

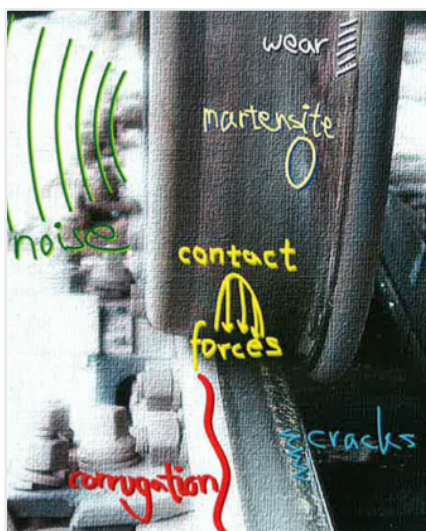
Understanding wheel/rail interaction - A unique opportunity

BOB TUZIK *Executive Program Director, Wheel Rail Seminars*

Railway Engineers, researchers and suppliers come together to examine the performance of wheels and rails and vehicle/track interaction in a four-day seminar.

Ask railway engineers how they manage wheel/rail interaction on their systems, and they'll invariably mention: clean, hard wheel and rail steels; complementary vehicle/track and wheel/rail profile design and maintenance; effective friction management; and measurement systems that allow them to monitor and analyze conditions over time. The primary lesson they will have learned is that the wheel/rail interface is a system. Managing it requires a good understanding of what goes on above and below the rail, and at that little elliptical contact patch where it all comes together.

Twenty-five years ago, understanding of the complex interaction that takes place at the wheel/rail interface was limited to a few. Nomenclature, such as "friction management," a staple today, wasn't even part of the railway vernacular. Events have changed that. Today, it, along with metallurgy, and wheel/rail profile design and maintenance, are cornerstones of a well-managed VTI system.



The Wheel on Rail - Cause and effect: the interaction is a complex feedback mechanism. Image courtesy of Shankar Rajaram, Sound Transit



Dr. Kevin Oldknow, Program Director of the WRI Principles Course, lays the foundation for a firm understanding wheel/rail interaction. Image courtesy of Jack Lindquist

While it hasn't done it alone, one conference – Wheel Rail Seminars' annual Wheel/Rail Interaction (WRI) conference – has been at the forefront, working with rail engineers, researchers and suppliers from many countries to promote understanding, through a day of "Principals," and information on the practical application of techniques and technologies to address issues such as noise, wear, rolling contact fatigue and derailment potential. Information is presented against a background of supporting principals and theory that are delivered in an easily understood manner by seasoned professionals.

"Addressing the right topics is crucial, but perspective is important, too," said Wheel Rail Seminars' Founder Gordon Bachinsky. "Whilst there is a lot of published research now, we try to present case studies that focus on the practical application of new and existing technologies to solve or understand, at least, the WRI-related problems occurring on railways or rail transit systems against a background of how the knowledge can be turned into real benefit." The "Transit" portion of the 2018 WRI conference, for example, zeroed in on some of the noise- and vibration-related issues facing several North American Transit systems.

"To understand how to mitigate noise, you have to understand the root causes," Briony Croft, principal engineer at Acoustics, SLR Consulting (Canada) Ltd., told delegates at the 2018 WRI Transit conference. The combined roughness of the wheels and rails directly affects the overall noise level. Higher roughness increases the noise from both vehicles and track. The other factor is speed. "Rolling noise is proportional to speed," she said, "The faster you go, the more noise you get." Properties including San Francisco's Bay Area Rapid Transit (BART) and Seattle's Sound Transit discussed their efforts to reduce noise and vibration and improve overall wheel/rail interaction through various techniques, including the use of acoustic measurement to find weak links in the track structure and to guide their grinding programs.

"Grinding is going to be the key to longevity here," BART's Principal Track Engineer - Maintenance & Engineering Gregory Shivy told attendees at this year's WRI Transit conference. Through the introduction of a family of four new rail profiles to match new wheel profiles that are being introduced on the system, and a grinding program guided by acoustic measurements to address corrugation and rolling contact fatigue, BART has improved overall rail surface quality and reduced noise levels at some locations by up to 20 decibels.

BART also reported that its new wheel/rail profile design has also reduced lateral loadings and wheel flange thickness and overall wheel profile wear by more than half, compared to the previous design.

Sound Transit reported that an investigation into broken fasteners pointed to a resonant frequency generated by a rail roughness wave associated with the finish quality of its grinding program that appears to push the clips beyond their design limit. As a result, Sound Transit is adopting an ISO grinding specification, which has more stringent requirements for the final surface finish than the EN (European) specification that North American grinders typically work to.

"This practical, 'problems – solutions' approach to the issues is what makes the annual WRI conferences tick," Wheel Rail Seminars Founder Gordon Bachinsky said.

Wheel wear patterns and wheel life are also recurring topics at WRI conferences. Simon Jarrett, Head of Technical Services at Chiltern Railways talked about the railway's investigation into wheel-turning practices at the first European WRI conference in 2015. "We have to minimize tyre-turning in order to maximize wheel life," Jarrett said. Chiltern Railways uses data from a program designed to monitor wheel tread condition to identify wear trends and optimise wheel-turning intervals. "We estimate that the program on its own has increased overall wheel life by 20 percent; when we wheel-turn, we know we're not taking any more metal than is necessary," he said.

Wheel profile and wheel-turning methodology are only one piece of the wheel wear picture, of course. Depending on the system, different parts of the wheelset can be the life-limiting factor. As a result, railways like Chiltern employ a variety of condition-monitoring equipment and techniques to take a comprehensive look at in-service wheelset health. This includes monitoring brake pads and actuators, axle bearings and suspension elements. It also includes the use of wheel impact load detectors to identify bad actors before conditions worsen.

"All elements of the wheelset have to be optimised, so all elements have to be monitored," Jarret said.

The 25th Wheel Rail Interface seminar will be continuing the discussion at the annual North American conference in New Orleans, La., in June 2019, and attendees from the UK and Europe would be most welcome. Later, following on from the 2015 event in Derby, there will be a WRI European Union conference in Vienna in October 2019, featuring ÖBB, Austrian Federal Railways, as a presenting partner.

For more information or background on the event in the UK and Europe contact Paul Baker, mobile 07779 135032 or paul.baker@bakerailservices.co.uk

WRI 2019

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The Rail Transit Seminar is devoted to examining wheel/rail, vehicle/track interaction on rail transit systems. This cross-disciplinary seminar includes

presentations from experts in vehicle/track dynamics, noise and vibration, vehicle/track design and maintenance, friction management, and State of Good Repair. Join a unique group of transit professionals, researchers and suppliers at this seminar to examine recent developments in research and technology, to participate in lively discussion and gain a better understanding of the complex interaction at the rail transit wheel/rail interface.

Sample topics include:

- Asset Management/State of Good Repair
- Wheel/Rail Monitoring and Analytics at NYCT
- Wheel/Rail Modernization Efforts at San Francisco—BART



The Principles of Wheel/Rail Interaction Course is an intensive, full-day course that provides fundamental coverage of the primary aspects of

wheel/rail, vehicle/track interaction. Drawing from both theory and practical application, the course covers contact mechanics, track geometry, vehicle suspension systems, vehicle/track dynamics, wheel/rail profile design, friction management, measurement technologies and more—all the elements that are required to promote a more complete understanding of vehicle/track dynamics and wheel/rail interaction. Typical topics include:

- Wheel-Rail Contact Mechanics
- Track Structures, Components and Geometry
- Vehicle Types, Suspensions and Components



The Heavy Haul Seminar is devoted to examining wheel/rail, vehicle/track interaction on rail freight and shared-track passenger systems. The Seminar

brings together track and mechanical users, researchers and suppliers in a positive, educational setting like no other in the industry. Information on where and how the latest technology is being used to improve wheel/rail interaction and overall performance on freight and passenger railways is presented by some of the best minds in railroading. Information is presented through a combination of seminar sessions, panel discussions, dedicated Q&A periods and “InfoZone” sessions. Sample Heavy Haul topics include:

- Wheel Condition Monitoring with Machine Vision System on Class 1s
- Examining the role of Wheel/Rail Interaction in Derailments
- Weighing the Benefits of Low-Impact Bogie Designs



For more information on the 25th Annual Conference, please go to www.wheel-rail-seminars.com or contact Brandon Koenig, Director of Operations: Brandon@wheel-rail-seminars.com, 847-808-1818

Conference produced by:
Wheel Rail Seminars

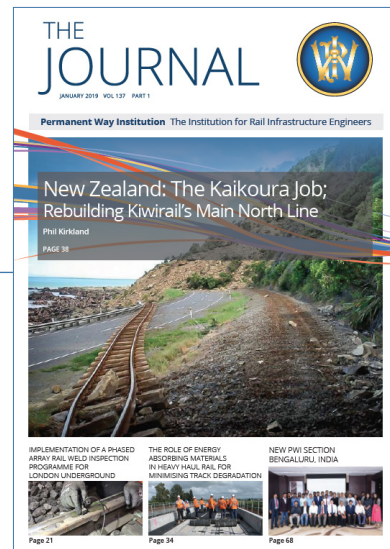
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TECHNICAL ARTICLE

AS PUBLISHED IN

The Journal January 2019 Volume 137 Part 1



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