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RAIL INDUSTRY SAFETY AND STANDARDS BOARD

FASTTRACK

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

Rail Engineering and the Climate Crisis

Author: Lucie Austen

The design process is rarely linear, and even less so on complex, multifaceted projects such as rail transportation systems which are large in scale, have a wide range of stakeholders, and are typically developed over a number of years. Due to many factors, the initial design concepts of such systems can look quite different to the final product, as the concepts slowly manifest into the physical solution, moulded by the driving forces of client requirements, national standards, legislation, capability and availability of technological solutions, as well as the changing physical environment and community expectations. These last two factors are becoming increasingly critical as the rapidly changing climate brings a heightened anxiety within the community and presents new challenges to adaptability and resilience of systems. Rail networks in Australia are far-reaching and in near-constant operation, thus they have immense capacity to drive positive action in the area of climate change. How, then, should our current-day design process respond to these challenges?

As with most complex problems, it is essential to first define the problem, then identify the objectives and explore possible solutions.

Although the rail industry faces other significant challenges such as population growth and the current pandemic crisis, this article limits its scope to the problem of climate change; more specifically, rail design's vulnerability to and contribution to climate change. The associated demands on current-day engineering and design are two-fold. Systems must now seek to be more resilient and adaptable to changing weather conditions, but also to minimise their environmental footprint, not only in terms of direct pollution but also in terms of further disruption to natural ecosystems such as river systems, forests, and other natural habitats. Fortunately, the issue of resilience to severe weather conditions should be captured and addressed by the Safety Engineering model

employed in rail systems engineering and the general commercial drive to minimise maintenance costs from system failures. For the issue of minimising environmental footprint, however, there may be many ways to tackle this, for example: increased engagement with the community at the concept design phase of a project; increased funding allocated to research and development of new technologies; or promotion of transdisciplinary design at the secondary and tertiary education levels to encourage lateral thought and creative design amongst the next generation of industry professionals. However, given the urgency of the climate situation, the critical factor, as I see it, is time. To meet these objectives in the shortest amount of time, I believe a systemic change is required.

To some, a "systemic change" may elicit a defensive response - but recent examples in the media demonstrate that vast portions of the population are desperately appealing for visible, systemic change. Such examples include the student strikes for climate change, the Extinction Rebellion protests, and even the recent landmark federal court case ruling that the Environment Minister has a duty of care not to allow harm to young people as a result of climate change. These examples also show that despite current efforts, it still appears that there is a heavy reliance on public outcry and legal dispute for desired environmental outcomes to be acted upon, leaving an onus on the relatively small population whose lifestyles afford them the time and energy to partake in such action. Although many of these public calls for action have been successful, many historical examples show that to effect change quickly and on a large scale, systemic change is key. One such example is that of the light bulb. In 2007, the US Congress instituted the Energy Independence and Security Act of 2007 (EISA) that demanded a 27 per cent reduction in energy use by common household light bulbs within 7 years. This bill helped to drive further development of newer technologies such as halogen and LED, having a significant overall environmental impact on a global scale.

A "systemic change" may also sound 'radical' - but it does not have to be. We in the rail industry already address challenging issues such as Safety as part of the standard systems engineering and design process. Safety is a multifaceted and ever-present issue for which every rail system confronts unique hurdles, yet I think most people would argue that despite these challenges, it is a crucial aspect of rail system design. Safety Engineering is enacted through the application of good practice and standards such as EN50126, EN50128, EN50129, and EN50159 that speak to risk analysis principles, specification of safety requirements, and methods for software development with safety integrity.

These standards, as well as the engagement of Independent Safety Assessors (ISAs) for major rail projects, focus heavily on the development of safety assurance throughout the design, to ensure that not only is safety central to the approach, but in fact the assurance of safety is critical to the acceptance of the system. This general safety assurance framework could be easily adaptable to the issue of environmental impact. While the development of an Environmental Impact Statement at the beginning of a project is useful, the engagement of stakeholders primarily at this early stage does not account for the fact that the design can change over its years of development. Furthermore, there is no standard, national framework that mandates independent oversight of environmental assurance similar to that of an ISA, after the project has been approved to go ahead. If it became the norm that a project was required to provide assurance of environmental safety and a duty of care to the public with respect to climate change, I believe positive change would be inevitable and perhaps set a progressive example for other industries alike.

Smart Train Windows

Author: Varun Bala

Passenger experience onboard trains is one area that is benefiting greatly from technology advancements.

Vision systems (Headquartered in France) are developing Smart Train Windows to enable this improved passenger experience.

The electronically dimmable windows are intended to:

- allow passengers to change the opacity as required (for chosen zones) to regulate heat and glare entering in, thus enhancing thermal and visual comfort for passengers
- allow for temporary view obstruction for privacy requirements using smart shading and partition solutions
- block out 99.9% of UV light (even in transparent state) thus protecting passengers and preventing interior furnishings from fading. Likewise, an integrated IR barrier strengthens heat blocking capability
- provide for an information display showing travel information (e.g. time, temperature, remaining distance to destination) and intent is to expand on this information display offering by enabling the broadcasting of videos and promotional content

The design of the system is such that it facilitates ease of retrofit to original equipment by integrating directly into the glazing of the windows. Vision Systems can also provide a complete solution which includes a high-tech composite frame. There is minimal need for ongoing maintenance as there are no moving parts and the design facilitates ease of cleaning.

As stated above, further enhancements of the system are being contemplated and developed, including the concept of a glass partition that allows operators to broadcast videos or promotional content whilst offering privacy between classes.

As an additional integration, Vision Systems also has a camera monitoring system offering, comprising of high definition cameras and interior displays. This integrated system has potential applications for increasing safety, security and providing video recording for legal purposes along the sides of trains and trams. Data already exists for a customised version of this system that is being trialled for buses and motorised coaches across the UAE, America and Asia.

Hence the current offerings, ease of retrofit, low ongoing maintenance requirements (low cost of ownership) and potential for future enhancement, suggest that the Vision Systems Smart Train Window shows great potential for operator uptake and future adaptability/customisation as the needs of customers evolve.

Sources and references:

https://www.globalrailwayreview.com/news/95970/smart-train-windows-passenger-experience/

https://www.smartglass.com/vision-systems-agc-improving-passenger-experience-onboard-trains-electronically-dimmable-windows-using-research-frontiers-spd-smartglass-technology/

Virtual Reality for Suicide Prevention

Author: Elle Carroll

Every year around 150-200 people die by suicide on the Australian rail network, and there are another 1,000 near misses. This is a devastating and significant challenge for our industry.

The impacts stretch far beyond the human loss caused by person–train collisions. There are long lasting & often traumatic consequences for railway staff and their families, bystanders, passengers, rail network operators, emergency response units and security & investigation teams who review such events. Railway suicides also cause economic losses. Authorities estimate the problem costs the economy around $1 billion a year through the disruption and delay of train services and driver absenteeism

However, there is light at the end of the tunnel. Advances in technology are providing promising new opportunities to address this complex problem.

Some effective measures that have been implemented on a global scale include physical strategies such as; platform screen doors, blue lighting, fencing, station and platform design and CCTV monitoring and sensors.

Recent research has also highlighted the significant role that the bystander plays in being a barrier to suicide. Data from an organisational database maintained for heavy rail networks in NSW, found that rail suicides in NSW could be up to 73% higher if not for bystanders intervening, either directly as first responders or by raising an alert.

Research into Pre-Crash Behaviour and the Role of the Bystander is underway to help strengthen suicide prevention strategies. Accompanying this research is a large piece of work which looks at utilising Artificial Intelligence (AI) and Virtual Reality (VR) technologies as a suicide prevention training tool. Ergonomie, based in Sydney is a leading Human Factors & User Centred Design consultancy who is combining knowledge with technology to combat suicide on urban railways. They have developed a VR tool to help train staff to identify behavioural markers of individuals who may be at risk or considering suicide and to implement intervention strategies.

Community campaigns are also key when developing a multifaceted approach to combat the issue of railway suicides. The "Small Talk Saves Lives" program in the UK (Samaritans, 2018), acknowledges the role of the bystander and empowers the public to save a life.

Here in Australia, a partnership between Transport agencies and Lifeline has seen the launch of a suicide prevention campaign, "Pause. Call. Be Heard." This pilot involves the installation of signs at selected stations in conjunction with upskilling customer facing staff in an attempt to promote and support suicide prevention in the rail environment.

Rail operators also turn to TrackSafe and Rail R U OK? Day to support their mission in reducing suicides and accidents on the rail network. Sydney Trains is just one agency who has leveraged off this collaboration to internally develop strategies such as Suicide Awareness training, Mental Health First Aid training, Providing Support after Trauma programs, Peer Support Programs and Critical Incident Support & Procedures, in an attempt to protect and improve the health and wellbeing of their employees.

Our industry requires a combination of different interventions which harness the link between technology, people and processes to drive shifts in suicidality on the rail network.

Sources and references:

https://www.ergonomie.com.au/suicide
https://reporter.anu.edu.au/tackling-railway-suicide
https://minervaaccess.unimelb.edu.au/bitstream/handle/11343/129526/Accepted%20version_predictors%20of%20using%20trains.pdf
https://www.transport.nsw.gov.au/data-and-research/research-hub/research-hub/grant-partnerships/preventing-railway-suicide

Automated Intelligent Video Review

Author: Graham Derrick

Emerging technologies are being implemented in the rail industry to increase efficiency in condition monitoring.

The Keolis group and partners in the UK (Go-Ahead, Network Rail, Transport for Wales and One Big Circle) are deploying Automated Intelligent Video Review (AIVR) trials on their rail networks.

A simple on-board camera at the front of the train collects live feeds that can be instantly accessed via a secure dashboard. More importantly, machine learning techniques are employed to detect changes over time as the trains cycle through duties.

This alerts users to anomalies (e.g. a certain tree is growing closer and closer to the track) so that maintenance teams can be deployed before a safety incident occurs. This has efficiency and safety benefits for critical and challenging environments where alternate inspection methods can be time consuming and more challenging from an access perspective.

As a variant to the above, thermal cameras have also been deployed to identify track defects, helping to increase efficiencies in asset condition monitoring and optimising costs over the asset lifecycle.

In addition, by collecting this valuable data the footage may be used for detecting signals at fault and driver route familiarisation.

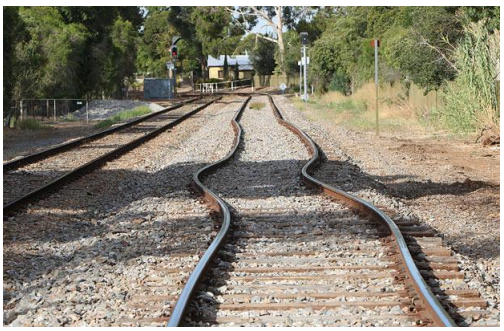
Sources and references:
https://www.aivr.video/
https://onebigcircle.co.uk/case-study-transport-for-wales/

Predictive Rail Temperature Monitoring

Author: James Freestone

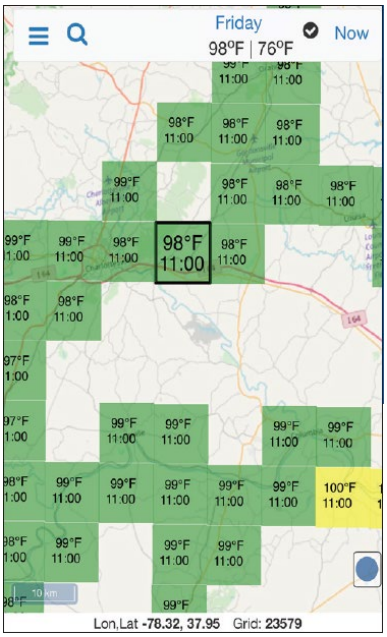
It is important for railway maintainers to monitor the temperature of railway tracks as hot and cold temperatures cause the rail to expand (compression) and contract (tension). These fluctuations in temperature can cause buckles or rail pull-apart to occur when not managed correctly, which can ultimately result in derailments. Usual practice is that when temperatures exceed defined thresholds, track inspections are undertaken to spot track buckles and train operational speeds are reduced. These temperature thresholds can be defined as a constant air temperature or a variable air temperature dependant on whether it's cloudy or clear skies. This is due to the infrared radiation from the sun being the primary heat source for the rail whereas cloud cover can block most infrared radiation.

Railway track is set up for the climate it is in by controlling the temperature at which the rail stops expanding and starts contracting, this is called the stress-free temperature. This is done by stressing the rail, which in a practical sense means stretching the rail to the length it would otherwise expand to at a selected temperature. This means when the rail heats up to the stress-free temperature it will not be under any tension or compression, therefore stress free.



The sleepers, fasteners and ballast prevent the track from buckling by resisting the forces generated by the expansion and contraction of the rail. The temperature at which the track structure can no longer support the forces imposed by the rail and will likely buckle is called the critical rail temperature. Under optimal conditions, the rail will heat up to temperatures above the air temperature much in the same way that concrete can heat up to burning temperatures under a hot summer sun. This means that for traditional heat policies, the air temperature at which restrictions are imposed is indicative of when the rail is at the critical temperature.

The main issue with current heat policies is that they assume a linear relationship between rail temperature and air temperature whereas there are multiple variables that influence it. Therefore, assuming this relationship often results in unnecessary operational restrictions and inspections since the minimum air temperature at which it is possible to reach the critical rail temperature must be used. Predictive rail temperature monitoring systems address these shortcomings as they use mathematical models that apply heat transfer principles and use a range of weather parameters accessible from weather forecasts to predict the temperature of the rail. They are capable of predicting the rail temperature within 2°C - 4°C depending on the model used.



Rail temperature prediction models offer an economical alternative to measuring the temperature of the rail at specific sites across a network. They require no hardware as the models use information sourced from weather forecasts and can produce accurate rail temperature predictions down to 9km grids. The predictive models provide a more precise estimate of the rail temperature which therefore improves operational efficiency and increases rail safety. By monitoring rail temperatures with predictive models, more comprehensive, less conservative heat policies can be implemented.

Railway Sleepers Made from Recycled Plastic

Author: Majid Abdollahi

The innovative sleepers made from recycled plastic will last three times longer than traditional railway sleepers and are made from recycled plastic sourced in Australia, including vineyard covers and cotton bale wraps. The sleepers are comprised of 85% recycled plastic waste.

The sleepers have already been installed with great success at a handful of different tourist and heritage railways in Victoria including Puffing Billy, Walhalla and Castlemaine.

The Duratrack composite plastic sleepers are produced in Mildura by Integrated Recycling and contain a mix of polystyrene and agricultural plastic waste, including cotton bale wrap, vineyard covers and pipe from the mining industry, which was previously unable to be recycled and sent to landfill. All the recycled plastic used in the sleepers is sourced in Australia.

The sleepers require far less maintenance and have a lifespan of up to 50 years – three times longer than traditional timber sleepers. At the end of their lifetime the sleepers will be recycled into new sleepers, fulfilling the promise of a truly circular economy.

The environmental benefits of using the sleepers are clear as they reduce the need for timber resources, reduce concrete production (the second-largest carbon emitter in the world) and meaningfully recycle plastic waste.

Compared to concrete, timber or steel sleepers, the sleepers also require less energy and resources to manufacture, thereby producing significantly less greenhouse gases.

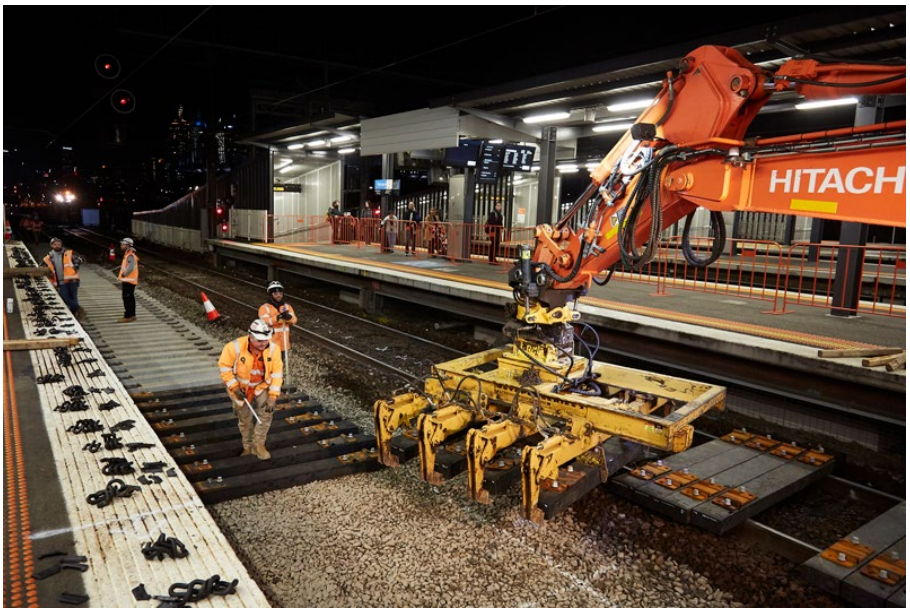
For every kilometre of track installed with the sleepers, 64 tonnes of plastic waste that would have otherwise gone to landfill is recycled.

The ground-breaking railway sleepers are the result of nearly four years of research and product development led by Integrated Recycling and Monash Institute of Railway Technology – and supported by Sustainability Victoria through the Research, Development and Demonstration grant and the Resource Recovery Infrastructure Fund grant totalling $630,000.

The project is a great example of government, industry, universities, and rail authorities working together to create a circular economy through innovation – and by rethinking the way we approach everyday products.

We're on the way to a future where commuters look through a train window and see recycled plastic sleepers flashing by instead of concrete or wood.

And that's something to smile about.



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