ACRI Rail Knowledge Bank update

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New to the ACRI Rail Knowledge Bank

If you would like your name/organisation added to the ACRI Rail Knowledge Bank alert list, simply email rail@arrb.com.au *with your request.*

Themed issue: CORE 2016: *Maintaining the Momentum*, Melbourne, Victoria, Australia

Below is a random selection of conference papers. To view all papers, on the home page under
Browse by Conference, click on folder CORE (Conference on Railway Excellence)\2016.

Advanced coal wagon monitoring using machine learning algorithms

The Remnant Coal Detection (RCD) system is a technology developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to detect residual coal deposits left in coal wagons after the dumping process is fully complete. This paper will examine the application of machine learning techniques in this scenario. It will also compare the performance of these algorithms to the current RCD system and explore their integration into the system in the form of a hybrid machine learning technique.

An Australian update of geosynthetic solutions to prevent mud pumping and prolong maintenance cycles

Geosynthetics have been used in railway trackbed for about forty years. When they were first introduced there were many site trials, but few were documented and there was a lack of understanding of the way that they performed. Those trials that were reported were often hailed as a complete success, based on the evidence of early performance of the track. Some claims were subsequently shown to be unfounded, because the failure of a geosynthetic treatment can take many years to become evident. This paper describes how the understanding of fundamental behaviour of traditional trackbed layers has led to the products that are available today. Case histories are described which show how customized solutions have been developed to address particular problems encountered in Australia.

Case study: coexistence of CBTC and ETCS on Crossrail project in London

Signalling projects are already being implemented combining communications-based train control (CBTC) solutions that are optimised for mass transit operations with the European Train Control System (ETCS) normally associated with mainline railways. This paper will look at the case study of combining CBTC and ETCS for the Crossrail project and at how both technologies are used efficiently to meet current and future requirements to optimise the rail infrastructure. Additional concepts for combining CBTC and ETCS based on real projects such as Thameslink in London, Marmaray in Istanbul and Sosa – Wonsi in Korea will be reviewed as well as the relevance for Australian railway networks.

Changing business strategies to reduce the total cost of risk

This paper will examine strategies to obtain benefits from a well-executed and managed “contractual risk transfer” protocol that many railways incorporate into their terms and conditions but then neglect to enforce or actively manage. As a result, they do not achieve the risk mitigation and cost savings they seek. By applying the hazard and risk evaluation principles of SMS, already adopted by all Australian states and territories, this paper cites some case histories to illustrate how to make the railway more profitable.

Designing rail vehicles to meet EN15227 crashworthiness requirements for railway vehicles

The crashworthiness of rail vehicles is an important design consideration, particularly for high capacity passenger vehicles. The unified European crashworthiness standard EN15227, released in 2008, brought together the existing research on best practice for crashworthiness design requirements combined with analysis of the most common and serious rail accidents in Europe. EN15227 sets standards for the passive safety design of rail vehicles as a last means of protection when active measures fail. This paper outlines the design process that Bombardier Transportation utilises from the conceptual stage through to detail design for development of carshells that comply with the passive safety requirements of EN15227.

Device to estimate overhead line fault location in 2x25 kV electric traction: prototype overview

Aurizon's Blackwater and Goonyella coal rail systems use 2x25 kV electrification. QR introduced almost three decades ago, fault locator devices named QRFLs which provide the Electric Control Officer (ECO) with an estimate of the location along the track within the section where the fault occurred. Currently, the technology used in the existing devices is ageing and the componentry is becoming obsolete: therefore, a new system is being designed and deployed. This paper firstly presents an overview of the fault location system. It then introduces the theory of fault location based on return current measurement, followed by a description of the currently installed fault locator system and of its characteristics and technical challenges. The technical challenges encountered with the system are outlined, and improvements introduced with the new design are described.

Driver assistance system for avoidance of collision on light rail vehicles

Bombardier Transportation constantly works on and researches into new, innovative concepts to increase the safety of the daily operation of light rail vehicles. In co-operation with the Austrian Institute of Technology, Bombardier Transportation has developed an optical driver assistance system to automatically identify as early as possible potential hazards (objects) in front and in the swept path of the vehicle and warns the driver via acoustic and / or visual warning. This paper will outline the technologies that the system uses, demonstrate how the software and the system functions to safely detect static and moving objects within the LRVs path. It will also report on the development phases to date, the trials already undertaken, the current status of the development and the future steps for the product.

I get paid to crash trains!

This paper discusses an actual project example to demonstrate the process that has been undertaken to meet modern crashworthiness requirements of European Standard EN15227. The processes and experience gained from designing rolling stock to meet the requirements of EN15227 is directly transferable to the Australian rail market because the crashworthiness requirements in Australia, stipulated in AS/RISSB7250, refers directly back to EN15227.

International experience on long term performance of geogrid reinforced ballast and capping

The performance of railways with geogrid reinforced ballast and/or capping layers has been proven through various lab tests and field investigations, but most have been short term measurements. This paper presents two recent international long-term field studies and monitoring results; a 5 year field measurement of a railway rehabilitation project with a geogrid reinforced capping layer on soft soil, and a 2 year field measurement of a railway rehabilitation project with geogrid reinforced ballast on soft soil. Both projects were cooperative field studies between Germany and Slovenia. The results present the long-term effect of geogrids and the beneficial behaviour of a geogrid reinforced ballast and capping system.

Investigating the interactions of road users and pedestrians in a dynamic rail level crossing environment

There are 23,500 level crossings in Australia. In these types of environments it is important to understand what human factor issues are present and how road users and pedestrians engage with crossings. This work offers insight into context specific issues associated with active level crossing protection.

The light rail revolution – a safety risk perspective

The safety risks associated with light rail are somewhat less explored and understood, in comparison to the more established transport modes of buses and heavy rail. Quantitative Risk Assessment (QRA) is a common method for evaluating the risk profiles of complex systems, such as public transportation networks. QRA is often applied as a basis for driving business decisions and as part of a risk management framework to satisfy legislative duties in relation to safety issues. This technical paper will gauge public perceptions of risks associated with light rail operations and outline the legal requirements (or guidelines) with regards to undertaking QRA on public transport projects. The common QRA techniques will be explored, with the benefits and corresponding challenges noted, with respect to light rail applications. We will also present case studies on QRA, as applied to light rail projects, to better understand the current risk management practices in the light rail industry.

Providing unassisted access at train platforms for passengers with mobility restrictions

The long-term goal for accessibility for Public Transport Victoria (PTV) and Metro Trains Melbourne Pty Ltd (MTM) is to provide unassisted access for all passengers at all accessible train doors. In Australia, the Disability Standards for Accessible Public Transport 2002 (Cth) (DSAPT) mandates requirements for public transport operators to increase accessibility and comply with the Disability Discrimination Act of 1992 (Cth) (DDA). Legacy infrastructure makes it difficult to achieve compliance with the DSAPT on the Melbourne rail network. This problem is not specific to Melbourne with various solutions developed worldwide to improve accessibility. PTV and MTM have trialled a series of Raised Boarding Pads (RBPs) to improve unassisted access to passengers with mobility restrictions.

Rolling resistance revisited

Resistance to motion is an important input for train performance simulations, and the Davis equation is a well-known resistance formula, widely used for freight trains. This paper begins with a review of some of the published formulae, and then presents a methodology for calculating the overall resistance of trains of known weight and composition operating on known track geometry, using tractive effort, GPS location and speed records downloaded from locomotive data loggers. A simulation program was modified to take the time history of tractive effort as an input, and to calculate velocity, which is then compared with the recorded speed. The “Davis” formula parameters are adjusted iteratively until the calculated speed approximately matches the actual speed. This approach is used to benchmark values of published constants and to suggest appropriate values for trains operating in Australia.

Theoretical investigation of the effect of rail cleaning by wheels on locomotive tractive effort

In this paper, the change of friction coefficients under locomotive wheels due to the effect of rail cleaning are analysed based on expert opinions obtained through a literature review process. Also, some assumptions have been made in order to investigate the effect of variation in friction under individual wheels on locomotive dynamics. These assumptions adopt a progressive increase of the friction coefficient (but in progressively decreasing increments) from the leading to each subsequent following wheel on each side of the locomotive. For this study, the multibody model and a full electrical system of a heavy haul locomotive have been used for numerical experiments. The results obtained show that the variation of friction coefficients can have a significant influence on locomotive dynamics under traction.

Train braking and signal design to prevent SPADS

The safe operation of a railway requires careful integration of the train operating and braking performance, the driver actions and the signalling system. This is made more difficult as various sections of the railway are responsible for each of these functions. Good communication between the various engineers and operations managers allows the information on each of these functions to be identified and shared. This is not a simple set of information. It will vary according to the rail network configuration, the types of trains and operations. These may also vary over time as the railway operating pattern changes. This paper will examine some of the fundamental issues that affect this interface. It will also examine different approaches to managing and controlling the train operations.

A unified approach to whole life cost modelling in Network Rail

Network Rail has developed a generic WLC model (CoBALT) which can be used to analyse an asset or a group of assets at any stage of the lifecycle. The model is particularly well suited to support the analysis of enhancement projects where new assets are being introduced on existing infrastructure. This paper outlines the current modelling approach and describes Network Rail's progress in addressing strategic challenges. Through its international consultancy arm Network Rail can share the benefits of these developments with Australasian railway organisations and through such collaborations hopefully gain experience to guide future model developments.

Visual performance at passive level crossings with long sighting distances

This study assessed the distance at which a train first becomes identifiable to a driver as well as their ability to detect the movement of the train. A site was selected in Victoria, Australia, and 36 participants with good visual acuity observed 4 trains in the 100-140 km/h range. While most participants could detect the train from a very long distance (2.2 km on average), they could only detect that the train was moving at much shorter distances (1.3 km on average). Large variability was observed between participants, with 4 participants consistently detecting trains later than other participants. Participants tended to improve in their capacity to detect the presence of the train with practice, but a similar trend was not observed for detection of the movement of the train. Participants were consistently poor at accurately judging the approach speed of trains, with large underestimations at all investigated distances.

Wagon squeal – is noise costing us money?

Squealing noise resulting from freight wagons that exhibit poor curving ability is a significant issue for railways located within residential areas. Railway operators practice a range of measures to manage this issue, but ultimately, well designed and maintained bogies are the key to optimised performance. This paper considers the problem of wheel squeal and its cause. Exploration of the performance objectives of freight wagon bogies, focussing on the domestic market, but informed by international practices, is used to establish an understanding of current freight bogie design approaches. The main types of intermodal bogies in operation, along with their advantages, limitations and improvements are presented. The capital, maintenance, operational and third party costs for the operation of intermodal bogies in Australia are subsequently evaluated. These findings are finally drawn together to identify if noise arising from the railways as a result of wheel squeal is costing us money.

Who is driving this tram?

Technology is great but no matter how technical or automated a system is people have a crucial role to play - who else will turn it on, turn it off, maintain it, and more importantly, step

in when the system fails. But people are not always given a voice to say what they need to make the system perform efficiently, reliably and in a way that supports their well-being. The intention of this paper is to present a process that when applied from the early stages of a project or system development will identify the physical and cognitive requirements of the intended users; and, allocates functions appropriately between the people and the technology so each does what they do best.

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The Rail Knowledge Bank is supported by ACRI and ARRB Group.

See the Rail Knowledge Bank Charter for more information on its objectives and resource coverage.