TURNOUTS

New Concepts for Turnouts in Urban Rail Transit Infrastructures

Funding: European (6th RTD Framework Programme)
Duration: Nov 2003 - Jan 2007
Status: Complete with results
Total project cost: €3,950,916
EU contribution: €2,019,646

Call for proposal: FP6-2002-TRANSPORT-1
CORDIS RCN : 74281

Background & policy context:

There is a significant difference between railway operations and urban transport (tram, metro) operations. The main one is speed. The speed varies from 100 km/h for a freight train to 160 km/h for medium-distance trains to 350 km/h for high-speed trains. In comparison, the maximum speeds of a tram and metro are far lower at respectively 50 and 100 km/h. Railway axle loads range from 18 tonnes for passenger coaches to 22.5 tonnes for freight and locomotives, whereas axle loads for tram and metro range from 8 to 14 tonnes.

Railways usually face fewer geographical and thus environmental concerns, as they run separately, typically at a greater distance from houses. Metros and trams face significant space constraints as they operate in an urban environment. Metro tracks are in a tunnel and turnouts cause great concerns, especially in terms of noise and vibration. Trams operating on the streets, often close to houses, cause similar problems.

In addition, trams operating on the street require special (girder) rails and thus special turnouts. All these elements show that, even though the basic concepts are the same, turnouts developed for railways cannot be simply implemented in urban transport.

Objectives:

The objective of the project is to improve the vehicle-track interaction of turnout systems as used in urban rail transit, and therefore improve their efficiency, enhance their safety levels, reduce their maintenance costs, increase their life expectancy and restrain the emitted noise.

Methodology:

The TURNOUTS project starts with the modelling of actual turnouts to provide the benchmarks against which the improvements will be measured. Design changes will be implemented in the models to predict their behaviour. The turnouts will be manufactured and installed for validation purposes and measurements will be performed to confirm the predictions from the models. The end result will be a series of turnouts with improved characteristics.

The project is divided into several groups of activities:

1. Six different existing turnout systems representing the conventional turnouts used today will be measured and modelled. The models will be optimised to reflect the actual measurement results. Improvements and changes will be made to these turnouts. The models will then be used to optimise the proposed changes.
2. A large number of potential measures to reduce impact forces will be defined. Conceptual design studies will be made for some of these designs.
3. Seven test sites will be selected within the networks of the participating operators and the most
optimal design for each particular location will be developed.
4. The most optimal designs will include the use of new materials, new manufacturing techniques and new installation techniques. The selected designs will be manufactured and tested in the lab.
5. After installation, the performance of the designs will be tested and compared against the calculated results.
6. The results of the new designs will be used to develop conclusions about the benefits of various designs.

**Parent Programmes:**
**FP6-SUSTDEV-3 - Global Change and Ecosystems**

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

**Lead Organisation:**

*Dynamics, Structures & Systems International*

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Key Results:

A comparison of the initially planned activities and work actually accomplished is given below, based on the major milestones of the project:

- Validated modelling procedures for existing types of turnouts - models considered as validated if they can predict the wheel/rail forces in the turnout with an accuracy of 3 dB: as described above, POLIMI and NTUA have developed innovative numerical modelling techniques capable to simulate the passage of a vehicle along the turnout, taking into account the variable geometry and stiffness of the turnout. These models have been validated on three different reference turnouts. Comparison with measured data has shown that the targeted accuracy of 3 dB has been reached.

Availability of 7 new validated turnout designs, including drawings with geometry and material characteristics: the available 7 designs are:

1. New BFM frog with railpads with a stiffness of 50 kN/mm.
2. Embedded FDP turnout with discrete rail fixations.
3. JEZ turnout with movable point frog.
4. D2S solution: turnout with under sleeper pads and ballast mat.
5. COGI embedded low profile turnout with wheel flange bearing.
6. COGI embedded low profile turnout, running on wheel tread.
7. Industrial turnout with casted manganese steel crossing.

- Availability of 6 new turnouts (hardware) with quality verification: there were finally 7 new turnouts manufactured and tested, corresponding with the 7 designs listed above.
- Availability of seven turnouts on site (6 new turnouts and 1 modified turnout) with performance verification: there were finally 7 new turnouts and 1 modified, corresponding with the 7 designs listed above + one longitudinally reprofiled turnout. The performance is considered as valuable, i.e. it shows a reduction of the impact forces with 50 %, for most of them. In cases where the performance is not reached, an explanation could be found, based on numerical modelling or technical installation contingences.

In general, initially planned activities have well been accomplished and the results are fully compliant with the project’s objectives.

Technical Implications

The project has realised a major technical breakthrough in turnout designs for urban rail.

Following validated findings are of utmost importance:

1. low rail can be used in turnout systems without jeopardising the system;
2. completely embedded turnout systems (without discrete rail fixations) can be used without jeopardising the system;
3. noise and vibration impact during turnout passage can be reduced to minimal (less than 4 dB or 4 dB(A) increase vs. tangent track) when using:
   - embedded turnout systems (COGIFER);
   - hybrid turnout system (FDP);
   - turnouts with movable point frog (JEZ);
   - elastically supported frog (D2S).
4. all validated turnout systems can be integrated in the street pavement (road traffic).

Readiness

The major European industrial players for turnout systems (COGIFER, JEZ (VA) and BFM) have worked together in this project to come up with these solutions which are immediately applicable and available on the market.

Documents:

- PUBLISHABLE FINAL ACTIVITY REPORT.pdf (Final report)

STRIA Roadmaps: Network and traffic management systems, Infrastructure
Transport mode: Rail transport
Transport sectors: Passenger transport, Freight transport
Transport policies: Safety/Security
Geo-spatial type: Infrastructure Node