Utilising new technology on railways

This seminar was held in the Manchester Conference Centre on the 4 March 2020. PWI CEO, Stephen Barber, welcomed the delegates and introduced them to the format of the day, before welcoming the first speaker to take the stage.

KEYNOTE
GARETH EVANS, NETWORK RAIL

Gareth talked about getting the "Best bang for every pound" when explaining that the UK was pledging £550M, and the EU another £820M to research and innovation over the next four years. He touched upon how the full asset lifecycle of the railway would be considered when deciding where to spend the budget. Network Rail will be targeting five key objectives during CP6 which include:

Safety:
- Making improvements in train accident risk by 10%
- Improvements in level crossing risk by 13%
- Improving lost time injury frequency rates by 54%

Reliability:
- Improvements in delayed trains in 2019/2020 by 12%
- Improvements in delayed trains by the end of CP6 by 28%

Efficiency:
- Incremental efficiency savings between 2019-2024 of £3.5bn

Putting people first:
- Improvements to the numbers of women employed by 50%
- Improvements in occupation related mental health absence by 25%

Environmental impacts:
- Improvements in carbon emissions by 25%
- Improvements in energy consumption by 18%

Gareth discussed how Network Rail maps out their 'Line of sight from risks to solutions' in bow-tie shaped road maps to improve risk management and inform their funding. Gareth talked about the 2020 vision having three main challenges:

Challenge 1 - Safety challenge: Train accident risk reduction.

Challenge 2 - Performance challenge: Trend is that performance is generally falling against increasing traffic.

Challenge 3 - Innovation challenge. Gareth broke this down further into three key points:

Point 1 - There is a challenge to retain and transfer knowledge which can be achieved through academia-industry collaboration.

Point 2 - There is a need to replace inspections on track with desk-study data collection work as much as possible. This data needs to be open and transparent. To avoid the potential negative industry backlash, unions and people who work on site will need to be brought along with them and engaged in discussions. The workforce can use this to gain new skills. The use of drones should be adopted where possible to avoid hazards.

Point 3 - The use of automation for monitoring assets; one version of an asset register is needed. With one version of the truth, knowledge can be transferred more easily and using a BIM set up for this will allow for data alignment and wisdom can be gained. Gareth talked about the use of Digital Twins for training and inspection purposes.

Point 4 - Climate challenge; Gareth mentioned possible issues with climate change including track buckles, snow, gales, flooding, leaves and electrical component failures. He mentioned that Network Rail are drafting their CP7 track asset policy and this features heavily.

AUTHOR

Alison Waterworth CEng MICE

Alison is a Chartered Civil Engineer and Project Manager. With a career spanning over 10 years, Alison has worked in many sectors of the transport industry including structures, highways, airports and railways. She has extensive experience leading largescale multidisciplinary engineering teams through all phases of design and construction; from early strategic business case to handover for operational use. Her most notable projects include the M10 Moscow to St Petersburg Motorway Construction, the Forth Road Bridge Cable Band Bolt Replacement project, HS2 Phase 2B ACI JV, and is currently the Project Manager for Northern Powerhouse Rail Manchester to Sheffield corridor.

Alison is an avid promoter of equality and diversity in the industry; speaking at many high-profile events including the Women in Construction Summit and UK Construction Week. She is also the Mott MacDonald Advancing Gender Champion.

Point 5 - Vehicle related challenge – SET Ltd ActiWheel steered bogies can reduce the weight of a bogie by 2 tonnes and allows for the individual wheels to be steered independently.

Point 6 - Weather resilience:

- Drainage – Test facility can be used for training and system modelling.
- Embankment monitoring; Using track quality data to understand the vertical and lateral movement and to assess the number of false positive readings.

Point 7 - Tools and technology:

- Track decision support tool; Builds a holistic review of track data and plots traces from track recording vehicles. Track maintenance engineers can use this data to predict cycles on the track by wavelength and can make decisions on where to carry out inspections and maintenance.
- ESR/TSR design visualisation tool; Boards can be placed in the software which runs cab driver video footage and conflicts can be highlighted before people go onto site. The software produces images for where markerboards need to be placed.
- Improved rail management technology: CATER ultrasonics / Sperry E-Scan / Rail milling / Induction Welding / FELIX switch profile measurement system / Robel modular grinder.
- Composite materials: The use of composite materials in track can eliminate decay, reduce inspection and maintenance requirements, increase asset and whole lifecycle costs, have non-flammable properties and have the workability and durability of concrete. All beneficial factors.
- Cast crossing additive manufacturing; Benefits include tighter tolerances, eliminates tri-metallic welds, has better performance under degraded track and has increased fracture toughness.
- Discrete defect repair: The use of automatic defect milling and automated weld repairs enables an increase in efficiency, quality and repeatability of repairs. This also means an increase in productivity and removes staff from the track, therefore increasing safety as well.

In summary, Gareth welcomed any help in meeting these challenges and welcomed any ideas which support the ability to manage assets in the future. Let's be progressive! (He suggested).

THE USE OF TECHNOLOGY ON TRANSPORT FOR LONDON (TfL)

ANDREW BRICE, TFL

Andrew opened his talk by announcing that working on TfL is all about "Logistics, logistics, logistics" and suggested the greatest challenge they face is around access and space limitations. There are eight main technologies that assist in driving logistics used on TfL assets. These are:

1. TRACK ADHESION MANAGEMENT (TAM) The TAM project is a three-year funded project aimed at predicting the likelihood of low track adhesion using Predictive Adhesion Management Software (PAMS). This is an in-house software which incorporates live Met Office weather and leaf fall forecast data, as well as internal line-side vegetation, topography and rolling stock characteristics. The benefits of this software include the prevention of excessive occurrence of signals passed at danger (SPADS), station overruns and rolling stock wheel flats.

2. SURELOCK POINT MACHINE PERFORMANCE MONITORING - Another real-time monitoring system developed in-house which provides text alerts to specific maintenance staff and Technical Officers when the system is operating outside the thresholds of calibration data. Each site is independent and processes its own data, avoiding single-point failures in the system and removing the reliance upon people to view and analyse data. Future developments to this software include adding improved filters to detect more failure modes, predicting failures more accurately and avoiding false alerts.

3. LIGHTWEIGHT MODULAR TROLLEYS Due to the limited space inside the Tube, modular trolleys can be broken into parts and are lightweight for easy handling. These trolleys also use lithium battery technology which are much lighter and provide a longer life.

4. Q-RAIL TUNE MASS RAIL DAMPERS TfL are currently trialling Q-Rail tuned mass rail dampers between Kentish Town and Camden Town, which are designed to suppress rolling contact noise and corrugation growth by reducing vibration from the rails. These dampers utilise 14 oscillating masses of different sizes which are free to oscillate in both vertical and lateral directions. This technology is already in use in Hong Kong.

5. DRONES/UAV SURVEYS - Data collection is quicker with the use of drones. They are particularly useful where only short access times are available. There are secondary benefits to engineers with these, as imagery is good, and Ortho photos can be overlaid with CAD. This can remove the need for boots on site.

6. IMU (INERTIAL MEASUREMENT UNIT) DATA COLLECTION - Data such as track curvature, cant and gauging can be collected through using IMUs. An accurate picture of what is in the ground can be built using software such as Truview and Jetstream (point cloud viewers). Time can be minimised on site for inspections as these viewers enable measurements to be taken on screen, rather than on site.

7. MANAGEMENT OF PLATFORM TRAIN INTERFACE - Platform 2 at Baker Street, the "Mind the Gap" platform, is approximately 150 years old. Half the platform is straight, the other half is curved, leaving quite a challenge with the changing gap. Over the years, TfL have introduced bright blue light strips at the edge of the platform, but people on phones don't seem to notice these, so other fail-safe ideas are needed. Active and passive gap fillers are being trialled in the next year which will stroke the edge of the platform and allow the train through. Watch this space…

8. CONCRETE STRENGTH MONITORING Real time monitoring has been trialled as part of the renewal of the crossovers at Paddington on the Bakerloo Line. Nodes were installed through the layout and the concrete temperature and strength was transmitted to the monitoring system as soon as the concrete contacted the nodes. The use of this technology will enable works to commence quicker within the limited timescales available.

Andrew closed with a hint that TfL are also looking into composite materials for their asset renewals.

USING TECHNOLOGY TO REDUCE RISK NICK MILLINGTON, NETWORK RAIL

Nick explained that in the last 13 periods, Network Rail reported 58 near misses involving 158 track workers and 146 operational close calls involving 584 track workers. The riskiest times are between midnight and 11am, with Sundays and Wednesdays seeing higher numbers of near misses. Nick stated that it is better to work with facts rather than anecdotes. He said we should "Delete anecdotes; remove risk." Referring to the Margam incident, Network Rail has responded by setting the following three key goals:

1. ELIMINATE UNASSISTED LOOKOUT WORKING - There has been a 30% reduction in unassisted lookout working since July 2019. Various technologies are being used to replace track visits including the Eddy Current Tool, Plain Line Pattern Recognition and Remote Condition Monitoring. The aim is to reduce the maintenance standard task reviews to zero by July 2022.

2. 100% ADDITIONAL PROTECTION FOR TRACK WORKS - Additional protection measures are being introduced in line blockages. Nick is a firm believer in "What gets measured, gets managed", so he is keen to ensure statistics are accurate and they are building a largescale data set. Up to 25,000 line blockages are taken per period on average

and at Period 11, 17% of these have additional protection. Period 12 had 23%. These protection measures include focussing on the use of TOWS (train operating warning systems) and SATWaS (satellite-based warning system), as well as LEWIS, RDD (reference document database), ZKL TCOD (track circuit operating device undergoing an accelerated roll out) and EPR (engineering possession reminder).

3. ALIGNING WORK TASKS INTO SAFER ACCESS - Each year there are approximately 28 million maintenance tasks carried out by Network Rail, approximately 15,000 per week. Nick says there simply aren't enough line blockages being used and welcomes ideas from the audience and the industry to put forward any ideas to improve on this. Nick doesn't pretend to understand the theory behind the algorithms he says can map align tasks to safe work access, but it is something Network Rail are looking into for cyclical maintenance tasks and possession planning.

Nick suggested Network Rail are looking to refresh their safety standards as the feedback from the front line is that the standards are no longer fit for purpose. In the spirit of welcoming everyone's ideas they are making it easy to do this online or in paper form and this challenge runs to the end of April 2020. Participants will be recognised with personal notes and certificates for those whose ideas are implemented. All ideas welcome…

ASSET MANAGEMENT FOR CONTINUOUS ASSETS DAVID CHUBB, NETWORK RAIL

David opened his presentation by defining asset management as working out what asset is needed to allow the organisation to fulfil its role, then working out the most efficient way to keep that asset working and when that asset can be disposed of. This is a very complex prioritisation exercise when you have many assets. A continuous asset is an asset that can be drawn as a line over a geospatial area. Examples include track, overhead line equipment and cable troughing.

TRACE allows us to illustrate the current track performance by splitting the continuous asset (track) into many discrete assets. Subsequent traces can be added to monitor the performance over a longer period. Turning the trace graph onto its side creates a P to F curve which indicates the performance of the asset over time. If the curve is known, a risk appetite can be applied; this appetite depends on the level of risk willing to be accepted. With this knowledge, maintenance activities can be planned over long/short/medium terms of time. The problem faced is that each discrete asset would need to be analysed individually to create this maintenance schedule, but luckily the Euler-Bernoulli model can help! This is where machine learning comes into play.

Provided with enough data, a computer can learn how to link data points together and by creating patterns, it can begin to predict what will happen next. This can be done at a much quicker rate than a human using P to F curves. At present, this technology isn't fully developed but David suggested that soon machines will be able to predict multiple metrics data such as dip angles and side wear. This technology will allow for proactive planning, as opposed to the current reactive planning situation we have in the industry.

NEW SURVEY TECHNOLOGY FOR SKELMERSDALE STEVE COOPER, NETWORK RAIL & ROLLO RIGBY, SEVERN PARTNERSHIP

To start the presentation, Steve reminded the audience that there is a Network Rail surveying standard (NR/L2/TRK/3100) and a project survey strategy should be created by the project manager prior to the commencement of work.

A brief history of Skelmersdale tells us that the old Skelmersdale station was axed in 1956 when the local populace was less than 7000. Today current population is more than 40,000 people and the public transport available takes two hours to get to Liverpool and Manchester and one hour to Wigan. Skelmersdale is the largest urban conurbation in the UK not served by a direct rail connection.

Using Snake Grid and LIDAR, 15 km of pway survey and 14 km of highway survey was able to be captured. Following the motto: "Survey once, use many times", the survey data is linked back to the Permanent Survey Control Network, ensuring the data can be used in the future for other schemes. Using these technologies to survey, Severn Partnership were able to reduce boots on the ground by 70-90%, their workforce has diversified, quality of data has increased, and the skill sets of staff members have been retained.

Steve closed by saying that "The power of survey data is getting it into everyone's hands" as he hopes this technology will become the norm for surveying.

INLINE EXCAVATION & MATERIALS HANDLING SYSTEM – WHO NEEDS RAILS? CARL GARRUD, RHOMBERG SERSA

Carl described the unique inline excavation and materials handling system which consists of three types of machine and is made up of six machines in total. Together the machines form a group capable of single line excavation but are also capable of delivering several other solutions either singularly or in combination with other machines. The three machine types are:

ITC BL4 ROAD RAIL EXCAVATOR - Used to rapidly excavate bottom ballast on S&C and plain line renewal projects. The inline conveyor system allows material to be fed through the main body onto the rear conveyor system. This rear conveyor can feed the spent ballast into wagons on an adjacent line or into an MFS+ directly behind. The machine features a W6A Gauge, dust suppression system, delivered by road transport, excavation rate 100 to 130m(^3)p/h.

UMH (UNIVERSAL MATERIALS HANDLING) The UMH are materials handling wagons that can receive materials from either MFS+ or MFS and distribute the material via a series of conveyors. The UMH can also distribute materials to other machines, open wagons or directly onto the infrastructure. The machine features a maximum distribution rate of 400m^3/hr, a maximum skew of 90 degrees left or right, and a distribution of 7 m. With the lower conveyor in the central position, ballast can be directed to the ballast boxes which distribute ballast either side of each rail simultaneously.

MFS+ MATERIAL REMOVAL - MFS+ are tracked MFS capable of travelling by rail but able to move into crawler mode to access the dig area. When in the materials removal mode, two MFS+ work behind the ITC. The first acting as a silo while the second acts as a materials transporter, taking the excavated material back to the MFS rail mounted wagons at the start of the excavation. By reversing the working direction, the MFS+ can receive materials from the rail mounted MFS wagons. As in the removal process, one MFS+ acts as a transfer wagon from the rail mounted MFS, while the other MFS+ acts as a silo and a materials distribution machine.

With these machines, the whole system provides excellent versatility likened to a Swiss army knife. Carl says operators are matched to each individual machine and as part of their service, dedicated planning engineers are integrated with the client to ensure the long-term planning and optimisation of the logistics.

MANCHESTER METROLINK TRAFFORD PARK LINE TOM LIGHTFOOT, MOTT MACDONALD

Tom opened his talk with an explanation of the Trafford Park Line; a 5.5 km new light rail scheme within Trafford Park, extending from Pomona Junction to the Trafford Centre. Tom provided the key details for the following four stops:

POMONA STOP - Part of the phase 3 works was to extend the existing viaduct by 200 m to bring the track alignment down to Wharfside. The works also involved replacing the existing 40 m plain line curves out to Eccles with a bespoke double junction.

WHARFSIDE STOP - This section runs adjacent to the Manchester Ship Canal. There is a total of 15 structures required to get the alignment from Pomona to Imperial War Museum.

PARKWAY STOP - The original plan was to remove the roundabout and replace with a series of junctions, however a value engineering opportunity allowed for retaining as much of the highways as possible.

TRAFFORD CENTRE STOP - The alignment finishes with a terminus island platform, with two crossovers to allow access and egress to either platform. The alignment has been future proofed for potential future extensions towards Port Salford.

The purpose of the project was to stimulate regeneration and economic growth in the area, linking people to jobs and providing viable alternatives to car travel. The business case required a journey time of 15 minutes and through various alignment tweaks in the concept design stages, this was able to be met and improved upon; providing a journey time of just under 14 minutes.

BIM Level 2 requirements meant the use of a common data environment (ProjectWise) and a federated model (Navisworks). For BIM Level 2 compliance, asset tags were needed to be assigned and matched to the work breakdown structure. Clashes were detected within Navisworks. Looking to the future, Tom suggested further development of asset tags could be used for construction and operation. Working towards BIM Level 3 would require all disciplines to work in the same live model; something that might bring one out in cold sweats for now.

IMPACT OF THE APPLICATION OF EXCEPTIONAL TRACK DESIGN RULES ON RIDE COMFORT AND TRACK FORCES

PAUL ALLEN, UNIVERSITY OF HUDDERSFIELD

Paul opened with an explanation that the findings from a literature review of the comfort threshold for passengers showed that the values varied quite widely and were very subjective. He concluded from this research that he would approach his work using the existing railway as a benchmark for comfort levels relative to a Class 185 ride trial.

Paul carried out ride trials between Manchester Victoria (MCV) and York (YRK) (return) on 29th July 2019. The vehicles and configuration were Class 185 3 cars sets (185142 and 185122) on the Down Line (MCV-YRK) over lead bogie, centre unit of 3-car set, and on the Up Line (YRK-MCV) between bogies, centre unit of 3-car set. The instrumentation used were:

- Accelerations measured in three axes
- Measured at table seats (on table) at the positions described above
- GPS receiver equipment fitted but no signal within carriages!
- Locations (stations, junctions) marked using event marker button
- Perceived ride quality recorded using event market button
- Rising severity Index of 1, 1.5 and 2 adopted

Measurements taken were:

- Mean ride comfort over a 5-minute window
- Continuous comfort over a 5-second window
- Discrete events (both standing and seated passengers), over a 2-second window
- Jerk – lateral jerk between 0.5 to 2 m/s^3
- Test engineer – perceived ride index – the “Allen” Index.

VAMPIRE vehicle dynamics simulations, combined with several ride assessment methods (EN 12299 and others), were used to predict the likely ride comfort on the proposed alignment design (focused on lateral ride comfort). The results were:

- Increased design cant gradients resulted in slightly higher peak Jerk rates in transitions, but this did not significantly degrade passenger comfort
- Increased steady-state lateral accelerations (cant deficiency) were not predicted to significantly degrade passenger comfort
- Due to increased speeds in curves, the proposed Exceptional values negatively impacted ride comfort where lateral track alignment (irregularities) were poor
- Increases in track shifting and peak rail forces were predicted as a result of the Exceptional values
- Derailment indices were not significantly affected
- Lateral jerk values greater than 0.8 – 0.9 m/s3 are likely to reduce perceived passenger ride comfort

Paul’s recommendations for better passenger comfort levels included constructing trackbed formation to a high standard when applying exceptional cant, a lateral track alignment maintenance limit value of 16 mm and reducing the effects of track shifting and peak rail forces. All help to maintain acceptable ride quality.

S&C LASER PROFILE MEASURING SYSTEM

PHIL WINSHIP, NETWORK RAIL

Phil introduced the seminar delegates to the Loccioni Felix; a laser profile measuring machine that carries out S&C gauge and geometry measurements, rail profile measurements and assessment of switch rail wheel contact angles. Felix provides consistently accurate and repeatable measurements; removing the human factor issues present in manual gauging and produces these measurements at a much higher rate than a person can and at intervals of 2 mm. This means better and more accurate data.

Trials have been carried out on the machine in order to confirm compliance with RIS 1350PLT for product acceptance. The machine also had to be programmed for S&C designs on Network Rail infrastructure as it was made for the Italian infrastructure originally. 35 different switch types have been programmed for identification and recording, covering approximately 80% of S&C installed on the network.

To confirm the accuracy of the readings, the Felix results for P8 profile measurements were compared with Mini Prof readings and the results showed the results were very similar, but Felix’s results were more accurate – to more decimal places. This comparison was necessary in order to obtain the necessary Engineering Certificate of Conformity to enable it to be used on Network Rail’s infrastructure. There are still further steps to take for full acceptance of the equipment, including an ergonomic assessment and calibration testing, as well as carrying out a common safety method – risk assessment for introducing the system. Watch this space…

OBJECT DETECTION AT LEVEL CROSSINGS USING DEEP LEARNING

MUHAMMAD A B FAYYAZ, MANCHESTER METROPOLITAN UNIVERSITY

Muhammad introduced his topic by suggesting that the safest type of level crossing is to not have a level crossing. In the year 2018/2019 there were 73 near misses with vehicles and 308 near misses with non-vehicle users at level crossings in the UK. Statistics show that there is an average of 6.4 fatalities each year in the UK at level crossings. Even the RSSB states: “Level crossings provide communities with a convenient way to cross the railway but do represent a risk to the people and vehicle occupants that use them, and to the railway itself”. CCTV and radar are in operation at most level crossings, suggesting that large scale data collection could provide the necessary information for ‘deep learning’. Deep learning takes artificial intelligence and machine learning one step further; it is the automatic learning and categorising of objects. Using CCTV and radar from level crossings, an analysis of which category of level crossing user is most at threat can be identified, and how the level crossing could be redesigned to address this. The software could also provide details on how efficiently the barriers are working depending on how long they take to open/close.

Muhammad summarised with further applications for deep learning software, including platform risk analysis (crosslines near trains' doors), categorising users (passengers with bags or bicycles), and even the potential for analysing suspicious behaviour.

WHICH LOAD MODEL DO WE USE FOR RAIL TRACK DESIGN?

DR ELISABETTA PISTONE, VIENNA CONSULTING

Elisabetta opened her presentation with three possible analysis options for track designers. These are:

1. MULTI-BODY DYNAMIC SIMULATION
Currently the most accurate method which allows designers an element of reliability. The disadvantage to this analysis method are that stiffness, damping and mass information is not always available and creates challenging dynamics. This relies heavily on the experience of engineers to produce a solution.

2. DYNAMIC MOVING LOAD ANALYSIS
Simple and accurate with a relatively short computation with no vehicle-track interaction and no irregularities. The disadvantage is that the software requires a dynamic moving load module and a simplified reliability-analysis.

3. STATIC MOVING LOAD ANALYSIS -
Relatively simple and accurate, this analysis uses a spectrum of static to dynamic conversion factors, requires a short computation and no vehicle-track interaction and no irregularities. Elisabetta questioned whether reliability-analysis makes sense with static analysis.

Other considerations in track design are:

THE INFLUENCE OF TRACK IRREGULARITIES - The variations in track quality and statics and variation in velocity and irregularity.

DYNAMIC AMPLIFICATION FACTOR AND INFLUENCE OF SOIL MODELS - Weighted and normal dynamic amplification factors to be considered. Elisabetta asked "Is the Winkler model an accurate representation of the semi-infinite elastic half space?". Before discussing the Fourier Transformation, taking account of the approximation of the frequency dependent soil properties, the Rayleigh wave propagation and the degrees-of-freedom for dynamic analysis.

Elisabetta provided a comparison to the "Extended-Winkler" model with recorded data for ICE2 at v = 160 km/h in similar situations such as weight and geometry.

The measurements were conducted on a section of the high-speed tracks between Erfurt-Leipzig in 2014 by FCP in the context of the project entitled 'VDE 8.2, New Line Erfurt-Leipzig / Halle' (a part of the new German high-speed track network).

The results produced a good match with CEN/TR17320: "Railway applications - infrastructure - determination of laboratory test parameters for assessing the mechanical durability of rail fastening systems - complementary element" and with prEN/13230-6: "Railway applications - track - concrete sleepers and bearers - part 6: design"

Elisabetta proposed a novel procedure for designing rail tracks on earthworks using the following:

1. Classification of train (new/old HS train, commuter train, freight train)
2. Classify soil using EV2
3. Get expected top speed
4. Estimate velocity dependent dynamic amplification factor from diagram
5. Assign modified LM71 to your model
6. Perform static analysis

Her future research activities will investigate topics such as the quantification of vehicle irregularities on track response, sophisticated multi-body-dynamic simulation to simulate rolling contact, application to lateral/longitudinal direction and curved sections, stochastic simulation and sensitivity analysis using extended Winkler model, and harmonisation with en1990.

NEW AND FUTURE ROLLING STOCK

GILES PETTIT, ARUP

Giles opened with descriptions of various damages to wheels/rail interfaces including rolling contact fatigue due to primary yaw stiffness, vertical fractures due to speed and unsprung mass, gauge side wear due to long or stiff wheelbases, top wear due to poor curving ability and general wear and tear due to gross tonnage. Giles suggested Network Rail are looking into ways to improve rolling stock performance by producing the train infrastructure interface specification (TIIS). These requirements have been incorporated into the train technical specification for HS2.

Giles suggested the specifications are a means to charge train companies for damaging the infrastructure network. Technologies responding to the track-damage incentives include the following:

INSIDE-FRAME BOGIES - These can reduce the overall and unsprung mass.

'HALL' BUSHES - These have hydraulic cavities which ease low frequency movements and stiffen in response to high frequencies. These are becoming regularly specified for new assets, as well as being retrofitted on mid-life fleets.

MATERIALS - Composites are being explored for primary structures as they are lightweight and good on mass and have better maintainability (in theory). The costs of these are still high today.

MECHATRONICS - There are variable primary springs, variable rate dampers and actuators in place of dampers available.

STEERING, WHEEL DE-COUPLING - Passive steering mechanisms are in use, active steering ones may be introduced which would allow for independent power and rotation of the wheels. These are likely to become mainstream in the next 10 years.

Other things Giles suggested will be looked at for future rolling stock will include the way trains will be powered; electrified infrastructure, battery hybrids and fuel-cell hybrids. As part of the de-carbonisation implications, full electrification might stretch beyond 2050 which means the UK fleets may need to utilise a mix of power. Batteries are good for short off-wire journeys, fuel-cells are good for longer off-wire journeys but don't cater for speed or mass. Mass increases are inevitable with the non-electrified options due to the continued increase in demand.

Giles closed the end of the presentation with the following statement by Mark Kermode: "It will be alright in the end, and if it's not alright, it's not the end!"

SUMMARY

The coming years will bring a big challenge for the railway. With increasing demand and future growth in travel on the network, the question will be "How can we fit it all in?". Backward compatibility will be key to meeting capacity needs; retrofitting new technology to an old network and utilising new materials and technologies to capitalise on space whilst minimising maintenance activities. As the modal shift moves towards railway, and with HS2 and Northern Powerhouse projects bringing economic growth to the North, there are exciting times ahead. One key message from the presentations was that safety is paramount, and we should not be complacent – if we can do something better, we absolutely should!

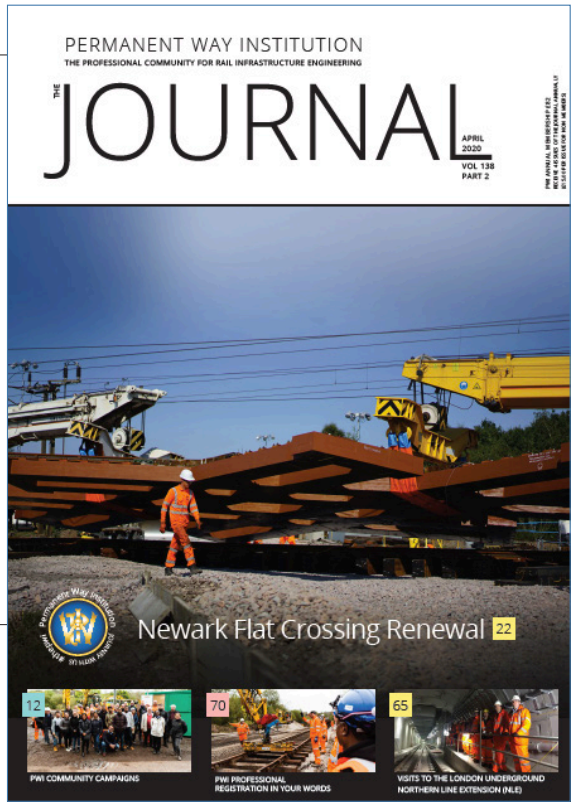

TECHNICAL ARTICLE

AS PUBLISHED IN

The PWI Journal

April 2020

VOLUME 138 PART 2



#thepwi

W thepwi.org

PermanentWayInstitution

@PermWayInstit

Permanent Way Institution

@the_pwi

If you would like to reproduce this article, please contact:

Kerrie Illsley
JOURNAL PRODUCTION EDITOR
Permanent Way Institution
kerrie.illsley@thepwi.org