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Charting the future of heavy haul

RESEARCH Work is in progress in North America on a range of projects to refine heavy haul technology, raising productivity and reducing costs.

In a wide-ranging presentation at the IHHA's 9th conference, held in Shanghai on June 22-24, Transportation Technology Center Inc's Vice-President of Research & Development Semih Kalay described work in progress in North America to refine heavy haul technology. Better productivity, higher standards of safety and lower costs are all in prospect thanks to research at the test centre in Pueblo, Colorado.

The FAST (Facility for Accelerated Service Testing) track at Pueblo continues to deliver a wealth of valuable information for North America's Class I railroads. Last year 135 million gross tonnes rolled over the 4·3 km loop, subjecting rail steels, sleepers and other track components to the real-life conditions of heavy haul operations.

Driverless train trials

Over the last three years the FAST loop has been put to good use to test the feasibility of unmanned trains. Using funding from the AAR and FRA, work initially focused on 'hardening' communications and minimising in-train forces. An on-board track monitoring system has been developed, and this is designed to ensure that a train comes to a halt if a red alert indicating a rail break or other critical condition is detected. Full-time unmanned operations on FAST are now up and running.

Wagon inspection at Qinhuangdao. The IHHA party looks on as Chinese Railways inspectors check screen images of coal wagons for faults. Typical faults ringed in red feature on large posters in the hall of the inspection office. The facility was of great interest to visitors from North America, where wagon fault identification is being automated.

Next generation wheels and rails

TTCI is making good progress in defining an advanced wheel design. The specification called for a yield strength of 130 ksi and a Brinell hardness of 380 to 420. Laboratory tests on eight types of wheel have been completed, and an SRI (Strategy Research Initiatives) design that met all the specifications was chosen for trials at FAST. So far the wheels have completed 32 000 km, and Union Pacific was due to start revenue service tests in June.

Other recent work at TTCI includes the development of a low-alloy premium steel rail with superior resistance to wear and rolling contact fatigue. It is now possible to produce rail with a Brinell hardness exceeding 400, and evaluation of seven types led to the choice of a rail with a Brinell hardness of 412 from Austria's Voestalpine for further investigation — TTCI is planning to install a section in the FAST test loop at the end of this year.

TTCI is also working on a next-generation sleeper design with the help of Prof Klaus Riessberger from the University of Graz. Known as a 'dogbone' because of its shape, it fits the general envelope of a conventional sleeper and can be tamped with existing machinery. Features include integral pads on the bottom of the sleeper and larger end and vertical footprints.

Another track component warranting investigation is a partial flange-bearing turnout frog offering a continuous rail on the main line. Wheels on trains taking the branch of the turnout are raised so that the flange tip is even with the rail on the main line. The wheels then run across the main line rail on the tips of their flanges. The design is being developed in partnership with VAE-Nortrak.

Hybrid bridge structures

Other work in progress covers the development of an advanced bridge design making use of hybrid composites. The span structure features steel tension ties, filler foam and a glass fibre housing. Endurance tests for a 'second generation' prototype span are in progress at FAST, and so far this has been subjected to 80 million gross tonnes. Deflection is greater than for prestressed concrete, but structural performance is satisfactory.

Inspection technologies

TTCI has been developing rail inspection technologies for some time now, and work is in hand to perfect technology that can 'see' inside a rail. This uses laser-based ultrasonics developed with Tecnogamma and MerMec, with four beams looking at each rail.

Train inspection is another major focus of research, and an array of technologies is being brought to bear in an attempt to reduce damage to infrastructure across North America. Three broad inspection categories can be identified:

Wayside condition detection
- cracked axle detectors;
- cracked wheel detectors;
- thermal scanners;
- acoustic bearing detectors;
- low air hose detectors;
- dragging equipment detectors.

Wayside performance detection
- bogie hunting detectors;
- bogie performance monitors;
- wheel impact load detectors;
- warm bearing trend detectors;
- warm wheel trend detectors.

Wayside machine vision technology
- wheel profile modules;
- brake shoe modules;
- automated safety appliance inspection;
- automated wagon structure inspection.

A fully-automated train inspection system has been installed at Pueblo, and one side of a train can be inspected in 13 min. A commercial version of the system is currently being commissioned on a Union Pacific line serving North Platte.

According to Kalay over the last eight years, derailments in North America caused by broken rails and broken wheels have been cut by 10%, and bearing-related derailments by 25%. The number of high-impact wheels has been reduced by 90%, and more than 2000 wagons have been identified for repairs.