2018 a year of note for Monash

PHILLIP CAMPBELL, CHAIR OF THE Railway Technical Society of Australasia, noted two milestones this year: Monash University celebrates its 60th anniversary and it was 100 years ago, in 1918, that General John Monash was knighted on the battlefield – the first such event for more than 200 years.

"It says much about the regard in which Sir John Monash was held and his name is a fitting name for a fine university," Mr Campbell said.

Mr Campbell, introducing the guest speaker for the Stephen Marich lecture, said that to have a lecture named after you required one of two things: either you had made a big donation or you had overwhelming merit.

"Very few people earn that accolade and Stephen Marich is one such person."

Mr Campbell then outlined some of the highlights of Dr Marich's career.

"He has been working on railway research and development applications for 40 years and has been the author and co-author of more than 90 technical publications on railway engineering."

Mr Campbell said Dr Marich had also written two post-graduate courses in railway engineering and worked at BHP's research laboratories from 1969 until 1998, completing his career as manager of the transport and mining and services technology research group.

"Under his leadership the group became a recognised leader in the field of heavy haul railway and technology. He is regarded as one of the world's leading experts on wheel-to-rail performance and track performance, interaction, maintenance and management," he said.

Since going into semi-retirement in 1999 Dr Marich has been involved in as number of activities, including implementation of a range of rail wheel management strategies and track designs for heavy haul as well as many training programs.

He received the Australian Institution of Engineers' individual award in 2000 and was inducted into the International Heavy Haul Association Railway Hall of Fame in 2003.

–TONY DUBOUDIN

The Stephen Marich lecture:

'Don't save yourself into trouble'

TONY DUBOUDIN

Increased operational demands were being placed on railways – axle loads, train speeds, train lengths, the window of opportunity for maintenance on rolling stock and track – and these demands were being seen on a daily basis.

These demands usually came together with financial constraints, Dr Robert Fröhling, principal engineer in the technology management department of South Africa's Transnet Freight Rail, told an audience of railway professionals at the annual Stephen Marich lecture in Melbourne in March.

He said the approach was usually "do this and that but don't let it cost too much". "But what I am saying is don't save yourself into trouble," he said.

In his presentation 'Vehicle Track System Dynamics and Long-term Behaviour', he said one needed to be "knowledgeable about the cause and effects in your system so that you spend on the right things to achieve the best result".

Images TONY DUBOUDIN and IRT

+ Dr Robert Fröhling, principal engineer in the technology department of Transnet Freight Rail, South Africa, delivers this year's lecture in railway engineering honouring Dr Stephen Marich. The lecture is hosted annually by the Institute of Railway Technology, Monash University, Melbourne.

"What we have to realise in trying to optimise the system of operating demands and financial constraints and deliver to our shareholders is that the maintenance we have to do to the track is load-dependant," Dr Fröhling said.

"So as the loads increase, we can expect to do more track maintenance. The problem is that this is not usually a linear relationship, rather an exponential relationship for most of the time. We must be aware of that, for if we compare a system that has linear degradation to one that's has exponential degradation we have to react differently.

"We have to find a cost-effective balance between operational demands and maintenance. To be able to do this in effective way we need to understand the short-term and the long-term behaviour of our vehicles fleet. The short-term is defined by catastrophic failures; long-term is really fatigue related and the deterioration of the track. We have to understand these two concepts to be able to analyse the interaction between the wheel and the track," Dr Fröhling said.

His overriding message was 'work smarter within economic restraints'.

Dr Fröhling said it was necessary to understand the relationship between the wheel and the track and interaction between the two.

Turning to the importance of design parameters of rolling stock, he said the rail vehicle must not be forgotten as it would ultimately show what was happening between the wheel and the rail.

"On the bogie side, which is our important shock absorber suspension element, we need to look at the structure of the bogie. Can the bogie's structure itself survive all the forces? Is the suspension tuned for the track structure it will go over? Is it able to last long enough or will it have a fatigue failure? Is the material used for the coil spring of the suspension system well designed? Are we overloading our suspension?"

Turning to wheel profiles, he stressed the importance of a correct profile and pointed out that the difference between a good wheel profile and a bad profile was between 0.1mm and 0.2mm.

He said the other key element of rolling stock was the wheel. Dr Fröhling listed the key requirements of materials used in wheels as:

- resistance to wear (hardness);
- resistance to plastic deformation (yield strength);
- resistance to rolling contacts fatigue (shear strength); and
- toughness against crack growth.

He then turned to the forces at the wheel–rail interface and the factors contributing to lateral forces, which he said were:

- flanging and lateral creep forces;
- curve radius;
- couple angle;
- rail lubrication;
- speed;
- buff or draft forces;
- misaligned bogies;
- word friction wedges and side frame pocket;
- wheel diameter mismatch;
- bogies' turn resistance;
- track misalignment; and
- traction/braking.

On vertical forces, Dr Fröhling listed 12 factors contributing to these, some of which were the same of those impacting on lateral forces:

- vehicles weight;
- curve super-elevation;
- speed;
- track misalignment;
- torsional stiffness of vehicles body;
- skew or shifted load
- worn friction wedges;
- broken/missing springs;
- suspension stiffness and damping;
- rigid frame bogies;
- small/no side bearer clearance; and

• torsional stiffness of bogie suspension.

Dr Fröhling said that the vertical and lateral force on the rail would dictate to a large extent the probability of a wheel derailment.

He said that while a track might be well maintained, there would be some odd bumps here and there and a bit of deviation. On the rolling stock side, there might be similar issues of deviation or suspension and a few changes on the wheel profile.

If the axle load is required to be increased, then due to that shift in the loads and the forces that interact between the vehicle and the track there is now a problem and the challenge of the worst wagon meeting the weakest track.

"To manage this conflict between the structure strength of the track and the load coming from the rolling stock and to make an informed decision, we need to not only look at the impact of the flat wheel we need to look at the long-term vehicle track system behaviour," he said.

He listed some of the likely problems of structural fatigue, suspension deterioration, bearing failure and component wear.

Dr Fröhling said achieving operational efficiency required a balancing act between operational requirements, essential maintenance interventions and costs.

He said that many system components deteriorated exponentially and it was cost-effective to conduct maintenance more frequently. He stressed the importance of track tamping, rail grinding and wheel re-profiling.

+ Dr Stephen Marich presents a commemorative plague to guest lecturer Dr Robert Fröhling.

He used this equation to calculate the wheel damage factor:

F=(P/Po)n

P = increased wheel load

Po = reference wheel load

n = damage exponent

On track components, the largest cost of maintenance was taken up by the rails – 70 per cent – with wear, making up 65pc, being the largest single contributor to the total and the damage exponent being 2.0, while surface fatigue comprised 10pc (damage exponent 2.5) and internal fatigue 25pc (damage exponent 3.3). Sleepers took up 10 pc (damage exponent 2.0) of the cost and ballast and subgrade 20pc, with the damage exponent being 1.0 for good ballast/subgrade and 6.0 for poor.

With rail wagons, wheels and axles represented 58pc of the total cost, broken down into 50pc due to wear (damage exponent 1.0), 20pc shelling (damage exponent 3.3), 20pc discolour (damage exponent 1.0), 9pc thermal damage (damage exponent 2.0) and 1pc journal fatigue (damage exponent 9.0).

Air brakes accounted for 3pc of the total maintenance cost broken down into 80pc shoes (damage exponent 2.0), and 20 pc system issues (damage exponent 1.0) while bogies took up 15pc (damage exponent 2.0) of total maintenance costs, bearings 13pc (damage exponent 3.3), couplers 4pc (damage exponent 4.1) and wagon bodies 7pc (damage exponent 6.1).

Dr Fröhling concluded by quoting Professor Roderick Smith, of Imperial College London, who said that in "the vehicle track system, which is married at the rail–wheel interface, anything less than the good condition of both – the vehicle and the track – causes a vicious spiral downwards to a bad condition of both". T+S

Rail's key role in national development

RAILWAY TECHNOLOGY WAS A key to the building and economic development of a country, Professor Elizabeth Croft, the new Dean of Engineering at Monash University, told the audience at the Stephen Marich annual lecture on railway engineering.

Professor Croft, from Vancouver, Canada, said she bought with her to Melbourne an understanding of the importance of railways.

"Canada, like Australia, with a large land mass, small population and large resource-based economy with many remote locations, was absolutely dependant on rail; rail developed and formed the shape of the country I was born in. So it is a very important, proud part of our history, and it continues to play an incredibly important part in the development of Canada, as it does in Australia."

She described Monash University as doing outstanding research and said she was proud that Monash engineering was the number one engineering facility in the country.

Professor Croft said she was looking forward to telling the world about the outstanding research work being done by the university.

"We have an amazing opportunity to work together to solve the true technical challenges that are facing the railway industry with our mechanical, civil and material science and electrical and computer and chemical engineers along with our IT and science colleagues... in our quest to provide a clean, safe, reliable and efficient transportation," she said.

"I and my colleagues have great plans for this fine university and this wonderful school; we are planning to have 50 per cent women in all of our programs in engineering."

She said they were planning to develop an entrepreneunal ecosystem, enhance the engineering school's industry engagement and provide opportunities for all students to participate in "meaningful research and work experiences".

– TONY DUBOUDIN

Rail experts share knowledge around

WITH TWO LEADING INTERNATIONAL rail engineering experts scheduled to travel to Melbourne for the 2018 Stephen Marich lecture, Monash University's Institute of Railway Technology (IRT) seized the chance to give Australians maximum opportunity to glean insights from the visitors' experiences.

Lecture presenter Dr Robert Fröhling, principal engineer in the technology management department, Transnet Freight Rail, South Africa, and Gary Wolf, a rail derailment investigator from the United States, who delivered the annual Marich lecture last year, spent additional time in Melbourne either side of the event itself on the evening of 14 March.

In total, at IRT's invitation the two men taught three classroom-based

courses over four days to roughly 60 rail professionals.

On Tuesday 13 March Dr Fröhling and Darrien Welsby, team leader for wheel–rail interface and track at IRT, led a single-day course on wheel–rail interaction. Interest was high and the allotted positions were booked up quickly.

At the request of Metro Trains Melbourne management, IRT slotted in a private repeat of the course in its Rail Innovation Lab specifically for an MTM group later in the same week.

Mr Wolf, who has investigated more than 4000 derailments worldwide and trained more than 5000 individuals in such investigative work, provided a course on the subject over two days on Thursday and Friday 15 and 16 March.

His sessions were held in the New Horizons building at Monash University's Clayton campus.

Fittingly, a bogie donated by the Fortescue Metals Group sits on permanent display directly outside the strikingly angular building. T+S