PROJECT

WIDEM
Wheelset Integrated Design and Effective Maintenance

Funding: European (6th RTD Framework Programme)
Duration: Jan 2005 - Dec 2007
Status: Complete with results
Total project cost: €3,766,500
EU contribution: €1,949,900

Call for proposal: FP6-2003-TRANSPORT-3
CORDIS RCN: 74943

Background & policy context:
The economic efficiency and competitiveness of the rail transportation mode depends on safety, availability and maintenance of its individual highly loaded structure components such as railway wheelsets. The WIDEM project aimed to improve efficiency and competitiveness through a fundamental re-examination of wheelset design, which in turn will facilitate improved maintenance practices. Combining inputs from reliable service measurement of wheel-rail forces carried out by means of an innovative instrumented wheelset and extensive assessment of actual material properties, an original endurance strength design concept was developed and validated through a comprehensive testing programme on full scale wheelset prototypes.

Objectives:
Combining inputs from reliable service measurement of wheel-rail forces carried out by means of an innovatively instrumented wheelset and an extensive assessment of actual material properties, an endurance strength design concept was developed and validated through a comprehensive testing programme on full-scale wheelset prototypes. A flexible numerical tool was also proposed as an upgrading of existing knowledge.

Additionally, the project developed and evaluated alternative NOT (non-destructive testing) techniques that allow a greatly increased detection probability and a size estimation of cracks to set up a schedule for NOT periodic inspection. The research work led to the definition of wheelset design procedures and maintenance methods to be implemented into existing standards for a quick and easy optimisation of the process.

Methodology:
Description of work:
• creation and validation of an innovative methodology to design and validate wheelsets. This methodology is based on load spectra and S-N curve for the material in the full-scale condition;
• definition of a rigorous methodology to test the fatigue resistance of full-scale axles and wheels;
• research on fretting fatigue phenomena, which takes place under axle seats, by taking into account seats and section transition geometry, press fit pressure and axle/hub slip;
• the WIDEM project has developed an innovative measuring wheelset using up-to-date wireless data processing and transmission technology.

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Parent Programmes:
FP6-SUSTDEV - Sustainable Development, Global Change and Ecosystems - Priority Thematic Area 6 (PTA6)

Institute type: Public institution
Institute name: European Commission
Funding type: Public (EU)

Lead Organisation:

Lucchini Rs Spa

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EU Contribution: €0

Partner Organisations:

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Organisation Website:
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EU Contribution: €0

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EU Contribution: €0

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EU Contribution: €0

Dynamics, Structures & Systems International

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**Key Results:**

A new real-time measurement methodology of wheel-rail contact forces based on the acquisition of axle deformations having a bandwidth of about 70Hz has been developed. The development of a standard procedure for processing load (or stress) measurements has allowed the computation of a wheelset design mission profile.

The innovatively instrumented wheelset developed in WP1 was mounted on a Czech Pendolino vehicle and used to determine the load spectra. Specific measurements were made by running on switches and turnouts. The possibility of combining full-scale experimental fatigue tests resulting from a current testing campaign together with a FEM model representing the actual longitudinal stresses and micro-slips between hub and seat has enabled the definition of design criteria against fretting fatigue. This work was conducted for A1N, A4T and 30NiCrMoV12 steel grades.

Full scale tests were carried out on the Lucchini test rigs to find the fatigue limit at \(10^7\) cycles for different diameter ratios with the aim of validating the above described fretting fatigue model and of defining the 'D/d border'. Below this value, cracks would appear on the axle seat; above this value, cracks would appear on the body fillet. Such a value would increase with the fatigue resistance of the steel grade so that it was appropriate to define the optimal D/d for each kind of material. Different inspection methods were applied on both fatigue tested axles and real in-service cracked axles to find the probability of inspection related to crack or defect dimension.

Inspection intervals: significant work has been completed in deriving crack growth rate parameters under both plane and rotating bending conditions.

Documents:
- [Publishable final activity report.pdf (Final report)](http://example.com)

**STRIA Roadmaps:** Vehicle design and manufacturing, Infrastructure  
**Transport mode:** Rail transport  
**Transport sectors:** Passenger transport, Freight transport  
**Transport policies:** Societal/Economic issues  
**Geo-spatial type:** Other