A CASE STUDY ON EU INTERIM RAILWAY NOISE MODELING METHOD ADAPTATION

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In compliance with EC directive on environmental noise 2002/49/EC, in countries without their own national railway noise modeling method, RMR – the interim method for EU countries has to be used. Using this method strategic noise maps are to be built and strategic action plans are to be developed. RMR method was initially developed with particular reference to typical for the Netherlands train and track types, wheel and rail rolling surface conditions. Results of empirical investigation of railway noise on Latvian railway had shown that the real life train pass by noise levels can exceed those modelled with RMR method by up to 20 dB(A). A dedicated project "Innovative solutions for railway noise management" (LIFE11 ENV/LV/376 ISRNM) was initiated by Latvian Railway within the framework of LIFE+ program, addressing the problem of interim railway noise modelling method adaptation along with development of innovative trackside noise barrier made from environmentally friendly composite materials. This paper describes experience of RMR method adaptation on Latvian railway.

1. Introduction

Transportation system development plays a vital role in the economic growth and improvement of life quality, however, this development usually comes at a price of unwanted impact to the environment and during last years, noise became one of the most important impact factors.

EC addresses this problem with the directive on environmental noise 2002/49/EC, stating that strategic noise maps should developed in all EU member states, followed with development and elaboration of strategic action plans for noise reduction.

In order to be efficient, noise mapping is based on semiempirical models for noise radiation and propagation prediction. In many countries, national railway noise modelling methods were developed, well describing the features of local railway network. In case if model is being used for other conditions, special attention should be paid to verify the adequacy of chosen model and modelling results should be validated by measurements.

Latvia, Baltic states and some other EU member states lack national modelling methods and interim EU modelling method RMR [1] is recommended for the use.

Results of empirical investigation of railway noise on Latvian railway had shown that the real life train pass by noise levels can exceed those modelled with RMR method by up to 20 dB(A), pointing out on the necessity of RMR methods adaptation to local railway network conditions. [2]

Within the framework of LIFE+ program's project "Innovative solutions for railway noise management" (LIFE11 ENV/LV/376 ISRNM) initiated by Latvian Railway, it is intended to adapt RMR method for application on Latvian Railway.

2. Description of adaptation approach

Depending on the rolling stock type, propulsion system and brake system, RMR method allows to choose from 11 predefined train type categories. Each train type category is represented as a group of dominant noise sources at different heights with speed dependent octave band radiation spectra. There are also several predefined track types available for selection, depending on the sleeper and ballast type and rail disconnection class. [1]

There are three train type categories currently in operation on Latvian railway, which correspond to those described in RMR: electric passenger trains - RMR category 1, diesel passenger trains - RMR category 6 and freight trains – RMR category 4.

For these three train categories 2 source heights are defined in RMR: at the level of the railhead representing the track radiated noise and 0.5 m above the railhead representing the wheel rolling noise. [1]

To adapt RMR method to local railway conditions, it is necessary to empirically define speed dependant rolling noise source radiation spectra.

Since rolling noise is described by two sources, special measurements should be performed to separate the track and wheel noise. Until now, no separated rolling noise measurement results are available for track and wheel noise on Latvian railway.

For rolling noise source separation in accordance with procedure described in [3], the integrated railway noise and vibration measurement system based on multi-channel data acquisition system from National Instruments was developed within the ISRNM project.

Measurement system allows to simultaneously measure sound and vibration in 4 channels and incorporates two diffuse type optical sensors for train wheel detection. Optical sensors are used for triggering and stopping measurements; detection of train direction, speed and type and for registration of the each train wheel measurement point pass-by moment. Measurement system operates under LabView software and is easily configurable and supports automated measurement result post processing.

Rolling noise, being the result of train and track interaction, is directly dependant on the roughness level in the rail / wheel contact point. Yet, no qualitative information about rail and wheel rolling surface roughness is available on Latvian railway. It is planned to perform the first direct rail rolling surface roughness measurements within the ISRNM project. There is no possibility to directly measure the train wheel rolling surface roughness levels, therefore indirect estimation will be performed following procedure described in [3].

In addition to that, recent research results had shown that the rolling noise levels differ for different types of freight cars on Latvian railway, therefore sub categorization of the freight trains is required.

It was also discovered, that the diesel locomotive traction noise can be dominant noise source, especially at slow speeds. This is highly important for shunting yard areas, where locomotive traffic is very intensive. Moreover, diesel locomotive traction noise is a low frequency noise source which is placed high above the ground (engine noise, exhaust noise) and the effectiveness of trackside noise barriers can be strongly overestimated in case if this is not taken into account during the modelling.

Within the ISRNM project it is also intended to investigate the impact noise due to rail joints, train brake noise and curve squeal noise.

It was discovered, that the frequency content of train brake noise is often different in case of Latvian rolling stock, compared to that modelled by RMR method.

The increase of rolling noise levels due to rail joint is underestimated.
The curve squeal noise is not yet taken into account in the RMR method.

3. Conclusions and expected results

Using the EU interim railway noise modelling method without appropriate adaptation for local railway conditions can lead to significant underestimation of railway noise levels and overestimation of trackside noise barrier effectiveness. It is necessary not only to review the noise radiation of defined in RMR noise sources, but also to evaluate the presence of other dominant noise sources, such as traction noise and curve squeal noise.

Within the ISRNM project it is planned to perform first on Latvian railway measurements for railway rolling noise source separation, using the developed integrated noise and vibration measurement system. First direct rail rolling surface roughness level measurements and indirect estimation of train wheel rolling surface roughness levels will be performed.

Additionally, diesel locomotive traction noise, impact noise due to rail joints, brake noise and squeal noise will be evaluated.

Expected results of experimental research should allow to adapt and improve the RMR method for application in Latvian railway conditions and will be disseminated to be used in other EU member states with the similar demand.

4. Acknowledgements

The article is written under the scope of LIFE+ project “Innovative solutions for railway noise management” (LIFE11 ENV/LV/376 ISRNM), carried out by Latvian Railway SJSC, Riga Technical University, and Composite Constructions Ltd. with the financial contribution from the EU funding instrument for the environment LIFE+ and with the co-funding by the Latvian Environmental Protection Fund.

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