RISSB
RAIL INDUSTRY SAFETY AND STANDARDS BOARD

FASTRACK

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INSIDE THIS ISSUE – WHAT IS SHAPING THE RAIL INDUSTRY TODAY AND INTO THE FUTURE

Condition assessment of Stone Arch Masonry Bridges in Regional Victoria using Drones

Angela Qiu – V/Line

Drone or Remotely Piloted Aircraft (RPA) commonly known as drones have the potential in undertaking visual inspections with high accuracy and are gradually being introduced to inspection regimes. V/Line introduced the trial of Drone or Remotely piloted Aircraft (RPRSs) to investigate whether this method of inspection would satisfy V/Line detailed inspection standards. This was initiated due to the level of access difficulties around the bridge. The drone inspection captures high-resolution (<0.5cm/pixels) images on all faces of the structures including the underside and captured them into a 3D model. The data is then delivered in the inSite Platform Portal shown below. The accurate 3D model of the structures can also enable inspection and measurements.

A drain trial was completed on one of our arch bridges located in Carlsruhe, the bridge is a 3-span arch bridge of up to 15 m constructed in circa the 1860s spanning across Campaspe River, supporting two tracks on the North line. The traditional method of inspection includes Elevated work platforms and scaffolding, and with the introduction of drones, it could be potentially used for visual inspection and on a case-by-case basis such as bridges over large waterways. The engineering team found that although it provided a great overview of the structures, it still does not satisfy the level of detail compared to the 'touch and see' distance or level 3 bridge inspection. As a result, the use of drones can only be used dependent on access and can be accepted as a pre-inspection method. The typical defects identified such as dropped blue stone arch units, cracking and spalling at the stone units, wall distortion and accumulations of salt deposits, and stalactite formation can be shown using drone inspection on-site and pictures imagery through the InSite Platform Portal. However, the extent of the defects will need to be re-assessed by a level 3 inspection to ensure the inspection covers the condition of all components.

Supporting Maintainable Design with 3D Models and Maintenance Scenarios

Nicholas Faleide Lester – Frazer-Nash Consultancy

Why care about Maintainability?

Maintainers are often the only people who regularly directly interact with Rail Assets across the O&M lifecycle, from commissioning to disposal. Systems designed with poor maintainability can lead to negative effects such as inefficient maintenance, operational service delays, degrade safety, and a frustrated workforce, all of which increase costs and often persist for the life of asset, which can be multiple decades.

Improving Maintainer feedback in the Design Process

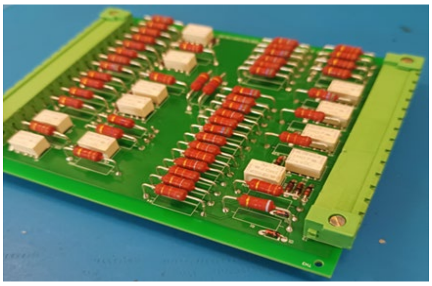
Typically, maintainer feedback is often sought in the design process through the attendance of experienced Maintenance representatives in SiD workshops or similar forums. Such an approach can work well in projects in which the maintainers are already highly familiar with the equipment and/or the maintenance environment (e.g. brownfield line upgrades). However, their input is not as easily leveraged when new environments and/or systems are implemented e.g. automatic train control, a new tunnel, new rolling stock etc.

A Solution

The use of 3D models (e.g. BIM), combined with a conceptual understanding of new Maintenance Scenarios (e.g. how do we access and maintain a novel asset in a tunnel cross passage?), can greatly assist in the facilitation of “Maintainability in Design” workshops. Such an approach allows for maintainers to virtually step through each step in a maintenance scenario to facilitate the identification of potential issues. Ideally, this is undertaken as early in the project as possible to allow for any issues to be “designed out”. A federated 3D model can provide invaluable insight to understand maintenance access pathways and logistical considerations, impacts of exclusion zones, restrictions in using plant and equipment such as elevated work platforms or manual handling equipment, as well as potential equipment clashes or obstructions that may lead to the requirement to disassemble surrounding systems in order to gain access to the target item. Additional benefits can be realised outside of the design directly, with such analysis potential providing evidence to support Safety, HF and RAM assurance arguments.

In-House Rapid Prototyping of Circuit Boards for Rolling Stock

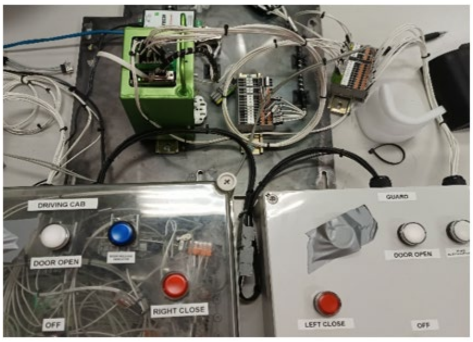
Alex Hart – Queensland Rail



Circuit boards are used in nearly all systems on rolling stock to serve a variety of functions. Circuit boards may serve safety critical purposes, such as passenger door control and driver vigilance systems; or they may be used to indicate toilet occupancy. As newer, more modern rolling stock is brought to the market, these vehicles are consistently delivered with more and more circuit boards, making them fundamental to the safety, reliability and usability of the asset.

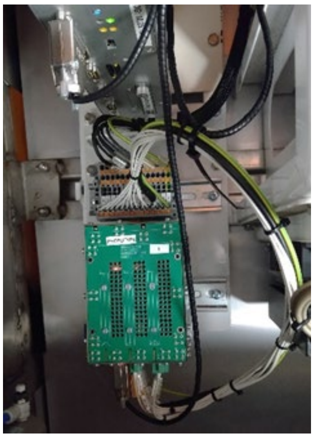
At Queensland Rail, the Electrical Design Rollingstock Engineering team is working to bring the ownership of these circuit board designs in-house so that aging, OEM unsupported rolling stock can safely and economically remain in service. The following points expand on the motivations for why this team has decided to move away from purchasing third party electronics and move towards in-house design.

Higher Maintainability:
Regardless of device reliability on paper, all electronics will fail, and this often means very large OEM bills for repairs and redesigned replacements. In-house design means that all of the intellectual property is readily available for maintenance staff to troubleshoot and rework electronics as necessary to keep older fleets running at minimal costs.



Higher Compatibility:
Purchasing an off-the-shelf device will always be cheap and quick but will likely not result in an optimal component being installed on rolling stock. Going through an OEM for a custom design will be costly and require detailed contracts and management effort to ensure delivery of an acceptable product. In-house design delivers solutions that are specifically designed to fit the purpose of the installation environment.

Higher Confidence: Taking ownership of electronics allows operators to gather feedback at all stages of a rollout and address issues as they arrive. Bench testing, single-unit testing, and fleet wide installation can all be used as points to step back and improve the product as needed. When issues occur with third party equipment, feedback is rarely given to OEMs and is even more rarely applied to improve the overall solution.



What about the costs? A common concern with performing in-house design is the financial investment, particularly in terms of engineering hours. While the initial overhead of in-house design tends to be comparable to simply purchasing third party products; the true cost savings come through over the lifetime of the product. The above three points illustrate that in-house design will deliver more reliable products, and when these devices do fail, maintainability is significantly enhanced.

How is this being done safely? The Rollingstock Engineering Electrical Design department has developed a design control process to ensure the reliability, accessibility, maintainability and safety of all prototypes and products. This third-party verified process ensures that all solutions consistently meet each of the requirements set forth by stakeholders as well all relevant clauses from Australian and International standards. The advantages of in-house circuit board design are numerous and undeniable, and quite often all it can take is for a company or department to rise to the challenge and embrace the technical expertise of its own staff.

Digital Human Modelling

Guy Johnston - SYSTRA

What is DHM?

Digital Human Modelling (DHM) is a tool for simulating human interaction with a product or system within a virtual environment. It enables designers and human factors professionals to evaluate designs using anthropometrically and biomechanically accurate avatars. SYSTRA utilises industry leading Santos modelling software to facilitate DHM assessments.

Key benefits of DHM

DHM largely replaces the traditional methods of building physical models and then developing a design through a trial and error process, which can be time consuming and expensive. Another limitation is the sizes and shapes of the participants available to us. In contrast, when working with DHM in a virtual model, design changes can be made and their impact assessed within a matter of minutes. Human body dimensions can be scaled individually to accurately represent the extreme users in the target population. Nothing is left to chance as it is possible to comprehensively demonstrate the suitability of a design for all its intended users. One of the key benefits of DHM is this can all be done in the early design stages, which significantly reduces the cost of any design changes.

Using DHM

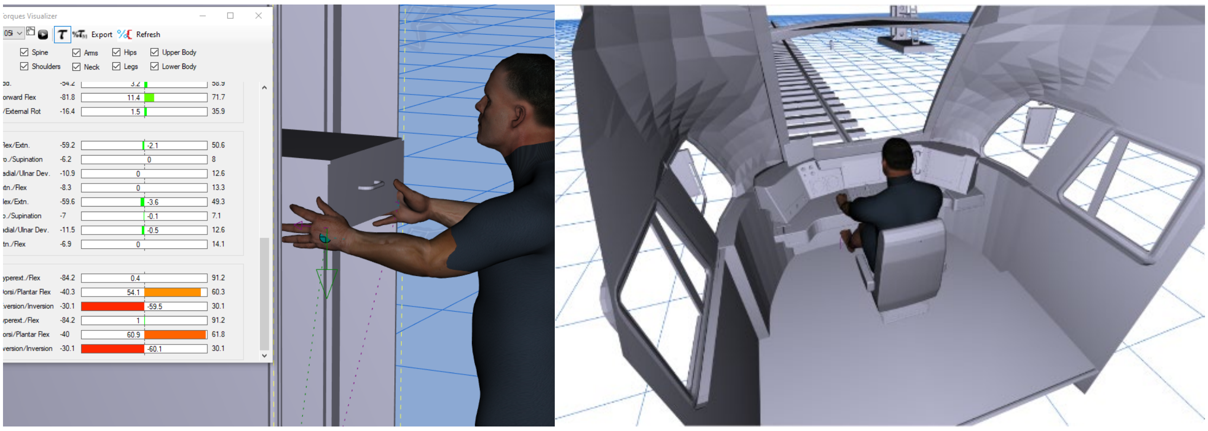
Following Early Human Factors Analysis and creation of the physical environment, we are able to adapt the human models to represent the target population and fit these models into the environment. Here we can test how a user might interact with different equipment, for example reach to a screen, viewing angles, adjustability of equipment and suitability of placement.

This can be tested by establishing model constraints between the digital human and simulated environment (e.g. left hand holding brake lever and eyes focusing on the track ahead). Once these constraints have been established you can adjust the model geometry and the digital human will automatically adopt the resultant posture.

Analysis tools, such as the joint range of motion tool, are automatically updated with each movement to allow real time ergonomic assessment of design solutions.

This process of iteration and evaluation within virtual environment allows us to explore a wide range of design solutions. We can quickly identify the optimum solution and provide robust assurance evidence to support the design.

Please contact Guy Johnston (gjohnston@systra.com) if you would like to know more.



A wayside Top of Rail friction control solution for high density tram operations

Leah Bygraves – Keolis Downer (Yarra Trams)

The Yarra Trams network, operated by Keolis Downer, is the world's largest operational tram network with over 250km of double track. The St Kilda Road corridor is the busiest corridor in the world, with headways of around one minute in peak hour and operates a mixed fleet. It is estimated that approximately 200,000 passengers travel along this corridor each day.

The future introduction of the Metro Tunnel and Anzac train station in the Domain precinct is intended to assist in mitigating the congestion along this tram corridor. The staged construction of the new underground station has resulted in disruption and changes to the tram corridor. An initial temporary realignment of the central reserved tram track as well as traffic and bicycle lanes took place in April 2018. This included installation of over 800 metres of track including turnouts, crossover and diamond crossing infrastructure as well as the installation of new tram poles, overhead fittings and wires and construction of a new tram platform stop. The alignment comprised of several curves, including 22 metres at Park Street and a shallower curve of 90 metres on the mainline section of St Kilda Road. This resulted in a reduced design speed of 25km/hr (previously 60km/hr). A second realignment followed in October 2019, with the final arrangement due to be completed in late 2022.

The track structure uses Ri57A grooved rail fastened using Pandrol E-clips on dual block concrete sleepers laid at standard gauge (1435mm). This is embedded in a special 50MPa tramway concrete slab foundation with compacted crushed rock and bitumen surface

Problem Statement
Following the completion of the new track alignment in April 2018, residents adjacent to the corridor provided feedback regarding an atypical, prominent high pitch wheel squeal. This was predominantly occurring on the longer, shallower curves along St Kilda Road in both the inbound and outbound directions with no correlation to a specific tram type or number. The typical sections of track where the wheel squeal occurred are highlighted in orange.

Solution
Following trials of several possible remediation measures, a top of rail (TOR) friction control technology was chosen to reduce the noise from wheel-rail surface roughness and wheel flanging. The technology had been successfully deployed on several transit networks globally but had never been used in Australia. The friction control product, LB Foster's KELTRACK® Trackside Transit (KTT) product used for this project reduces stick-slip oscillations by allowing low rail wheels to roll more freely thereby producing notable reductions in high-frequency wheel squeal noise.

Due to the unique operating, environmental and safety conditions of the St Kilda Road corridor, an appropriate distribution system solution was developed for the section.

Key considerations were as follows:

i. The reverse curve section targeted for both the Inbound and Outbound tracks required use of a wayside distribution system versus more complex and expensive vehicle-mounted TOR application solutions typically used to achieve broader network coverage extent.

ii. The high road vehicle, bicycle, and pedestrian traffic densities present in the St. Kilda Road area mandated the need for a non-obtrusive, effectively sized trackside system that would safely and aesthetically blend into the neighbouring environment.

iii. The existing embedded design of the track structure in this area (bitumen and crushed rock-concrete slab track structure) required use of TOR FM distribution hardware that could similarly be embedded to maintain track structure design integrity.

iv. The proposed system must be low maintenance to minimize the number of site visits required to service the equipment in the noted high traffic density operating corridor.

v. The equipment design must contain consistent and precise application rate controllability to ensure zero impacts to tram braking and tractive effort.

A LB Foster PROTECTOR© IV (PIV) DC solar-electric TOR unit was selected as the basis for the solution, including a 95-litre tank, TOR distribution bars (installed on the rail), tram sensors and a digital control box, with a specialised enclosure developed in consideration of the targeted embedded track operating environment. This enclosure also allows for access for inspection and maintenance.

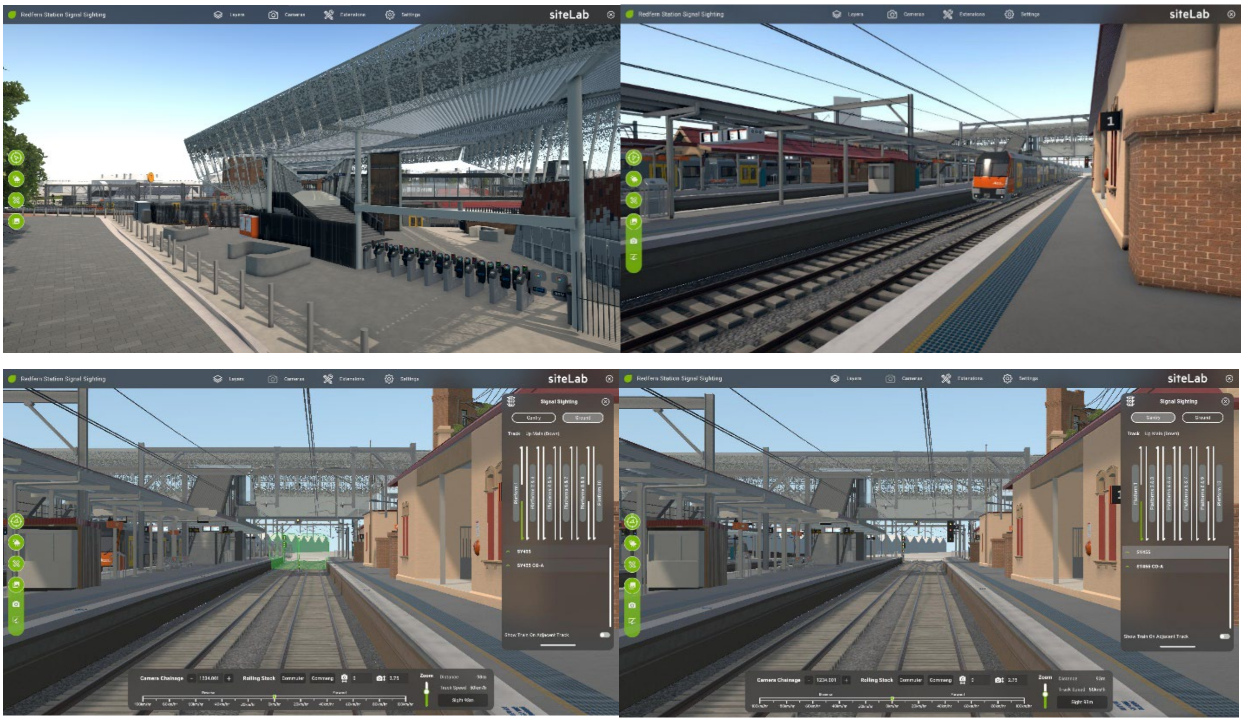
The finished track TOR applicator site shown below demonstrates the seamless integration of this equipment solution into the tram operating environment. The incorporated LB Foster embedded track design was an applied variation of an existing wayside gauge face (GF) design previously incorporated for other transit railway customers globally. The automated system allows for the ongoing application of the friction modifier solution from the distribution bars as trams pass through the corridor. The tank is regularly monitored and topped up with the friction modifier solution as required.

Noise reduction results for frequencies associated with tram squeals during pre-mitigation (i.e. non-TOR) FM noise monitoring (3150 and 5000Hz) have been reduced by 11-18.5dB, representing an approximate 50% reduction in subjectively perceived noise loudness existing prior to TOR incorporation. In addition, feedback received from area residents has been mostly positive.

Digital Design Tools for Immersive Optioneering & Signal Sighting

Bevan Lee - Aurecon

Aurecon's siteLab platform has recently been used to showcase and simulate a fully interactive digital twin of the historic Redfern Station. Using precise survey information and architectural concept designs the model was brought to life using siteLab to visualise the impact of a proposed new footbridge at the southern end of the station. The dynamic model was used throughout the design phase to rapidly visualise, and prototype solutions to various project challenges, from trialling early bridge concepts through to optioneering of functional design decisions.



The platform, built on a software framework leveraging mature 3D modelling technologies popularised by the video gaming industry, allows for a real time interactive experience and can be VR enabled at a flick of a switch. Designed to be extensible and adaptable for a wide range of client use-cases, the platform enables the experience to be tailed for any project-specific visualisation requirements with relative ease.

For the Redfern Station project, siteLab enabled bespoke functions to provide valuable insights when optioneering and to utilise the dynamic model for Signal Sighting exercises. When used as a Signal Sighting tool, designers could visualise and check each signal for issues arising from the new bridge structure, as well as temporary structures such as construction hoardings. Identified issues could then have their proposed solutions rapidly prototyped and considered in the full context of the model, ensuring that all options were considered, and the most optimal outcome ultimately achieved.

The visualisation platform also allowed the design team to virtually drive each of the routes passing through Redfern Station and sight each signal as it would appear at each distinct phase of construction, all from the safety of the office – insights that are simply not possible when undertaking signal sighting the traditional way on-site. Thanks to the dynamic accuracy of the model, designers and stakeholders could even see exactly what the drivers would see approaching each of the signals at line speed or otherwise.

Duratrack Recycled Railway Sleepers

Karl Smith – V/Line

What are Recycled Sleepers?

Duraktrack Recycled Railway Sleepers are an Australian first sustainable railway sleeper that can be used as a direct replacement for traditional wooden sleepers. The sleepers are a compatible size and profile with timber and use the same equipment to drill and fasten as well as machinery for transportation and placement. The sleepers are UV, fungal, termite, fire and rot resistant. They last up to 50 years, which is a significant improvement over timber life of 15 years, and use less energy than concrete sleepers to produce.

The product uses material that would otherwise end up in landfill and reduces the amount of natural hardwood timber required to be felled.

The sleepers are made in Mildura from a mix of life expired rigid and flexible plastics and polystyrene products from local agriculture use such as pipes, drums, agricultural films and nets, and produce boxes.

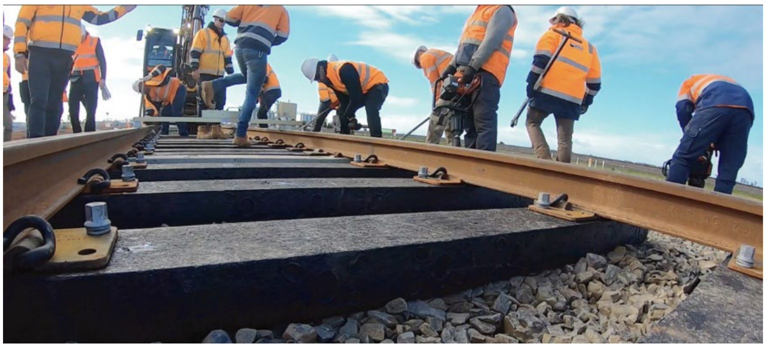
Key benefits of Recycled Sleepers

- Sustainable reuse of waste materials. (90 tonnes of waste reused per kilometre of standard gauge track).
- Longer life and lower maintenance.
- Tested by the Institute of Railway Technology at Monash University.
- Reduction in production energy used.
- Encourages a circular economy where a company making plastics can accept their products back at end of life and reuse.
- Sustainability credits towards IS rating.

Using Recycled Sleepers

As mentioned previously, Duratrack Sleepers can be used directly to replace existing timber sleepers during routine re-sleepering or installed on new track with the same tools and machines used for timber sleepers.

Duratrack sleepers have been given type approval by both Metro and V/Line after successful trials at Wyndham Vale stabling yard and Richmond Station Platform 3. There is currently a 12–18-month trial being undertaken on the Queensland Rail mainline between Chinchilla and Miles in the Western Downes region. Duratrack Sleepers were also used at the V/Line Waurn Ponds stabling facility which delivered significant credit towards the required project IS score.



Article and photo source and for more information please see http://www.integratedrecycling.com.au/railway-sleepers/

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