SMART RAIL

SMARTRAIL LEADS TO OPTIMISED WHOLE LIFE MANAGEMENT OF RAIL INFRASTRUCTURE ELEMENTS

In order to effectively manage ageing railway infrastructure, a well-defined safety assessment framework is required. In the 36-month FP7 Smart Maintenance of Ageing Rail Infrastructure (SMARTRAIL) project, which finished at the end of August 2014, a reliability-based framework was developed for optimised whole life management of rail infrastructure elements including **bridges, tracks and slopes**. Here we present the main results of the project.

NEW TECHNIQUES

Methods to obtain real-time information on the performance of rail infrastructure, which could feed the reliability based model and allow updating of the safety level were developed and tested on railway infrastructures across the EU. These techniques included; the development of innovative sensors to monitor the corrosion rate of steel and concrete bridges, the application of geophysical techniques as a non-destructive method of evaluating the condition of open-track and embankments, the use of simple accelerometers to derive a vibration based method of measuring the development of bridge scour and the development of an early warning system for rainfall induced landslides.

LIFE CYCLE ANALYSIS - WHOLE LIFE CYCLE TOOL

In order to make rational choices on the economic and environmental benefits of any remedial works, a life cycle analysis (LCA) and life cycle cost (LCC) tool were developed within the project. The tools, available on **smartrail.fehrl.org**, were used to prove the environmental and economic cost benefits associated with the remediation techniques demonstrated in the project.

DEMONSTRATION PROJECTS

The framework documentation includes typical distributions of stochastic variables and recommends target levels of reliability. The approach was illustrated by the application of the methodology to two demonstration projects, a steel railway bridge in Poland and a 150-year-old railway embankment in Ireland. Given the different challenges faced by infrastructure managers across the EU and the range of local materials available to effect solutions, a series of full-scale demonstration projects was undertaken in conjunction with infrastructure managers who participated in the SMARTRAIL project. These included the remediation of a metallic bridge using ultra high-strength fibre rein-

forced concrete in Croatia, the use of geosynthetics to prevent ballast fouling in Slovenia, and the demonstration of the efficacy of a new technique which uses vertical anchors to provide a smooth variation of stiffness across the transition zone for the reconstructed Buna Bridge in Croatia.

INNOVATIVE USER PLATFORM

The SMARTRAIL project was a truly collaborative project which through the establishment of a user platform, involved major stakeholders including rail operators, infrastructure managers, engineers, researchers, regulatory bodies and policy makers from the beginning of the project. A particular feature of the project is the publication of the following non-technical user guidelines, which can be downloaded from **smartrail.fehrl.org**.

- Bridge Scour Monitoring A Guideline - WP1
- Reliability based Infrastructure Safety Framework Guideline - WP2
- Implementation of Geosynthetics Guideline - WP3
- Life Cycle Assessment Whole Life Cycle Tool Guideline – WP4

RESULTS PRESENTED AT FINAL CONFERENCE

Opening Session of the Smartrail Final Conference (Ljubljana, Slovenia)

The practical application of the scientific research findings was the key theme running through the final conference held on 25-26th August in Ljubljana, Slovenia. The agenda featured presentations of the cutting edge science developed, as well as three engaging and salient keynote speeches. The programme concluded with a lively round table debate on the future of the project.

Roundtable Session at Smartrail Final Conference (l-r) Michael Robson, Irina Stipanovic, Eduardo Fortunato, Eugene O'Brien, Andreas Zimmer, Stefan Eisenbach

1. SMARTRAIL SCIENTIFIC RESULTS

Project Coordinator Dr. Ken Gavin (UCD) opened the meeting with an overview of the project, following which WP leaders presented a summary of the main project outcomes.

For **WP1 (Monitoring and Inspection),** WP leader Dr. Ken Gavin explained how an instrumented smart slope experiment was performed in Ireland with two types of sensors, suction probes and water content probes. Work on monitoring bridge loading (Adaptronica) and corrosion monitoring (ZAG) at demonstration sites in Poland and Slovenia were also described.

Professor Eugene O Brien of Roughan and O'Donovan Innovative Solutions (ROD-IS) outlined that **WP2 (Assessment and Models)** covered methods to extend the life and optimise rehabilitation/renewal. The tasks were explained by Dr. Stefan Lachinger (AIT) and Arkadiusz Mroz (Adaptronica).

For **WP3 (New rehabilitation technologies to extend service life of existing railway infrastructure)**, Stanislav Lenart (ZAG) presented work on open tracks, Marko Vajdic (IGH) on Transition Zones, Duo Liu of (TUM) on Modelling, Tanja Mikulic (IGH) on Tunnels, Irina Stipanovic (UT) on Bridges and Aljosa Sajna (ZAG)

on a novel application of Ultra High Performance Fibre Reinforced Concrete (UHPFRC). Parts of **WP3** and **WP4 (Whole Life-Cycle Cost Calculation Tools)** were picked up by Stanislav Lenart (ZAG) and Simon Kovačič (SŽ), while Karmen Fifer Bizjak (ZAG) presented the LCC tool.

2. DIVERSE AND ENGAGING KEYNOTES

Keynote speakers included Andreas Zimmer of UNECE's Trans-European Railway (TER) Project, Stefan Eisenbach (UBIMET) and Prof. Meho Saša Kovačević (University of Zagreb).

Full project results, deliverables, conference presentations and supporting documents are available on **smartrail.fehrl.org**. Contact **smartrail_admin@ucd.ie** for more information or see the SMARTRAIL group on **in**.

Smartrail Final Conference second day visit to a building site for railway rehabilitation

Smartrail Final Conference Site Visit: (l-r) Witold Opinski, Vladimir Soloviev, Brian Bell, railway museum staff, Ales Žnidarič

PARTNERS