The project 'Low noise Train on a Real Track (LZarG)'

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Introduction

The growing railway traffic causes increasing sound emission. Therefore Deutsche Bahn AG makes every effort to reduce the sound emission, especially of composite block braked freight trains. So DB has set itself the goal of halving, by the year 2020, the level of rail traffic noise experienced by local residents in 2000.

As one of the major railway companies in Europe, DB performs continuous investigation to respond to public demand for railway traffic with low noise impact. The aspects of the reduction of the generation of noise are being tackled in several projects, mainly together with expert partners. Joint research projects provide a common knowledge base and strongly support the harmonization of existing national rules and guidelines for train design and operation.

Thus, a research and development program for a low-noise railway is under way at DB to treat the noise of the vehicles and infrastructure. The direct noise experienced by railway-lineside residents due to train movements on the track can be reduced by minimizing the sound radiation directly at the source. This is the first-choice solution as it proves to be the most effective countermeasure regarding a cost-benefit relation.

This article describes three efforts of DB to develop a modern ruling for railway noise prediction and to reduce railway noise.

The Environmental Noise Directive

The European Parliament and the Council have put into force the Directive on the Assessment and Management of Environmental Noise ("Environmental Noise Directive (END)" [1]), aiming at avoiding, preventing or reducing harmful effects of environmental noise on human health. END requires member states to produce "strategic noise maps" by using noise indicators assessing the number of people affected by noise, to inform the public about noise exposure, and to draw up "action plans" to reduce noise where necessary. The directive was transposed into German legislation [2] in 2005 and has tightened the requirements governing traffic noise abatement. In future, local authorities will have to set down action plans to prevent and reduce environmental noise based on noise-mapping results. Cost-effectiveness will play a crucial role when assessing the proposed noise reduction strategies.

DB has responded positively with its self-obligation to decrease the environmental impact of railway traffic [3 - 7].

Deutsche Bahn takes its responsibilities seriously and has set itself the ambitious goal of halving, by the year 2020, the level of rail traffic noise experienced by local residents in 2000. If this target is to be achieved, all available noise abatement techniques need to be used.

Deutsche Bahn is aware of the effects that noise emissions from rail traffic can have. This is the reason why a noise reduction program was initiated [8]. Efforts are being made to reduce noise at the source, i.e. from the vehicle itself or from the wheel-rail interaction. Having optimized the acoustic characteristics of new vehicles used for local and long-distance passenger services, major reductions in noise emission levels from freight wagons are now feasible. The novel composite brake block (known as "K-block"), which has undergone extensive testing, was recently approved for international use [9, 10]. Up to now, wheel treads were roughened every time the cast-iron brake blocks were applied. With this new development, the treads remain smooth - a fact which will lead to a reduction of 8 to 10 dB(A) in rolling noise.

DB's national plan to reduce railway noise

An important building block in DB's national plan to reduce railway noise by at least 10 dB(A) by 2020 compared to 2000 is the "LZarG"-project (see Figure 1), which was launched in December 2007 [11]. The outcome of this project will add notably to the effect of the federal noise rehabilitation programme and to the noise reduction by retrofitting composite brake-blocks to freight wagons. LZarG is funded by the German Federal Government and adopts the strategy to decrease the noise of trains by reducing the sound radiation at its origin, i.e. at the wheel/track interaction.

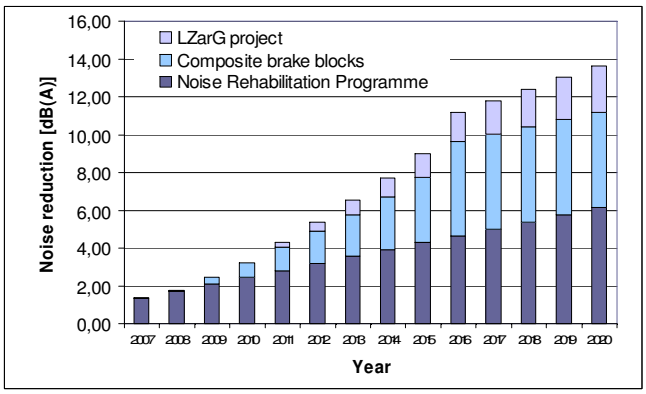

Figure 1: The project 'LZarG' is one of three building blocks in DB's strategy to reduce railway noise by at least 10 dB(A) by 2020 compared to 2000.

Project structure

The project consists of the three parts A, B and C where part B "reduction of the rolling noise" covers the technical as-

pects of the project. It comprises the optimization of wheels, bogies and the track system in the subprojects B1 to B3.

At the end of the project all improvements achieved will be evaluated in field tests with a test train on different track systems which is the content of part C.

In order to ensure that each development within LZarG is in agreement with the relevant regulations and the special requirements of rail traffic and in particular with the special needs of Deutsche Bahn including maintenance procedures, an additional part A "System integration and implementation" was defined embracing the other parts "B" and "C". Within subproject "A" all project partners are consulted by Contraffic GmbH.

The structure of the project is shown in Figure 2.

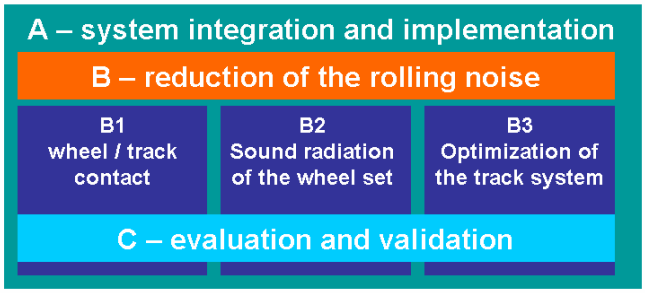

Figure 2: The structure of the project 'LZarG'

Subproject B1

This subproject led by Transtec Vetschau GmbH covers the wheel/track contact in detail with the aim to optimize the bogies of freight trains in order to find single low-noise components. Components such as the CFCB-module of Knorr Bremse or the Gigabox-system of Contitech will be included in that optimization process. In order to reduce the noise Bochumer Verein Verkehrstechnik GmbH is doing research on different wheel steel grades like "ER7" or similar low-alloyed pearlitic-ferritic steels based on specifications such as EN 13262. Special focus will be given to the damage behaviour and plastic deformation of these steel qualities, in particular to the contiguities of short pitch corrugation development and material properties. Optimizing the heat treatment processes to produce an especially fine-grained microstructured monoblock and investigating the influence of the material behaviors in order to reduce the short pitch corrugation with methods of an enhanced melting technique is part of this subproject. Also the usage of rail absorbers will be taken into account. Partners of this subproject are Bochumer Verein, Knorr Bremse, Contitech and the Technical University of Berlin.

Subproject B2

Minimizing the sound radiation of the wheels of regional trains and freight trains will be done by developing a new wheel set design as well as wheel dampers within a second subproject led by Bombardier Transportation. Wheel dampers fixed on block braked freight wheels have to withstand high temperatures which is one important topic of investigation (Fig. 3). Also the disks of the braking system connected to the wheel set in case of regional trains will be taken into account. Partners of this subproject are Gutehoffnungshütte Radsatz GmbH, Faively, Deutsche Bahn and the Technical University of Dresden.

Figure 3: Recent wheel damper of the company Schrey & Veit to be improved within the project 'LZarG'.

Subproject B3

This subproject covers the acoustic optimization of the track system led by DB Systemtechnik. Three topics will be handled: special rail fastening systems (see Figure 4), soft under sleeper pads and damping devices mounted at the rail.

Figure 4: Recent elastic rail fastening system "Delcor Egg" of the company Vossloh to be improved for railway bridges within the project 'LZarG' (above: total vies, below: cross section).

The rail dampers on investigation are already used in tram traffic (see Figure 5) and show a good sound reduction behaviour. Now that dampers have to be adjusted and optimized to meet the special needs of freight traffic within the subproject using special calculation tools (see next chapter). The optimization of the rail fastening system "delkor egg" will focus especially on specific scopes like e. g. bridges. Up to now this system is often used in slab track systems with the effect of reducing ground borne noise. Since a bridge structure is excited by the vibrations of the track system, usage of such a special rail fastening system with high resilience will lead to lower vibration of the bridge structure and therefore the drumming noise will be reduced. Partners of this subproject are Vossloh Fastening Systems GmbH, Werkstoffe Getzner and the Technical University of Munich.

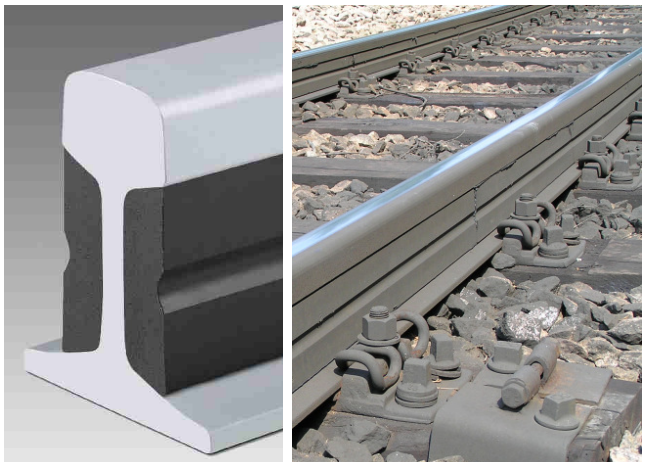

Figure 5: Recent rail absorbers of the company Vossloh for tram systems will be improved and adapted to tracks especially for freight trains within the project 'LZarG'.

Conclusions

This article describes three recent efforts by DB to develop a modern ruling for railway noise prediction to reduce the generation of railway noise and the mitigation of vibrations. These projects will support DB's self-obligation of halving, by 2020, the level of rail traffic noise experienced by local residents in 2000. To achieve this ambitious target, well co-ordinated implementation of state-of-the-art noise abatement techniques covering both vehicles and infrastructure is needed.

After completing the projects mentioned, DB will be able to use the end results to reduce railway noise significantly. The key results and deliverables are noise abatement techniques for rail vehicles and the infrastructure. Tools, methodologies and input data for decision support systems are available as well.

The project is intended to finish in 2010 and it is expected that the noise-reduction technologies developed will be available for regular use at the end of the project.

Acknowledgement

The LZarG project receives funding from the German Federal Ministry of Economics and Technology, which is gratefully acknowledged.

References

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