new freight loop for aggregate trains from Hope and Buxton at Dore, together with the redoubling of the North Chord; quadrupling around Chinley and a turnback facility for Manchester trains and new loops at Grindleford. The route between Huyton and Roby would also be remodelled in two stages.

David Holmes gave a Vote of Thanks to Adrian.9M, 1V.

BRISTOL AND WEST OF ENGLAND SECTION
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Secretary: Phil Harrison, Arup, 63, St Thomas Street, Bristol. BS1 6JZ
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E-mail: philip.harrison@arup.com
Meeting Venues – Arup Auditorium, 63 St Thomas Street, Bristol at 1800 Refreshments available from 1730
Great Western House, Swindon at 1230, Refreshments from 1200
Great Western Hotel, Exeter at 1200, Refreshments from 1130

CROYDON AND BRIGHTON SECTION
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Tel: 01293 657274. Mobile: 0781 596 8245.
E-mail: Martin.Cresswell@amey.co.uk
Meeting Venue – Mott MacDonald House, Sydenham Road, Croydon, CR0 2EE, at 1730 for a 1745 start

Thursday 12th April 2012 – We were delighted to welcome **Nick Agnew**, Safety and contingency Planning Manager from Transport for London who gave his presentation **Hosting a great games and keeping London moving this summer**. Nick began by explaining his background as an LUL railway operator who has spent the last ten years with Transport for London. Now currently their Safety and Contingency Planning Manager. His role has provided him with the challenges of getting London's transport network ready for the Olympic Games.

Nick has two objectives, of equal importance, to deliver a great London 2012 Games and to keep London and the UK moving. He also needs to keep both businesses and freight moving. It is Britain's largest logistical exercise. We expect 9M spectators to attend the Olympic Games between 28 July and 12 August 2012. With a further 2M spectators for the Paralympics between 30th August and 9th September 2012. Most of the key games sites are located in the London area. Almost 300,000 athletes, officials, media, other Games Family members and workforce will take part or attend. Other events such as the Queens Jubilee celebrations have made this a busy year for transport planners. London already handles four million tube journeys per day which is equivalent to the whole of Britain's rail network. Half of all bus journeys in England also take place in London. The Olympic Park in Stratford is connected to four London Underground lines, the DLR, London Overground, numerous national rail services as well as having a dedicated Javelin shuttle service using High Speed 1 from St Pancras International.

TfL is experienced in providing transport for major events such as Royal Weddings, FA Cup Finals, New Year's Eve celebrations and the London Marathon. £6.5Bn has been invested in the transport infrastructure and capacity increases which were completed about a year ahead of the Games. The legacy which will remain after the games will benefit commuters, residents and visitors to London. This should be the most accessible Games ever, with an emphasis on making wheelchair users more welcome with infrastructure alterations, easy access buses and taxis and staff located at key locations to assist passengers who need help. The infrastructure will be particularly important during the Paralympics. All planned engineering works will be curtailed throughout the duration of both games events. Tube, DLR and London Overground services will run an hour later than usual, with last trains leaving Central London and the key venues at 0130. There will be extra services in the late evening to allow for increased passenger flows. Two hundred extra bus services will be provided in London and between 8 and 10 Javelin shuttles will run from St Pancras to Stratford per hour. There will be additional Thames Clipper fast river services at certain times and places. Extra staff and volunteers will be located across London to assist passenger movements.

A thirty mile Olympic route Network (ORN) will be created 2 days before the start of the games and will be in force till 2 days after the Paralympics. Vehicles can use the vast majority of the ORN, which is around 1% of the road network in London. There will be designated Games Lanes for official traffic only. The Games Lanes are only used where more than one lane is available and are located in the offside lane, in some cases replacing bus lanes. Users will be mainly media, athletes, officials and workers, with priority given after that to sponsors and IOC members. If traffic is low and capacity is spare, Games lanes will be re-opened to general traffic using variable message signs. When demand from Games traffic is high, low priority vehicles will be taken off the ORN. The ORN and PRNs will require temporary changes to traffic signal timings, ban turns to and from some side roads as well as the removal of some parking and loading bays and pedestrian crossings. There will also be a ban on planned road works on the ORN from March 2012. The smaller Paralympics Route Network (PRN) will only be put into operation if required. Other road users are being advised to avoid the area during Games times and are being encouraged to use TfL's online road journey planning tool to calculate the extra time required to undertake a journey. The impact of the ORN / PRN on specific roads and junctions will also be made available online. As a result of the impact on the roads, businesses and freight operators have been advised to consider carefully how they will move essential goods around London during the Games. Servicing and delivery companies will be affected by a no stopping restriction on the ORN/PRN between 0600 hours and midnight. There will be parking restrictions around venues and longer journey times in affected areas.

Sixty five per cent of tube stations will be unaffected although some stations and routes may be busier than normal. TfL have published the impact of changes at thirty key stations across London, to show that with some forward planning, avoiding these stations at the busiest times will enable passengers to have smoother journeys. A list of forty further stations which will be affected to a lesser degree will also be made available. TfL are making it clear that London and particularly its theatres will be open for business as usual during the games. It is anticipated that during mornings, interchange at London Bridge station should be avoided and passengers will be advised to use Cannon Street, Blackfriars or Charing Cross stations for interchange to the tube network. Business leaders have been encouraged to adapt staff travel arrangements, delivery, service and freight arrangements. Detailed information is being made available so that businesses can plan deliveries in advance.

Greater use of the internet will influence spectator travel patterns. Those living and working in travel hotspots will be encouraged to reduce journeys, change their normal routes where there is likely to be conflict with Games traffic, retime their journeys and if necessary change from their usual mode of transport.

There will be a Games Transport Coordination Centre (TCC) that will have representatives from all transport operators. It will monitor transport conditions across the UK and provide a coordinated and effective response to incidents. The TCC is fully equipped and ready from March to allow the plans to be tested.

The testing programme is now under way and will continue right up to the Games, to ensure that transport at all levels, from individual stations, to the whole transport network, and its connections with venues, security and other aspects is operationally ready. A number of simulated exercises have already taken place – for example, in February 2012, a two day exercise, involving 2500 people, tested security response on the transport system. Testing also took place during the London Marathon and the Queen's Diamond Jubilee celebrations. A series of test events is also being conducted with disabled stakeholders. One such test at Green Park station in the weekday evening peak checked the efficient operation of lifts and ensured that mobility impaired customers were able to move through the station quickly.

Nick reminded us of the twin objectives; to deliver a great 2012 Games and keep the UK moving. New infrastructure is delivering an early legacy. Detailed analysis has shown the impacts on the road and public transport networks at certain times and in certain locations. Transport hotspot information has been published enabling businesses to plan ahead and direct communication has taken place with public.

The success of the Games will be dependent on the ability of London's transport network to handle the additional traffic and move spectators and existing transport users to their destinations with the minimum of disruption.

Tim Kendall gave a Vote of Thanks to Nick. 16M, 2V.

Thursday 10th May 2012 - Colin Watts welcomed our speaker for the evening **Gerry McFadden**, Fleet Director, Southern Railway who gave his presentation **Southern Fleet**. Gerry set the scene of his presentation by outlining a few facts about the current fleet. Southern have 1200 vehicles available daily, the fleet is some of the newest stock on the rail network, but also still has some of the oldest. The trains are amongst the highest reliability and availability figures. Overhaul of trains is carried out in house. Southern are the only train operator in the UK to do this. Selhurst depot covers 40 acres of land.

The most reliable trains are the class 455 and the full fleet is currently undergoing refurbishment at Selhurst during 2012. Door failures are the main problem in daily operation. The smaller but similar two coach class 456 trains are also reliable, but will be transferred to South West Trains in 2014. They will be replaced by 5 cars, class 377/6 units which are currently being built and will enter service from December 2013. The trains will have power sockets for computers throughout the train. The present class 377 fleet consists of 700 vehicles and these trains form the bulk of Southern main line and some suburban services. They operate using Windows 95 software, using a 486 processor. This can cause some delay if there is a need to re-boot the system. The casualty rate is fairly good with one failure every 40,000 miles. Many services run in portions and Southern have more portioned services than any other european rail operator.

Southern also have class 171 two and three car diesel multiple units. The design is one of the most reliable in the UK. The Uckfield line is already over capacity and Southern have been unable to find new units. However, future electrification projects around the UK will eventually release diesel multiple units.

The class 442 five coach trains were built for use on the Bournemouth line and have many bespoke systems. They were designed as an inter city train using Mk3 body shells. They have four traction motors and are fitted with static converters which convert 750V DC to 110 V AC. They have ample luggage space and are therefore more suitable for use on services to Gatwick Airport. The design is more suited to faster services with fewer stops.

Birmingham University has designed a new system for Third Rail Inspection and Monitoring Equipment (TRIME). This is being introduced to monitor third rail damage incidents. A recent incident at Gatwick Airport caused £425K in penalties. Colin Watts gave a Vote of Thanks to Gerry. 15M, 3V.

DARLINGTON & NORTH EAST SECTION
Chairman: Trevor Horner
Secretary: Walter Clarke, 6 Laburnum Avenue, Walkerville, Newcastle upon Tyne NE6 4PP
Tel: 0191 230 5884, Mobile: 0786 626 8637
E-mail: Thomas.clarke@networkrail.co.uk
Meeting Venue – Railway Athletic Club, Brinkburn Road, Darlington at DL3 9LF, 1830, refreshments from 1815

Saturday 23rd June 2012 – See the Manchester and Liverpool section notes.

EDINBURGH SECTION
Chairman and Secretary: John Edwards
Mobile: 0780 315 8663.
E-mail: johnaedwards@mypostoffice.co.uk
Meeting Venue – The Scots Guards Club, 2 Clifton Terrace, Opposite Haymarket Station, Edinburgh at 1800.

GLASGOW SECTION
Chairman: Jill Coleman
Secretary: Jack Scott, 104 Clarence Street, Clydebank G81 2DL
Tel 0141-952-2562 Mobile 0778-976-5291
E-mail: Jack.scott1@Btinternet.com
Meeting Venue – Upstairs Lounge, The Iron Horse, West Nile Street, Glasgow.
Meetings start at 1730. Refreshments available from 1715

Wednesday 16th May 2012 - Jill Coleman opened the meeting and welcomed members. We were delighted to welcome Glasgow Section Member John Bell, P'Way Design Manager from Atkins Rail in Glasgow who gave his presentation **P'Way Design then and Now**.

John set the scene of his presentation by detailing some of the difference between past practices with current day practices. These covered a number of areas of design, from Hallade schemes, which were labour intensive on site surveys being carried out, to current day practices using laser stations which are placed off track. The work of preparing drawings and tracings was also explored in past practices to modern computer aided design production of data. John also covered other areas of design from clearances for rolling stock and modern day clearances, where there are now a number of profiles in use, particularly in the freight train areas.

Whilst modern day schemes are designed by computer there is still no common programme in use. Software houses are buying out their competitors to remove any choice in the future. This will probably not come on stream until the support for the competitor programme is withdrawn.

John explored the vast amount of detail that is now required from Network Rail for what would otherwise be provided in the past as a few drawings. Specifications that run to 40 and more pages do not appear to be a good use of resources. However what the client wants it gets and pays for.

Jill Coleman from Carillion Rail gave a Vote of Thanks to John and the meeting closed with 25 members in attendance.

Saturday 23rd June 2012 – See the Manchester and Liverpool section notes.

IRISH SECTION
Chairman: Tom Ruane
Secretary: Tara McCadden, Track & Signal HQ, Iarnrod Eireann, Inchicore, Dublin 8.
Tel 00353 1 703 4323, Mobile 00353 87 2943562
e-mail : tara.mccadden@irishrail.ie
Thursday 8th March 2012 – At the Ashling Hotel, Dublin

LANCASTER, BARROW & CARLISLE SECTION
Chairman: John Parker
Secretary: Philip Bull, Lonsdale Barn, Hutton Roof, Carnforth, Lancashire. LA6 2PG
Tel: 01524- 272475, Mobile: 0796 410 3202
E-mail Bullnet98@aol.com
Meeting Venues – Railway Hotel, adjacent to Preston Station 1730 for 1800
Carnforth Royal Station Hotel 1730 for 1800

LONDON SECTION
Chairman: Mike Allen
Secretary: Fiona Thomson
E-mail: fiona.thomson@tube.tfl.gov.uk
Tel: 0207 918 3544, Mobile 0780 277 9838
Meeting Venue – 10th Floor, 55 Broadway (LUL HQ), London St James Park tube 1730 for 1800

MANCHESTER & LIVERPOOL SECTION
Chairman: David Woods
Secretary: Rob Cummings, Mannin House, Macon Way, Crewe CW1 6RT
Tel 01270-727548 Mobile 0779 885 8784
E-mail rob.cummings@networkrail.co.uk
Meeting Venues – Mott MacDonald, Altringham at 1700 for 1730
SQ1, Network Rail Offices, Manchester, at 1230 for 1300 start or 1700 for 1730

Saturday 23rd June 2012 - This was the Annual Inter Section Quiz, with teams taking part from Darlington and the North East, Glasgow and Manchester and Liverpool sections.

The Manchester and Liverpool team along with Quizmaster Jack Scott and the John Hill Memorial Trophy.

A special thanks to Ian Ellis for providing this years questions for the Quiz.

Jack Scott from Glasgow Section opened the meeting and welcomed those in attendance. Jack, who was the Question master, advised those present of the Rules of the quiz. He then went on to introduce the teams.

After a number of rounds, the victors were the team from Manchester and Liverpool, of George Bowden and Rob Cummings.

MILTON KEYNES SECTION
Chairman: James Dean
Secretary: Kevin Thurlow, Network Rail, 11th Floor, Mailbox, 100 Wharfside Street, Birmingham B1 1RT.
Tel: 0121 345 3158, Mobile: 0780 289 0299.
E-mail: kevin.thurlow@networkrail.co.uk
Meeting Venues – Room 3.5, Third Floor, Network Rail Station Offices, Milton Keynes at 1700

NORTH WALES SECTION
Chairman: Alastair Roberts
Secretary: Lynne Garner, 9 Longcroft Place, Lymm, Cheshire. WA13 9UD
Tel. Mobile. 0777 167 2274
E-mail: lynne.garner@networkrail.co.uk
Meeting Venue - The Town Crier Inn, City Road, Chester commencing at 18.30 with light refreshments at 1800

Thursday 10th May 2012 – We were delighted to welcome **Azhar Quaiyoom**, from Network Rail as our speaker for the evening who gave his presentation on **Birmingham New Street Redevelopment**. Azhar set the scene of his presentation by outlining the current Birmingham New Street Station. This includes a 1960's concrete exterior and a dated interior, lighting is poor, there is little ventilation in the station area and communications are difficult. The main driver for change is to improve these areas, along with the need to cater for increased passengers and improve connectivity to the city. One of the big challenges for this project is to enable the station to remain open during the works.

Azhar showed a video which took us through the proposed design changes. This showed the new station as a modern structure that makes use of as much natural light as possible and includes spacious public areas and a large John Lewis store. The impressive frontage of the station includes a reflective cladding, this is necessary to conduct detailed glare studies to ensure that light would not be reflected in such a way as to dazzle train drivers on their approach to the platforms, or affect their ability to view signals. A scale model of the station exterior was constructed to assist with this analysis. Computer modelling software was then used to map the path of the sun across the building during the course of the year and provide details of any areas that may cause unacceptable glare. As a result of this study some modifications to the design were made.

NOTTINGHAM & DERBY SECTION
Chairman: Liam Purcell
Secretary: Colin Cowey, 8 Douglas Road, Bingham, Nottingham, NG13 8EL.
Tel 01949 837067, Fax 01949 838826
Mobile 0794 648 2343
E-mail: colin.cowey@talk21.com
Meeting Venues – Aston Court Hotel, adjacent to Derby station, Derby at 1800 for a 1815 start
Jury's Inn Hotel, Station Street, Nottingham at 1800 for an 1815 start

Thursday 10th May 2012 - The Section had a technical visit to the Progress Rail, Switch and Crossing layout assembly plant at Beeston, near Nottingham. The facility is situated in an Ex Freightliner terminal yard. The visit gave us the opportunity to see a range of switch and crossing layouts being assembled, from 113A and NR60 rails, as well as a demonstration of the modular switch and crossing tilting wagons, which are used to deliver the completed layouts to site. It also allowed members to discuss the merits of making use of the new delivery medium to site, as a complete layout.

Our thanks go to Lloyd's Register, Progress Rail and Network Rail for making the visit possible.

More than 20 Section Members from organisations as wide as Lloyd's Register, Network Rail, Rail Accident Investigation Branch, Tube Lines, Scott Wilson URS, Parsons Brinkerhoff, Balfour Beatty, Amey and Derby University attended.

SHEFFIELD AND DONCASTER SECTION
Chairman: Ian Knowles
Secretary: Vivek Vilay
Mobile; 0776 372 4259.
E-mail: v1v3k007@gmail.com
Meeting venue – Sheffield Hallam University, Sheffield at 1800

SOLENT SECTION
Chairman: Tony Newton
Secretary: Brian Hackford,
Tel 02392 602631, Mobile 0751 562 7041
E-mail: Brian.Hackford@networkrail.co.uk
Meeting venues – Crofton Club, Stubbington at 1930

SOUTH & WEST WALES SECTION
Chairman: Andy Franklin
Secretary: James Hepburn, 10 Farmhouse Way, Caerau, Cardiff CF5 5HH
Mobile 0791 930 7726
E-mail: james.hepburn2@networkrail.co.uk
Meeting Venues – Queens Hotel, 19 Bridge Street, Newport at 1800
Grand Hotel, Ivey Place, Swansea at 1800

Thursday 10th May 2012 – In Swansea - This was the Annual General Meeting of the Section, and elections took place for the following Official for the year 2012/13. Chairman Andy Franklin, Vice Chairman Paul Daly, Secretary James Hepburn, Vice President for Wales David Williams.

We were delighted to welcome Julian Harms from Network Rail who was our speaker for the evening who gave his presentation on earthworks.Julian career has been in geotechnical engineering, including his current role of Route Asset Manager (Geotechnics) in the London North Western Zone of Network Rail.

Julian covered the various types of earthworks used on railway infrastructure and how they were constructed. He then explained some of the key engineering principles of geotechnics, including soil mechanics, hydrology and cohesion of soil particles and explained the key governing principles for different soil types.

Julian then discussed how Network Rail manages the associated risks of earthwork failures.

Julian concluded his presentation with some case studies and explained some future developments underway in geotechnical engineering on railway infrastructure.

Alex Hinshelwood gave a Vote of Thanks to Julian. 10M, 2V.

THAMES VALLEY SECTION
Chairman: Jeremy Smith
Secretary – Malcolm Pearce,
Tel: 01635 550326, Mobile: 0796 766 7019
E-mail: malcolm.pearce@bbrail.com
Meeting Venue – Network Rail RSAR Site Office, 80 Caversham Road, Reading at 1745,
Refreshments available from 1700

Wednesday 2nd May 2012 - We were delighted to welcome **Stephen Cox** from Balfour Beatty Rail, who gave his presentation **Monitoring the Signalling Asset**. Stephen set the scene of his presentation which had three interrelated parts. The first part focussed on the various types of signalling assets, their individual failure modes and how each interface with Permanent Way. One particularly importance facet was detection. Whether this was accomplished by track circuits or axle counters. Stephen explained the function of each type of asset and highlighted the common causes for failure. The common theme was a loss of power supply; control circuitry failure; crushed or severed cables; poor track geometry or maintenance.

Individual failures can be caused by signal lamp or LED modules as well as physical obstructions to signals like untreated vegetation.

Track circuits failures are mostly diagnosed to the poor condition of insulated joints. Sometimes a failure is caused by excess ballast conditions. This can cause shortcircuiting in wet weather.

Axle counter failures are mostly caused by damage to sensor heads; incorrect count; section not proved clear, after a possession is given up.

Points failures are another common cause usually related to a motor, clutch or pump breakdown. This can be seen on mechanical or hydraulic drives. Mechanical or electrical detection failures; back drive function; detection function.

Stephen moved on to describe the AWS and TPWS functions, interlocking and control systems, and the overall operation of the signalling system as a unit.

Stephen also looked at why, what, where and how monitoring of signalling could be achieved. He also described the many locations where monitoring could be carried out and the benefits or problems involved in each of these locations. Stephen highlighted the different types of monitoring used whether this be digital or analogue. The need to monitor is to improve safety, reduce maintenance costs, detection of a developing failure before it takes place, reduce time taken to diagnose actual failure, reduce the cost of reports of faults and reduce renewal costs by extending life of components by strategic maintenance intervention.

There are a number of areas which can be monitored: train detection; points, signals, interlocking, SCCs, cabling, power supplies, level crossings, buildings security and systems like air conditioning. Each specific site is usually determined by the degree of disruption that a failure will cause. Obviously many locations do not need to be continuously monitored as the temporary loss of a

particular item may not be critical and may not cause delay and disruption. The benefits of analogue or digital monitoring, intrusive or non-intrusive, continuous or triggered, direct or derived measurements, temporary or permanent were also discussed.

The why, what, where and how to monitor will be governed by: space available for the monitoring equipment, availability of power supplies, availability of communications methods, security of the location, environmental conditions, maintainability and the effect of the monitoring system on the system being monitored, both in normal and in failure mode.

Stephen demonstrated some of the many different types of signalling asset monitoring systems which are currently in use both within the UK and overseas and showed examples of the information which can be gained by the use of such systems.

Stephen concluded by looking at some of the benefits and issues related to the monitoring of assets. The benefits being the ability to prevent a failure, by predicting it before it happens. Allowing better targeting of maintenance and even reducing the number of assets. The issues covered included making sure the end user was involved in the process.

Wednesday 6th June 2012 – This was the Annual General Meeting of the Section. Our Chairman Matthew Savastano opened the meeting. The meeting elected the following Officer for the year 2012/13.

Chairman – Jeremy Smith, Vice Chairman Phillip Holbourn, Secretary Malcolm Pearce, Committee all the above and Rodney Pinchen, Ray Pocock, Tony Roberts and Matthew Savastano.

We had two presentations for the evening. The first was from **Dave Walker** from the Isle of Wight Steam Railway (IoWSR), which was **Winter Maintenance and Renewal Work on the IoWSR**.

Dave gave us a short history of the railway from Smallbrook Junction to Wootton which is now the IoWSR.

During the winter of 2011/12, the railway carried out many items of track and civil works at Wootton Station to stabilise a number of track problems. The main cause was the clay formation. Works were also undertaken to improve some operational facilities including the reconstruction of the station buildings and the platform wall.

Dave detailed the work by showing a selection of slides, showing how the works were designed, planned and carried out. After the track was removed, formation blanketing was carried out with a sand layer sandwiched geotextile and bottom ballast, and drainage scheme.

The track was replaced to a new alignment, with the S&C placed to allow loco release to the loop at the Western end of the platform.

Works at the station itself involved the provision of station buildings, built to the original design and rebuilding the platform wall and copings which had been foul to gauge due to formation subsidence resurfacing the platform.

Most of the work was done by volunteer labour, with plant hired-in as necessary. The platform surfacing was done by a local contractor. Access to the site is difficult often needing time-consuming double-handling of materials using low-capacity plant and equipment. Despite poor weather conditions over the winter the work was completed to time and budget.

The new station buildings have been well received for their historical authenticity and build quality. The track work also achieved engineering and operating objectives.

Our second presentation for the evening was from **Alistair Hall** from the Swanage Railway who gave his presentation **Winter Track Maintenance and Renewal Works at Swanage Station and Loco Depot**. Alistair reminded us of the history of the preserved railway, which is connected to Network Rail at Worgret Jct. near Wareham.

Some sections of track in the loco depot, main platform line and the loop at Swanage have been causing concern, making it difficult to maintain with formation failure. This has become more advanced with almost a complete failure of the drainage system. A major programme of work was proposed, authorised, designed, planned and carried out over the winter of 2011/12 to provide a long-term solution to the problems. Alistair described with the aid of excellent diagrams and slides how the works were undertaken. Work packages were designed to bring materials to site and make best use the use of the resources available. The loco depot works were first on the agenda with a formation renewal and drainage scheme, the interceptors and turntable. Drainage proved most difficult with on-site solutions being used to get round some unexpected finds. The design was achieved with a connection to the drainage system.

Work at the station proved to be a logistical challenge due to space constraints. A work package was designed to overcome the problems. Track was removed from the platform line and loop. The clay ballast dug out to the designed depth and crossfall. Drainage was installed between the two tracks with connections to the existing drains. The formation scheme was a sand blanket with geotextile and bottom ballast. The sand for the blanket was sourced locally on the railways own land making a saving on procurement and haulage. When the track was replaced the opportunity was taken to carry out a new alignment at the Herston end of the platform.

A number of innovative solutions were devised for the work, particularly to allow plant access and site operation.

Works were completed to specification on time and below budget, giving a new infrastructure fit for purpose for the future. The Swanage Railway regularly has visits from some of the largest preserved steam locomotives and the work will allow these visits to continue.

.All work was carried out under the direction of Alistair and his colleagues using volunteer labour with some specialist contractors' staff when necessary. The plant and equipment used was mostly owned and operated by the company with specialist units hired in.

Malcolm Pearce gave a Vote of Thanks to Dave and Alistair. 18M,4V.

WESSEX SECTION
Chairman: Jim Wheeler
Secretary: Richard Workman, Brown Hylda, Hindhead Road, Haslemere, Surrey GU27 1LR
Tel 01428 645771
E-mail richardworkman5@tiscali.co.uk
Meeting Venues – The Rose and Crown, Columbo Street, Waterloo, London at 1800
The Freemantle Club, Waterloo Road, Southampton, at 1800

Tuesday 4th September 2012 – In Waterloo

We were delighted to welcome **Phil Taylor** from SGS as our speaker for the evening who gave his presentation **Regenerative Braking in the UK Rail Industry**. Phil first became involved with regenerative braking in 2006. When the train company c2c first raised the subject of activating the regenerative capability of their class 357 trains. At that time Phil worked for Booz Allen Hamilton who have since left the UK rail market. Phil and his team have since moved to SGS. Phil set out the objective of how the business case was established. This needed a great deal of testing to be carried out, to first develop the controlling software and then provide the evidence that regenerative braking trains would not have any unexpected or unsafe impacts on the power supply and signalling systems. This was done in an 18 month programme of night possessions on c2c. A train was then fitted and taken to the Velim test facility in the Czech Republic for another 4 weeks of testing. After some modification the train was instrumented and ran 4000 miles in an 11 day slot. During this time it consumed 70 MWh of electricity and regenerated 12 MWh. The facility was not fenced and animals were a challenge on site.

After returning to the UK some 12 car train tests were carried out between Fenchurch Street and Upminster, as well in the Barking area. These confirmed that there were no adverse effects on the adjacent London Underground Lines or Docklands Light Railway networks. A further test at Shoeburyness confirmed that regenerated currents would not be a problem to trains using only hotel power. Full regenerative braking was then introduced on all c2c trains in less than 6 months from the initial tests.

C2c has achieved a 15-20% reduction in energy bills. Based on this, Southern is now hoping to bring in similar systems to their class 377 third rail trains. The business case suggested that savings as low as 3% to 6% could lead to costs pay-back in 2 years. Phil continued to explain that whilst AC power systems were entirely reversible, they could put regenerated power back into the national grid, however DC regeneration could not pass back through the lineside rectifiers and so was essentially confined to the conductor rails and DC switchgear. Network Rail was concerned that the very high currents could affect many parts of their infrastructure but was keen to be seen as a Green energy saver. An extensive series of trials were carried out during week night possessions between Dorking and Horsham to prove the system.

A section between 2 substations was fully isolated from the rest of the network, whilst a 377 carried out regenerative braking on receptive and unreceptive power supply conditions. A key problem area considered was the concealment, by the train, of an earth short circuit some distance from the breakers. These are designed to trip in such conditions. A spectacular trial confirmed that this could indeed happen in certain circumstances but an analysis of the parameters of every power supply section on the Southern Network showed that the likely rate such an occurrence was probably between 1 to 4 occasions in a hundred year period. This was considered to be an acceptable level of risk. South Eastern was concerned about the effect on older non-regenerative trains. However no effects have been recorded since introduction of regenerative braking.

South West Trains' Siemens trains were built to have regenerative braking but needed some modification alterations rather than software alterations. That programme is now complete too.

As a final part of the project a Network Rail study checked where the regenerative current actually went, particularly when there was no receptive train in the immediate area. It concluded that about 12% of regenerative power goes to feed the losses which occur normally in the conductor rail system. This still shows a reduction in purchased electricity. It would be preferable if it all went to another train requiring power.

Depending on varying conditions, somewhere between 66% and 99% of the power finds a receptive train which may be a few substation sections away. The overall result is a saving of about 18% on the traction energy bill.

Jim Wheeler gave a Vote of Thanks to Phil. 21M.

WEST YORKSHIRE SECTION

Chairman – George McMonagle

Secretary – Martin Wooff, c/o 74 Main Road, Denholme, Bradford, West Yorkshire BD13 4BL.

Mobile 0774 716 0949.

E-mail abcts@daelnet.co.uk

Meeting Venue – The Pullman Room, The Cosmopolitan Hotel, 2 Lower Briggate, Leeds LS1 4AE

Meetings start at 1830, refreshments available from 1800.

Tuesday 15th May 2012 – Our scheduled speaker for the evening, John Billcliffe was unable to attend. So at very short notice **John Meredith** kindly agreed to give us a presention **The Traction Engine**. Although not strictly railways or Permanent Way, John's presentation provided a fascinating glimpse into a different field.

Traction engines have impacted on the development of the steam engine, for use on railways as well as other industrial uses. In many ways they were part of the development of the railway.

Our thanks to John for his preentation. 7M, 4V.

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YORK SECTION

Chairman – Ian Kitching

Secretary – Ken Aiston, 34 Fulford Park, York, YO10 4QE.

Tel Mobile 0778 751 2227. E-mail *kaistonyork@btinternet.com*

Meeting Venue – Marriott Room, York Central Library, Library Square, York. Refreshments from 1730 for 1800

HOME SECTION PROGRAMMES
October 2012 - January 2013

'Check the website regularly for up to date information of Section meetings.

ASHFORD SECTION
Chairman: Steve Everest
Secretary: Phil Reynolds, 56a Burley road, Sittingbourne, ME10 1JH
E-mail: phil.reynolds@networkrail.co.uk
Meeting Venue – The Elwick Club, Church Road, Ashford (10 minutes from Ashford Station) at 1830

BIRMINGHAM SECTION
Co-Chairman: David Holmes/Bob Langford
Secretary: Ashley Pettifer, 5 Shottery Road, Stratford-upon-Avon, Warwickshire CV37 9QA
Tel: 01789 293578.
Email: arp5@btinternet.com
Meeting Venues – The Comfort Inn Hotel, Station Street, Birmingham 1730 for an 1800 start
The Gateway Centre in Shrewsbury at 18.00

Thursday 11th October 2012 – In Birmingham
SUGAR RAILWAYS OF JAVA
Mark Hambly

Thursday 8th November 2012 – In Birmingham
STAFFORD AND NORTON BRIDGE REMODELLING
David Lawrence, Network Rail

Thursday 13th December 2012
QUIZ NIGHT AND CHRISTMAS SOCIAL

BRISTOL AND WEST OF ENGLAND
Chairman: Bruno Taylor
Secretary: Phil Harrison, Arup, 63, St Thomas Street, Bristol. BS1 6JZ
Tel 0117 976 5432, Mobile No 0788 078 8531
E-mail: philip.harrison@arup.com
Meeting Venues – Arup Auditorium, 63 St Thomas Street, Bristol at 1800 Refreshments available from 1730
Network Rail, Western House, Holbrook Rd, Swindon at 1230, Refreshments from 1200
Great Western Hotel, Exeter at 1200, Refreshments from 1130

Wednesday 3rd October 2012 – In Exeter
CHAIRMANS ADDRESS
Bruno Taylor

Wednesday 17th October 2012 – In Bristol
CHAIRMANS ADDRESS
Bruno Taylor

Wednesday 21st November 2012 – In Swindon
SWINDON SECTION MANAGERS CHALLENGES AND SUCCESSES
Andy O'Malley, Network Rail

Wednesday 5th December 2012 – In Bristol
PUB QUIZ NIGHT

CROYDON AND BRIGHTON SECTION
Chairman: Tim Kendell
Secretary: Martin Cresswell, 60 Milton Crescent, East Grinstead, RH19 1TN
Tel: 01293 657274. Mobile: 0781 596 8245.
E-mail: Martin.Cresswell@amey.co.uk
Meeting Venue – Mott MacDonald House, Sydenham Road, Croydon, CR0 2EE, at 1730 for a 1745 start

Tuesday 9th October 2012
CROSSRAIL
Graham Reid

Tuesday 19th November 2012
EFFECTS OF CLIMATE CHANGE
John Dora, Network Rail

Tuesday 11th December 2012
look out for details on the PWI Website www.permanentwayinstitution.com

Thursday 10th January 2013
look out for details on the PWI Website www.permanentwayinstitution.com

DARLINGTON & NORTH EAST SECTION
Chairman: Trevor Horner
Secretary: Walter Clarke, 6 Laburnum Avenue, Walkerville, Newcastle upon Tyne NE6 4PP
Tel: 0191 230 5884, Mobile: 0786 626 8637
E-mail: Thomas.clarke@networkrail.co.uk
Meeting Venue – Railway Athletic Club, Brinkburn Road, Darlington at DL3 9LF, 1830, refreshments from 1815

EDINBURGH SECTION
Chairman and Secretary: John Edwards
Mobile: 0780 315 8663. E-mail: johnaedwards@mypostoffice.co.uk
Meeting Venue – The Scots Guards Club, 2 Clifton Terrace, Opposite Haymarket Station, Edinburgh at 1800.

Wednesday 3rd October 2012
THE LIFE OF A TME IN WALES
James Hepburn, Network Rail, Newport

Wednesday 7th November 2012
S&C MAINTENANCE AND GAUGING TECHNIQUES
Neil Denton, Network Rail

Friday 7th December 2012
TECHNICAL TOUR

Thursday 17th January 2013
QUIZ NIGHT
This will also be the Section AGM

GLASGOW SECTION
Chairman: Jill Coleman
Secretary: Jack Scott, 104 Clarence Street, Clydebank G81 2DL
Tel 0141-952-2562 Mobile 0778-976-5291
E-mail: Jack.scott1@Btinternet.com
Meeting Venue – Upstairs Lounge, The Iron Horse, West Nile Street, Glasgow.
Meetings start at 1730. Refreshments available from 1715

Wednesday 17th October 2012 – Upstairs Lounge, The Iron Horse, West Nile Street, Glasgow
TECHNOLOGY FOR TRACK
Niall Fagan, Network Rail, London

Wednesday 21st November 2012 – Upstairs Lounge, The Iron Horse, West Nile Street, Glasgow
YOUNG RAILWAY PROFESSIONALS PRESENTATION COMPETITION
REF Scotland Meeting - Joint Meeting with the IRSE, CILT, IRO AND IMechE

Wednesday 12th December 2011 – Upstairs Lounge, The Iron Horse, West Nile Street, Glasgow
QUIZ NIGHT AND CHRISTMAS SOCIAL

Wednesday 16thJanuary 2013 – Upstairs Lounge, The Iron Horse, West Nile Street, Glasgow
GAUGE RESTORATION – LINE SPEED IMPROVEMENTS
David Tomnay, Babcock Rail, Hamilton
Joint Meeting with the Institution of Railway Operators

IRISH SECTION
Chairman: Tom Ruane
Secretary: Tara McCadden, Track & Signal HQ,

Iarnrod Eireann, Inchicore, Dublin 8.
Tel 00353 1 703 4323, Mobile 00353 87 2943562
E-mail : tara.mccadden@irishrail.ie

Tuesday 9th October 2012 – The Bridge House, Tullamore at 1400
Look out for details on the PWI Website www.permanentwayinstitution.com

Thursday 11th October 2012 – Jury's Inn, Belfast at 1400
Look out for details on the PWI Website www.permanentwayinstitution.com

LANCASTER, BARROW & CARLISLE SECTION
Chairman: John Parker
Secretary: Philip Bull, Lonsdale Barn, Hutton Roof, Carnforth, Lancashire. LA6 2PG
Tel: 01524- 272475, Mobile: 0796 410 3202
E-mail Bullnet98@aol.com
Meeting Venues – Railway Hotel, adjacent to Preston Station 1730 for 1800
Carnforth Royal Station Hotel 1730 for 1800

Tuesday 9th October 2012 – In Carnforth
LOW COST TRAM SYSTEMS
Lewis Leslie

Tuesday 19th November 2012 – In Preston
NORTH WEST CONTRACTORS
A speaker from BAM Nuttall, look out for details on the PWI Website www.permanentwayinstitution.com

Tuesday 11th December 2012 – In Carnforth
ENGINEERING IN ETHIOPIA
Bill Hutchison

Tuesday 8th January 2013 – In Preston
NORTHERN HUB
Adrian Bocking, Network Rail

LONDON SECTION
Chairman: Mike Allen
Secretary: Fiona Thomson, E-mail: fiona.thomson@tube.tfl.gov.uk
Tel: 0207 918 3544, Mobile 0780 277 9838
Meeting Venue – 10th Floor, 55 Broadway (LUL HQ), London St James Park tube 1730 for 1800

Wednesday 17th October 2012
LONGDITUDINAL TIMBERS – THE LU APPROACH
Mike Allan and Paul Ebbutt, London Underground

Wednesday 21st November 2012
ADVANCES IN WELDING TECHNOLOGY
Dr Bernhard Lichtberger

Wednesday 12th December 2011 – At ICE, 1 Great George Street, London
SUBJECT OF TOPICAL INTEREST
Steve Norris

Monday 14thJanuary 2013
READING REMODELLING
Sean Murray and Ben Venerable, Network Rail

MANCHESTER & LIVERPOOL SECTION
Chairman: David Woods
Secretary: Rob Cummings, Mannin House, Macon Way, Crewe CW1 6RT
Tel 01270-727548 Mobile 0779 885 8784
E-mail rob.cummings@networkrail.co.uk
Meeting Venues – Mott MacDonald, Spring Bank House, Altringham at 1700 for 1730
SQ1, Network Rail Offices, Manchester, at 1230 for 1300 start or 1700 for 1730

Thursday 11th October 2012 - In SQ1, Network Rail Offices, Manchester, at 1230 for 1300 start
MIDLAND MAIN LINE
Carl Baker, Parsons Brinkerhoff
Thursday 8th November 2012 = In SQ1, Network Rail Offices, Manchester, at 1700 for 1730 start
TRACK DRAINAGE – SO YOU THINK NOT CLEARING DRAINS SAVES MONEY
Andy Franklin, Network Rail, London
Thursday 6th December 2012 – Venue TBC
FROM HUMAN BRAWN TO HYDRAULIC FLUID
Martin Welch

Thursday 10th January 2013– Venue TBC
LIGHT RAIL TOPIC
Look out for details on the PWI Website www.permanentwayinstitution.com

MILTON KEYNES SECTION
Chairman: James Dean
Secretary: Kevin Thurlow, Network Rail, 11th Floor, Mailbox, 100 Wharfside Street, Birmingham B1 1RT.
Tel: 0121 345 3158, Mobile: 0780 289 0299.
E-mail: kevin.thurlow@networkrail.co.uk
Meeting Venues – Room 3.5, Third Floor, Network Rail Station Offices, Milton Keynes at 1700

NORTH WALES SECTION
Chairman: Alastair Roberts
Secretary: Lynne Garner, 9 Longcroft Place, Lymm, Cheshire. WA13 9UD
Tel. Mobile. 0777 167 2274
E-mail: lynne.garner@networkrail.co.uk
Meeting Venue - The Town Crier Inn, City Road, Chester commencing at 18.30 with light refreshments at 1800

Thursday 11th October 2012
15 YEARS MODERNISATION PLAN FOR WALES
Jon Pegg, Network Rail

Thursday 8th November 2012
CONCRETE SLEEPER HISTORY AND MANUFACTURING PROCESS
Andrew Carey and Paul Crowther, Cemex

Thursday 13th December 2012
PLAIN LINE PATTERN AND RECOGNITION TECHNOLOGY - PLPR
Tim Flower, Network Rail

Thursday 10th January 2013
THE LIVERPOOL UNDERGROUND PUMPING SYSTEM
Allen Corcoran, Network Rail

NOTTINGHAM & DERBY SECTION
Chairman: Liam Purcell
Secretary: Colin Cowey, 8 Douglas Road, Bingham, Nottingham, NG13 8EL.
Tel 01949 837067, Fax 01949 838826,
Mobile 0794 648 2343.
E-mail: colin.cowey@talk21.com
Meeting Venues – Aston Court Hotel, adjacent to Derby station, Derby at 1800 for an 1815 start
Jury's Inn Hotel, Station Street, Nottingham at 1800 for an 1815 start

Wednesday 17th October 2012 – In Nottingham
NORTH WEST ELECTRIFICATION
John Clee

Thursday 22nd November 2012 - In Derby
MIDLAND MAINLINE SPEED IMPROVEMENTS
Carl Baker and Steve Pye

Tuesday 22nd January 2013 – In Derby
YOUNG MEMBER PRESENTATIONS
Short Papers from young members

SHEFFIELD AND DONCASTER SECTION
Chairman: Ian Knowles
Secretary: Vivek Vilay,
Mobile 0776 372 4259.
E-mail: v1v3k007@gmail.com
Meeting venue – Sheffield Hallam University at 1800

SOLENT SECTION
Chairman: Tony Newton
Secretary: Brian Hackford,
Tel 02392 602631, Mobile 0751 562 7041
E-mail: Brian.Hackford@networkrail.co.uk
Meeting venues – Crofton Club, Stubbington at 1930

SOUTH & WEST WALES SECTION
Chairman: Andy Franklin
Secretary: James Hepburn, 10 Farmhouse Way, Caerau, Cardiff CF5 5HH
Mobile 0791 930 7726
E-mail: james.hepburn2@networkrail.co.uk
Meeting Venues – Queens Hotel, 19 Bridge Street, Newport at 1800
Grand Hotel, Ivey Place, Swansea at 1800

Thursday 11th October 2012 – In Swansea
FORMATION STRENGTHENING PROJECT AT KINTBURY
John Edwards

Thursday 15th November 2012 – In Newport
Look out for details on the PWI Website www.permanentwayinstitution.com

Thursday 6th December 2012– In Newport
CAMBRIAN RELAYING CAMPAIGN
Gwyn Rees, Network Rail

Thursday 10th January 2013 – In Newport
CROSSRAIL
Graham Reid, Network Rail

THAMES VALLEY SECTION
Chairman: Jeremy Smith
Secretary: Malcolm Pearce, Tel: 01635 550326,
Mobile: 0796 766 7019
E-mail: malcolm.pearce@bbrail.com
Meeting Venue – Network Rail RSAR Site Office, 80 Caversham Road, Reading at 1745,
Refreshments available from 1700

Wednesday 3rd October 2012
Look out for details on the PWI Website www.permanentwayinstitution.com

Wednesday 7th November 2012
PRODUCTS, PROJECTS AND DEVELOPMENTS
Gavin Livie, Pandrol UK

Wednesday 5th December 2012 –In BRSA Social Club, Reading
ANNUAL CHRISTMAS SOCIAL EVENING

Wednesday 9th January 2013
EVOLUTION OF PLANT AND EQUIPMENT FOR RAILWAY RENEWALS AND MAINTENANCE
Malcolm Pearce, Balfour Beatty Rail Maintenance

WESSEX SECTION
Chairman: Jim Wheeler
Secretary: Richard Workman, Brown Hylda, Hindhead Road, Haslemere, Surrey GU27 1LR
Tel 01428 645771
E-mail richardworkman5@tiscali.co.uk
Meeting Venues – The Rose and Crown, Columbo Street, Waterloo, London at 1800
The Freemantle Club, Waterloo Road, Southampton, at 1800

Monday 1st October 2012 – In Waterloo
PROGRESS ON THE INSTALLATION OF MODULAR S&C
Kevin Percival, Network Rail

Tuesday 6th November 2012 – In Southampton
FRENCH TGV AND HIGH SPEED LINES
Michael Bunns, SNCF Society.

Tuesday 4th December 2012 – In Waterloo
LONDON BRIDGE STATION RECONSTRUCTION
Clive Loosemore, Costain

Tuesday 8th January 2013 – In Waterloo
THE VALUE CHALLENGE
Jol Bates, Mott MacDonald

WEST YORKSHIRE SECTION
Chairman: George McMonagle
Secretary: Martin Wooff, c/o 74 Main Road, Denholme, Bradford, West Yorkshire BD13 4BL.
Mobile 0774 716 0949.
E-mail abcts@daelnet.co.uk
Meeting Venue – The Pullman Room, The Cosmopolitan Hotel, 2 Lower Briggate, Leeds LS1 4AE
Meetings start at 1830, refreshments available from 1800.

Tuesday 16th October 2012
LINDLE TUNNEL WORKS
Bruno Martin

Tuesday 20th November 2012
TRANS PENNINE ELECTRIFICATION
A speaker from Network Rail Look out for details on the PWI Website www.permanentwayinstitution.com

Tuesday 18th December 2012
Look out for title details on the PWI Website www.permanentwayinstitution.com
Nigel Trotter, Section Member

Tuesday 15th January 2013
STATION REFURBISHMENT
A speaker from Network Rail Look out for details on the PWI Website www.permanentwayinstitution.com

YORK SECTION
Chairman: Ian Kitching
Secretary: Ken Aiston, 34 Fulford Park, York, YO10 4QE.
Tel 01904 656991, Mobile 0778 751 2227.
E-mail kaistonyork@btinternet.com
Meeting Venue – Marriott Room, York Central Library, Library Square, York. Refreshments from 1730 for 1800

Thursday 4th October 2012
WORKING ON THE RAILROAD IN THE USA
Phil Kirkland, Nexus

Thursday 15th November 2012
GRADIENT AND RESISTANCE MODELLING
Vladimir Rangelov, Tata Rail Projects, York

Thursday 6th December 2012
BLACKPOOL TRAMS
Fred Fitter, Mott MacDonald, Manchester

Thursday 10th January 2013
ELECTRIFYING THE EAST COAST MAIN LINE
Don Heath

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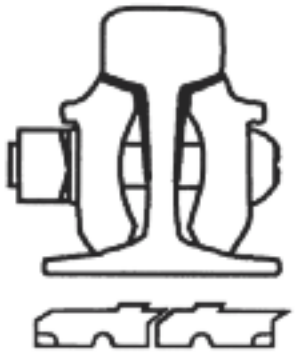

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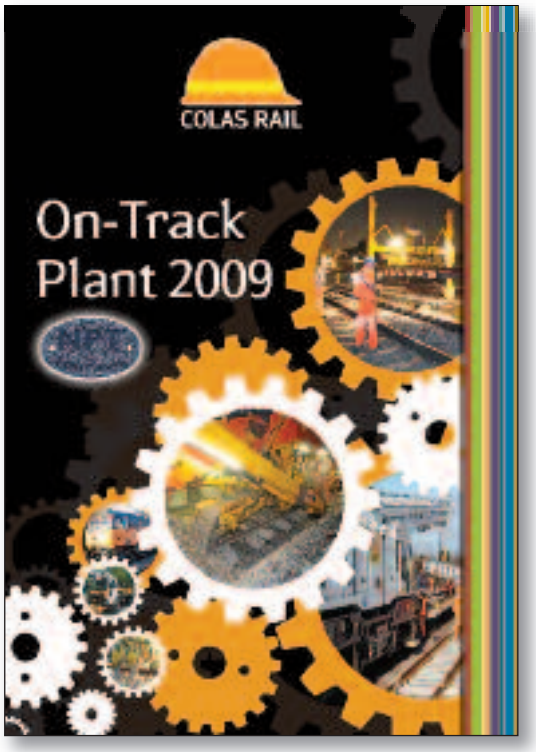

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