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Railway Noise: a Problem?
A Contribution to the Solution: sonRAIL

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ABSTRACT

The 2 European high-priority freight axes “Antwerpen – Basel – Genova” and “Rotterdam - Basel – Genova” are passing Swiss territory. It is the clear intention from the Swiss sovereign to transfer the goods transportation from trucks to railway. Regretfully, this means to run noisy freight trains in the noise-sensitive nighttime, because during the day the tracks are fully booked with passenger trains. It is the noble task of the project sonRAIL to know what the actual noise situation is, and to localize the turning keys in order to reduce the problem to an acceptable level. Project sonRAIL: a noise prediction model of a new generation for the next decades.

1. INTRODUCTION

sonRAIL is a calculation model for railway noise that is currently developed with an interdisciplinary project team. The project is funded by the Swiss federal office for the environment FOEN. The project team is composed of several enterprises and institutions:

- Empa, Swiss Federal Laboratories for Material Testing and Research, Laboratory for Acoustics
- Technical University of Berlin, dept. of rail vehicles: Sound emission model of the vehicles and tracks
- PROSE: dept. measuring and testing “Assessment of the rail roughness on Swiss network via indirect measuring method”
- Sulzer Innotec: Microphone array measurements and source identification
- PSIA Austria, noise measurement
- LCC Consulting: Integration in a geographical information system (GIS)
- SISE – Swiss Institute for Systems Engineering: interdisciplinary project management and consulting in complex systems design

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- akos communications, Basel, Switzerland, film production & promotion

2. AIM & PURPOSE

The model is designed to set new standards in the accuracy of the prognosis of sound immission levels from railway sources. The sound propagation model as well as the emission model of the vehicles and tracks is aiming at reproducing the fundamental physical processes. Therefore they not only allow a reproduction of current situations but also a forecast of noise mitigation measures can be investigated for different scenarios.
The project started in 2007 and shall be finished by the end of 2009. By mid of the year 2009 the development as well as the programming of the calculation algorithms will be completed. The model has been validated successfully in comparison with third-party measurement data and calculations with reference models. As next step calculations and noise mapping of larger areas e.g. transit-corridors long the Rotterdam-Genova priority freight-railway line is intended.

3. MOTIVATION

Many residents living close to very busy roads, industrial plants, railway lines or airports suffer greatly from the noise: They can hardly hold a conversation, sleep badly and are stressed or irritated. Chronic noise pollution keeps the body permanently on alert and can damage health. It stresses the nerves, weakens the immune system and can eventually cause illness – to the point of a fatal heart attack.

Although noise is experienced quite differently by different individuals, it nevertheless has various medical, psychological, social and economic effects. These include:

- health costs, which have to be paid for by the population as a whole
- economic losses due to property depreciation
- high costs as a result of noise protection measures
- and those who can afford it move away, leading to social segregation in areas plagued by noise. In other words: The poor are more exposed to noise.

The economic on costs of noise are high. Every year there is a huge loss of around a billion Swiss francs. Some 90 percent of this is caused by property depreciation and 10 percent by health costs.

Effective noise abatement has high priority in Switzerland. The federal and cantonal governments have already achieved a great deal, but much remains to be done. Above all, the principle that the polluter pays must be enforced. Financial incentives must be available to help suppress or at least attenuate the noise at source.

4. RAILWAY NOISE IS MAINLY FREIGHT WAGON NOISE

Rail traffic contributes to a large degree to the noise. Those who live near busy railway lines have plenty to say about it. It is mainly the kilometre long goods trains – especially at night – that get on their nerves.

This is relevant because the federal government is aiming to shift goods transport from road to rail. However, the rail network is already full to capacity during the day and only night-time is left for goods traffic. And this is where the problems start: The most widely used bogie on goods wagons is the Y 25 model. It is 50 years old and makes a terrific noise which can be accentuated by the condition of the rails. Newer and quieter bogies do exist, but unfortunately the replacement cycle for goods wagons is longer than for passenger transport. In the final analysis the goods do not care how noisy it is and transport in ancient goods wagons long since amortised is obviously cheapest...

But change is on the way here too. The company Joseph Meyer in Rheinfelden (Suisse) is developing a light, low-noise goods wagon bogie called LEILA, with financial support from the FOEN. It is 20 decibels quieter than the old bogies – so the new bogie makes four times less noise! The core element of LEILA is the braking system. Instead of brake blocks which act on the surface of the wheel to stop the wagon, it has discs brakes on the wheel, with braking forces acting laterally on the disc. This helps to prevent progressive deformation of the wheel surface as it comes into contact with the rail, which is partly responsible for the noise. With uniform wheels the wagon can run smoothly and quietly. Another economic advantage of LEILA is the considerably reduced wear on the rails.

Along with these advantages there is one major disadvantage: The new development is twice as expensive to produce as the popular Y 25, which makes its market prospects look fairly bleak, unless a noise-related track access charge is introduced to reflect the true costs. The quieter the goods wagon, the lower the costs for use of the line – and vice versa. This control measure would achieve an important objective: Investment in new rolling stock would be worthwhile and there would be much less noise.

5. MORE OPTIONS TO MITIGATE AND SOLVE THE NOISE PROBLEM

Apart from new rolling stock, which has already been introduced for passenger transport, there are other options for reducing railway noise.

The noise can be abated at source

- by track maintenance or damping
- by erecting embankments and building noise barriers

But these measures require investment running into billions. Who is to pay for it? The federal government has already provided two billion, but under the polluter pays principle it is not the public who should bear the cost, it is the polluters. Noise-related track access charge is therefore a step in the right direction.

Before billions are spent on noise abatement, it is important to be certain about where the money should best be spent.

Noise measurements can give good indications, but are not the full answer as measurements merely reflect the current situation. Up to date calculation models are what is needed now for predictions of how railway noise will develop in future, to determine whether it is generated mainly by the infrastructure or the vehicle and where it will be greatest.

The model currently used in Switzerland is essentially 30 years old and no longer meets the current requirements. In other countries the problem is very similar, and therefore extensive research has been conducted to improve the situation. These results were an enormously important contribution and a further motivation to build a new model on scrap – including all existing know-how worldwide. FOEN project manager Drangu Sehu much regrets that a sophisticated model only exists for weather forecasting – not for railway noise. These prognosis models must first be developed. With their help the money for noise protection measures can then be invested where the noise problems will occur in future and where the return on low-noise investment will be greatest. With their help there will be a basis for deciding where to build noise barriers and make trackside investment in the future.

Our FOEN colleagues have the task of developing a prognosis model of this kind. The project is called sonRAIL. As the basis for the model, extensive noise measurements were taken at 15 stations in western Switzerland in July and August 2007 by 12 teams. They included international experts from Berlin Technical University, the Empa, Sulzer Innotec, PROSE and PSIA. All in all, 3'000 train passes were recorded. The railway noise was recorded in a wide variety of measuring configurations – with different rolling stock, different rails, and different sleepers - such as timber, iron and concrete - and also completely different microphone systems.

The measurements were successful. A vast amount of data was collected which is now being analysed and discussed in detail by the experts. Questions are of course being raised: Is there enough data or does more need to be collected? Is the data of good quality? Is it conclusive enough? What other factors have to be considered during the analysis? And above all, what steps must be taken for the model to be available by the middle of 2009?

With an unprecedented effort of the whole sonRAIL team, it was possible to maintain the quality objectives of the model: especially the following scopes can be achieved by the end of the project:

With the help of this model
- Precise predictions and forecasts can be made about the origin and propagation of railway noise
- Precise assertions are possible regarding the performance of two metre high noise barriers (important in relation to double-decker trains)
- Predictions can be made as to the benefits of infrastructure investments.

6. CONCLUSIONS

Where people work or relax and where people or goods are transported, there will always be noise. But it can and should be reduced to a reasonable level. This is what we are working on.

7. ACKNOWLEDGMENTS

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