SA Newsletter

March 2009

NEXT CHAPTER MEETING:

Joint RTSA/PWI Lunchtime Meeting on Thursday 2nd April 2009

1200hrs at ARTC's Offices, Mile End

New Ultrasonic Rail Flaw Detection Contract for ARTC

& Recent Developments in Rail NDT

by

Alex Ivachev & Greg Matheson

of Rail Technology International and ARTC

Time: This lunchtime meeting will take place between 12 noon and 1pm and will be followed by a free BBQ from 1-2 pm.

Venue: ARTC, Off Sir Donald Bradman Drive, Mile End, SA 5031.

Contents

Publisher

This newsletter is a publication of the South Australian Chapter of the Railway Technical Society of Australasia, Engineering House, 11 Bagot Street, North Adelaide SA 5006. Opinions expressed within are not necessarily those of the Chapter, Society or Editor.

Contributions

Contributions, including news, opinions, or letters to the editor, are always welcome. Send material by e-mail to sa-editor@rtsa.com.au

Continuing Professional Development

Engineers Australia members are reminded that attendance at RTSA technical meetings contributes towards CPD requirements. Each RTSA technical meeting generally has a value of 1 CPD point.

RTSA Website

The RTSA website www.rtsa.com.au has details of RTSA activities, including future meetings and reports from past meetings, for all Chapters.

Membership

Information for potential new members and an application form may be found at www.rtsa.com.au.

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Newsletter Dispatch

Dispatch of the newsletter is undertaken by Steve Torok. Contact Steve on storok@tge.com.au if you have any problems receiving newsletter electronically or in hard copy, or change your e-mail address.

Chapter Meetings

Thursday 2 April 2009

Chapter lunchtime meeting hosted by PWI, at ARTC offices, Mile End – new Ultrasonic Rail Flaw Detection contract for ARTC.

Thursday 7 May 2009

Chapter meeting, 11 Bagot St North Adelaide – Improved Turnout Technologies + update on Australian Track Materials Standards.

Thursday 4 June 2009

Chapter meeting, 11 Bagot St North Adelaide – Rail Maintenance Developments in the Pilbara.

Thursday 2 July 2009

Chapter meeting, 11 Bagot St North Adelaide – Belair Line Upgrade, by Philip Agnew.

Thursday 6 August 2009

Chapter meeting, 11 Bagot St North Adelaide, with joint Mechanical Groups.

Thursday 3 September 2009

Chapter meeting, hosted by IRSE.

Thursday 1 October 2009

Chapter meeting, 11 Bagot St North Adelaide.

Thursday 5 November 2009

Chapter meeting, 11 Bagot St North Adelaide – ARTC Network Enhancement investment update by Ben Leske.

Tuesday 1 December 2009

Annual dinner meeting + AGM, Hyde Park Tavern.

News

RTSA Awards

In 2009, RTSA awards will be offered in the categories of Railway Engineering Student Thesis, Contact Mechanics, Young Railway Engineer and Individual. Nominations for the first two categories closed on 28th November 2008 and, for the other two categories, will close on 27th February 2009. Eligibility, and assessment criteria, are on the RTSA website.

Post Graduate Degrees

A number of universities now are offering post graduate degree courses in railway topics. The Central Queensland University offers a Signalling and Communication course, the University of Wollongong has a Master of Rolling Stock Engineering program, and a Track and Infrastructure course has been introduced by the Queensland University of Technology.

Coming Events

IRSE Convention

The Institution of Railway Signal Engineers is holding a Technical Meeting "Controlling Railways – Australia's Next Generation Systems" in Adelaide on 3rd – 5th April 2009.

Full details can be obtained from Malcolm Menadue: mmenadue@internode.on.net

Study Tour on Railway Engineering

The NSW Chapter is planning a Study Tour on Railway Engineering (STORE) of Asian Metro Systems which will take place on 12th – 23rd September 2009, visiting Singapore, Kuala Lumpur, Shanghai, Beijing and Hong Kong. Full details and invitations to register are to be published soon. Details will be advised in the newsletter as they become available.

AusRail Plus 2009, Adelaide

Between 17th-19th November, Adelaide will host the largest annual rail event in the Asia Pacific region, AusRail Plus, at the Adelaide Convention Centre. With trade exhibitions, networking functions and a program of international speakers, this 3-day conference will be the biggest rail event of 2009.

Full details can be obtained from www.ausrail.com/informaoz/AusRAIL/

CORE 2010

RTSA's biennial Conference on Railway Engineering, CORE 2010, will be held in Wellington, NZ on 12th – 15th September 2010.

The conference theme is "Rail – Rejuvenation & Renaissance". Details are becoming available on www.core2010.org.nz/

Chairman's Chatter

The half-yearly meeting of RTSA's Executive Committee was held on 24th February 2009. Highlights from the meeting included:

- Recognition of the need for an action plan to attract young professionals to join the RTSA and, having done so, the need to maintain their interest and participation.
- New Professional Development initiatives. One such initiative is to identify high profile leaders to make presentations to rail industry young professionals on non-technical managerial subjects. Initially, as a trial, this initiative will be pursued in Melbourne.
- An initiative is being pursued to hold railway career days at selected universities with the objective of stimulating the interest of undergraduates in the rail industry.
- Initiation of steps to increase the marketing and promotion of RTSA awards, to encourage a greater number of entries.
- A significant increase in membership, across all Chapters.
- Further initiatives to improve both the quality and the contents of the RTSA website, including the establishment of a template of railway related courses and seminars.

- Consideration of the Closeout Report from CORE 2008, acknowledging that the conference was a hugely successful event in terms of the number of delegates, the levels of sponsorship and the participation in the Trade Exhibition.

- A review of progress in redeveloping the RTSA Business Plan. As part of the considerations regarding the Business Plan, it has been agreed to conduct a review and rationalisation of the various RTSA sub-committees.

- A favourable report indicating that arrangements for CORE 2010, which will be held in Wellington New Zealand, between 12th & 14th September 2010, are moving ahead well.

- Successful publication of the history book "RTSA – The First Ten Years", authored by Dr Philip Laird, and published just prior to CORE 2008. Copies have been made available to all members of the RTSA at no cost.

Overall, RTSA is moving ahead on a number of fronts, under the leadership of Executive Chairman, Martin Baggott.

Duncan McLeod

Point of View

*The following is an edited version of an article by **Max Michell** in the RTSA NSW Chapter newsletter:*

In the last half of the 20th century, railways abandoned quite a significant volume of freight traffic.

Some traffic went when it was realised that it was an unsustainable financial drain on the railway, but added to that was a rather myopic zeal that threw out the baby with the bathwater. Inter-modal is good, so out went the majority of wagonload traffic. Shunting is bad so out went anything and everything that had any connection with shunters and shunting.

Effectively the main line railways of this country converted in a fairly short time from a variety of traffic in relatively numerous trains to fewer (but larger) trains that were mostly made up of inter-modal (container) traffic. The big bulk traffics, coal, grain, ores and a few other strays survived as block trains running point to point, but most of these did not involve hauls between the major population centres. That was left to the inter-modal business.

Over the last few decades, inter-capital rail traffic (which is closely aligned to the rail inter-modal traffic) has declined on all but the Perth corridor from a modest market share (30-50%) to negligible volumes (10%), which suggests that in amongst all the other issues, inter-modal is not the mechanism to save rail in the retail and consumer freight business.

There are many issues related to inter-modal, particularly on the east coast routes, and market share loss. Pricing is one – rail line haul on large trains (up to 1500 metres long) is relatively low cost, far lower than road, but when the pickup and delivery (PUD) costs are added the price virtually doubles. Is there not some way that the rail line haul could be coupled to something that is less costly for that last little bit at each end, which at the same time would strengthen rail's position?

Rail's love affair with Forwarding Agents, back in the 1960's and subsequently, detached the rail systems from their real customers – rail became the third person in a two party arrangement. Our visibility to the major originators and receivers of freight was eroded to the point where rail was essentially irrelevant to most freight customers. Even where Forwarders were essentially set up to make use of rail for line haul rather than being a large road operator, the invisibility of rail (and its poor service record) eventually drove these operators into acquiring line haul road capability.

Allied to the passion for all things inter-modal was the 'long trains are better' belief. Long trains, or rather trains that have increased revenue freight aboard, are indeed good, but only in the right context. In the case of inter-modal the extension of train lengths from around 600 metres (maybe 80 TEU at best) to 1500 metres (over 200 TEU) in the mid

1990s virtually halved the frequency of trains between east coast capitals.

In most cases adjoining capitals were reduced to a single daily inter-modal train with 24 hour gaps between successive departures which had only 14-20 hours transit time to the destination. From a customer's point of view (ignoring a number of other dargs in the system) the real transit time was between 14 and 44 hours for a journey that in most cases could be done by road overnight. With shorter trains there potentially was greater choice in departures and therefore a reduction in excessive wait times prior to the next inter-modal departure, but the line haul cost would then be higher – a classic trade-off between service and price which the railways never really came to grips with.

Inter-modal is not the devil in the system – it is just that, in typical rail fashion, it has been used as the 'one size fits all' answer, where such an approach is quite inappropriate. Intermodal works well on long haul, where there is break of gauge or where the customer is well away from any rail track, but it is not always useful where these factors are absent.

Abandonment of wagon load traffic has seen the end of virtually all the regional freight originating on main lines. Between Melbourne and Sydney for example, there are now only about five locations that generate any rail traffic at all (other than grain and coal) – and these are mostly train load traffics that were outside the 'wagon load is bad' remit.

Maybe a starting point in recovering the situation would be to reverse our attitude to one of 'how can we adapt ourselves so that we become an essential part of the supply chain'. Wagonload by definition is a complete service since it (should) provide transport between one private siding to another, cutting out all the problems of terminal handling and PUD that bedevil the current inter-modal operations. Wagonload may not be everyone's cup of tea but it should be an integral part of a viable rail freight portfolio.

Henry Posner III, Chairman of RDC (regional USA railroad) with experience in Estonia, Africa and South America as well as USA is quoted as saying "Wagonload is the canary in the coalmine - if it goes you have a sick business. But wagonload (in Europe, unlike America) is still considered a liability. If you convert customers from wagonload to inter-modal you are teaching them how to use lorries, and if you are successful, another open access operator will try to take the business off you"

Henry's comments are directed to Europe, but look to be entirely appropriate for Australia.

Non-destructive Measurement of Neutral Temperature in Rails

Summary of a presentation to the March 2009 Chapter meeting by Max Shuard and Duncan McLeod

Introduction

The ability to measure, non-destructively, the neutral temperature in rails has long been an objective of track engineers.

This article provides background information, and summarises the state of development of various measuring techniques.

Background

Rail which is unconstrained, as found in traditional jointed track, expands and contracts as the temperature changes (Figure 1).

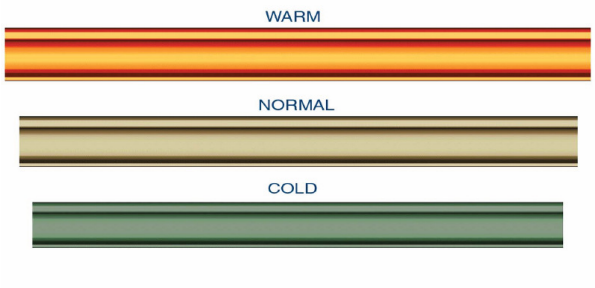

Figure 1 – Unconstrained Rail

With continuously welded rail (CWR), expansion and contraction cannot occur (Figure 2). Instead, the rail develops compressive stresses at higher temperatures, and tensile stresses at lower temperatures. In between, there is a temperature at which the rail is neither in compression nor in tension, i.e. is stress free. This temperature is known as the neutral temperature, or stress free temperature (SFT).

The design neutral temperature is normally specified to be at a level somewhat higher than the mid point between the maximum and minimum expected rail temperatures experienced in the area. Design neutral temperatures around 38^{O}C – 40^{O}C are typically adopted in Australia.

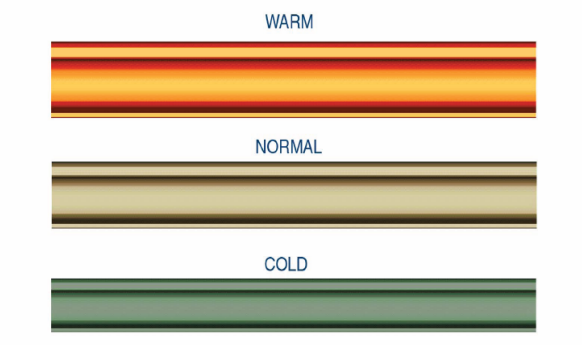

Figure 2 – Constrained rail

Forces Acting on CWR Track

Forces acting on CWR track at temperatures above neutral are shown in Figure 3. The compressive forces in the rails, which tend to cause buckling, are resisted by the ballast shoulder, friction on the sides and bottoms of the sleepers, and the rigidity of the track structure.

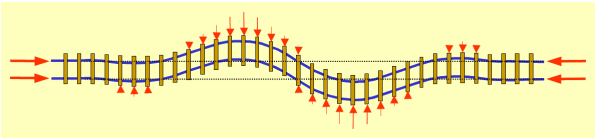

Figure 3 – Forces acting on CWR track

Track stability in hot weather therefore depends on both the quality of track materials (optimising the resisting forces), and a neutral temperature which is high enough (to ensure that compressive forces are not excessive).

When a train passes, lateral dynamic forces are imparted into the track, increasing the propensity for the track to buckle. Dynamic effects also reduce the friction between sleepers and surrounding ballast. Therefore, a track buckle is more likely to occur during the passage of a train.

A typical track buckle is shown in Figure 4.

Figure 4 – Typical track buckle

Obtaining Correct Neutral Temperature

CWR is adjusted to the design neutral temperature by a process known as destressing. A portion of the CWR of known length, typically up to 500 m, is identified for adjustment. The rail in the adjustment length is unfastened, cut, cropped to a calculated length, heated or stretched (tensed), and re-welded, so that it achieves a stress free state at the design neutral temperature.

Destressing must occur at a temperature lower than (or equal to) the design neutral temperature; at higher temperatures, the rail will expand, and the resulting neutral temperature will be too high. This increases the likelihood of the rail breaking (a pull-apart) when rail temperature is low.

Incorrect outcomes from the destressing process can result from causes such as non-adherence to correct procedures, rail temperature fluctuations, friction between rail and sleepers, and creep of rail into the adjustment length during tensing. Traditionally, there has been no process enabling verification of the neutral temperature actually achieved.

Destructive Testing

Until the advent of non-destructive measuring devices, rail which was suspected of having an incorrect neutral temperature had to be cut and destressed. The need for this would be based on tell-tale signs such a rail creep, curve pull-in, and "wriggly" line in hot weather.

In the absence of such indicators, there was no way of verifying compliance with design neutral temperature.

Non-destructive Measuring Techniques

Much research and development effort has been applied to the need for non-destructive measurement of neutral temperature in rails.

Several different concepts have been pursued:

- Strain gauge methods;
- Below yield bending methods;
- Magnetic fluctuation measurements; and
- Ultrasonic measurements.

Strain Gauge Methods

Strain gauges have long been used to measure rail stresses during experimental work. The concept has now been developed to provide a device which automatically records and stores measurements at prescribed intervals, and can be remotely interrogated by radio (Figure 5).

Figure 5 – Strain gauge measuring devices

Such devices are good for long term measurement of variations in neutral temperature (such as may result from changes in curve alignment), and also enable detection of broken rails. However, they are limited to measuring neutral temperature at the fixed locations where they are installed. They also require calibration at zero rail stress (i.e. the rail must be cut and restressed at the time of installation).

Below Yield Bending Methods

Two devices, based on bending the rail, have been developed and achieved significant adoption for measurement of neutral temperature.

These devices utilise the principle that the more a rail is in tension, the greater the force required to lift it. In use, a length of rail is unfastened and lifted at its mid-point.

One such device is "RailFrame", developed by Queensland Rail (Figure 6).

Figure 6 – RailFrame

A 20 m length of rail is unfastened, and lifted by a hydraulic jack to a defined height. The force required to achieve this is read from a dial gauge.

Neutral temperature is read from a lookup table for the specific rail size, derived from lifting force and rail temperature.

RailFrame is quite simple to operate and has a claimed accuracy of $\pm 3^{o}C$.

A slightly more sophisticated development of the concept is "Verse", marketed by Pandrol (Figure 7). With this device, a defined lifting force is applied, and the height by which the rail is raised by this force is measured. Neutral temperature is calculated by an integrated portable computer.

Unlike RailFrame, Verse is able to measure neutral temperature on flatter curves, as well as on straights.

Figure 7 – Verse

RailFrame and Verse represent an important step forward, by enabling the straight-forward and reliable non-destructive measurement of neutral temperature.

However, they do require the track to be unfastened, which necessitates appropriate safeworking procedures, increasing the cost of testing.

A limitation is the rail must be in tension at the time of testing, i.e. rail temperature must be below actual neutral temperature.

Another below yield bending method under development, and showing considerable promise, is a device called D'Stresen. This works on the basis of applying multiple small forces to the rail, at a frequency of around 70 Hz, and measuring the resulting deflections nearby. Unfastening of the rail is not required.

The concept is shown in Figure 8 (red = shaker applying force, blue = deflection measurement).

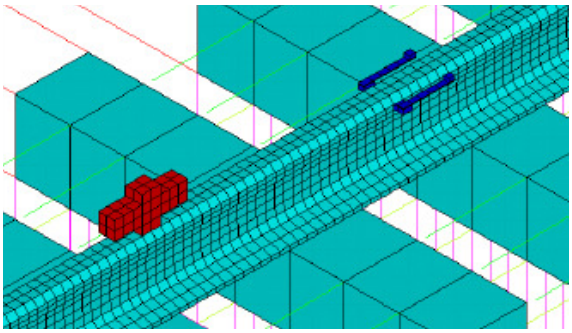

Figure 8 – D'Stresen concept

D'Stresen works for rails which are in tension or in compression, but it is necessary to know which prior to testing, in order to achieve correct results.

Magnetic Fluctuation Measurements

A concept known as Magnetic Barkhausen Noise (MBN) has been known since 1919 and is widely used for assessing internal stresses in the likes of automotive components.

MBN works on the principle that the magnetic hysteresis loop has a different shape depending on whether the material is in tension or compression, or is stress free.

Two companies have developed a device using the MBN concept. One, known as MAPS (Magnetic Anisotropy and Permeability System) has been developed in the UK, and the other, RailScan, is marketed by Thermit. (Figure 9) Multiple measurements of the magnetic field at a testing site are made, and sent away for detailed analysis.

Figure 9 – RailScan

Trials in Australia have indicated that although reliable results can be obtained, the device is sensitive to rail characteristics, and does not differentiate between thermal stresses and those due to other causes (e.g. on curves).

Nevertheless, MBN techniques hold considerable promise as a device which will be able to be easily and efficiently used on production testing.

Ultrasonic measurements

This concept is based on the principle that wavelength will vary with internal rail stress. It has been used successfully in testing manufactured components, but in rail applications has had calibration problems similar to MBN techniques.

Conclusions

Rail stress is a very important issue. There are great gains to be had from an ability to non-destructively measure neutral temperature.

However, in this field, as with may others, there are lots of assertions of capability, but much less hard data derived from independent verification.

It is most desirable that rail infrastructure owners actively support the development and testing of new devices. But, at the same time, they need to satisfy themselves as to the veracity of claims made.

Much research has been undertaken in sleeper design, wheel rail interface and other aspects of track design. Knowing with confidence the rail neutral temperature, will add another piece to the puzzle.

Max Shuard & Duncan McLeod 5th March 2009

Vote of thanks delivered by John Dring.