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NOISE AND VIBRATIONS PROTECTION ON CROATIAN RAILWAYS NETWORK

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Abstract

Reduction of noise and vibrations from railway traffic is one of the main tasks in which engineers are engaged today, with the purpose of achieving comfortable living conditions in settlements situated immediately next to railway lines. In the last few years, efforts have been made in Europe to switch as much cargo transport from roads to railways as possible, due to which the importance of railways has been constantly increasing. The result of redirecting transport is disburdening of the road network, increasing of passenger and cargo transport on the railway, but also increasing of noise and vibrations from railway traffic. In order to select an adequate measure for their reduction, it is necessary to register the situation in the environment on the subject location, analyze a possibility of application of particular measures and make a relevant decision about which measure is most cost-efficient to apply. For a more complete consideration of the problem of increased noise and vibrations, an incentive was started in Croatian Railways 2009 to establish a trial section on which field tests would be carried out in cooperation with scientific institutions within scientific-research projects, and thus achieve the effect of a particular measure. The paper analyzes the plan of researches on the future test section as a whole, and it also gives a detailed presentation of measures for reduction of noise and vibrations that are undertaken on reconstructed railway lines, and of the measures that are planned to be undertaken on future lines in the Croatian Railways network.

1 Introduction

The goal of the European transport policy is to redirect short-distance air traffic to high speed railways as well as the freight transport from road to railway and that is why the importance of the railway is increasing more and more. On the other hand, the European Commission Green Paper on Future Noise Policy states how the major public complaints are related to high noise and vibrations levels caused by rail traffic and as such represent a serious ecological problem. The increased noise and vibrations levels have a negative impact on human health and make normal, everyday life impossible. The major adverse effects are: concentration problems, impediments to communication, sleep disturbance, feeling of annoyance, sickness and so forth. Therefore, the reduction of noise and vibrations levels in railway traffic is one of the prerequisites for the railway freight and passenger transport importance increase. Having in mind the fact that the implementation of measures for noise and vibrations reduction is extremely difficult (if not impossible) to be economically justified, the European Commission created, among others, the Working Group Railway Noise, whose task was that of developing a strategy and priorities for noise level increase problem solving.
The Working Group drew up the Position Paper on the European Strategies and Priorities for Railway Noise (PPS) in which it states that, due to the international character of rail transport,

the strategies must include states currently outside the European Union and especially the accession countries. The need for all the parties to be involved in the process of protection against noise is also stressed out and these parties are:

- the European Union
- the Member States (governments, parliaments, agencies)
- regional and local authorities
- the Railways (operators, infrastructures managers, railway vehicle owners, maintenance companies)
- manufacturers (of vehicles and vehicle components as well as those of rails and rail components).

For the purpose of solving the problem and involving all the parties in the noise and vibrations protection process, in the year 2009 the Croatian Railway started an initiative for establishing a trial section on which field tests would be carried out in cooperation with scientific institutions within scientific-research projects and thus the effect of a particular measure would be achieved and the set of measures which provide the best return on investment would be determined.

2 Causes of noise and vibration on railway track

Train speed has an important impact on noise and vibrations emissions. Noise and vibrations caused by traction and other auxiliary systems (diesel engines, cooling equipment, compressors and so on) prevail at low speeds of up to 60km/h. Noise and vibrations produced by wheel-rail rolling prevail at higher speeds of up to 200-300km/h, while at much higher speeds aerodynamic noise prevails. The sources and major causes of noise and vibration emission in railway traffic are indicated in table 1.

Because of the maximum projected speed of 160km/h, the sources on Croatian railroads are: noise and vibrations caused by wheels rolling on rail, noise and vibrations caused by traction and other systems and local sources such as squeal, impact and so on.

Table 1 Major noise and vibration sources

Cause of noise and vibration emission	Passing of the train	Shunting and other
Sources	caused by rolling caused by traction and auxiliary aerodynamic noise local sources (squeal, impacts, bridges)	caused by rolling caused by traction and auxiliary squeal, impacts

Railway traffic noise and vibrations protections measures can be divided into four basic categories:

a measures at the source,
b measures on the way of propagation,
c measures at the point of immission,
d economic measures and regulations.

The first category pertains to primary measures whereas the remaining three pertain to secondary measures. This paper will discuss the first two sets of measures i.e. the measures the impact on noise and vibration level reduction of which is possible to examine on the aforementioned trial section. Noise and vibration level reduction at the source can be obtained by:

- choosing the adequate construction types of the upper structure
- regular maintenance of the rails surface
- choosing of adequate vehicles
- wheels maintenance
- reducing the speed of railway vehicles and managing the railroad capacities

Reduction of noise and vibration propagation is possible by:
- construction of noise and vibration barriers,
- enclosing the railway vehicles parts (wheels, bogies).

3 Participants in the noise protection process

The financial component represents the major problem in noise and vibrations protection measures implementation. In order for the problem of increased noise and vibration levels to be efficiently solved some time in the future, it is necessary to involve all interested parties. The participants in the noise and vibration protection process (Table 2), can be grouped in three categories: 1 policy in which the state, regions and local self-government bodies pertain; 2 railways (railroad infrastructure, railroad traffic, trains traction); 3 manufacturers (rails and rail components manufacturers, vehicle and vehicle components manufacturers).
HŽ Infrastruktura d.o.o. starts an initiative for including all other railway companies in the process of noise and vibrations protection. Only with active participations of all railway companies in field tests it would be possible to share responsibilities and costs related to noise and vibrations protection measures.

Table 2 Participants in the noise protection process

Parties in the Rep. of Croatia		Activities
Policy	Republic of Croatia	Harmonise legislation to EU requirements Create the national programme of noise and vibration protection (see Switzerland's example) Inform and involve the public Introduce the maximum permitted noise level for non-interoperable vehicles the national railway authorities should implement harmonised type test procedures and deliver the test data to the European authorities
	Regions	
	Local self-government bodies	
Railways	HŽ Infrastruktura d.o.o.	Implement measures for railroad tracks Subvention for "silent" vehicles Grinding and maintaining the railroad track rails Management of the railroads capacity with respect to noise level limits making harmonised test tracks available
	HŽ Putnički prijevoz d.o.o.	Requesting for the new specification to be brought forward regarding the purchase of new and rebuilt vehicles Implement measures related to vehicles noise related maintenance schemes by trackside or on-board monitoring systems
	HŽ Cargo d.o.o.	
	HŽ Vuča vlakova d.o.o.	
	HŽ Holding d.o.o.	
Manufacturers	of vehicle and vehicle components of rails and rail components	Participation in research projects Participation in standardization

4 Trial section on railway track

For the purpose of obtaining the most precise answers on the possibility of noise and vibrations reduction by implementation of some of the well-known measures that have been researched today or that are partially implemented, it is planned to create, within the research framework, a trial section on the Croatian Railways network. At the moment, the possibility of creating a trial section in the Eastern part of Zagreb (Retkovec settlement) is also being explored, more precisely on the railroad section for which many complaints by the people who live and work next to the said track were already brought forward. During 2006, noise measures

on the said site were performed and it was discovered that every time a train passes, noise level increases by 8 to 10 dB(A) (Figure 1). Specific for this location is the double track railway line placed on the south side of Branimirova Street, as shown in Figure 2. Maximal noise levels appeared every 6 to 10 minutes when the trains passed-by. They range from 80 to 84 dB, and to a smaller extent they also depend on the heavy vehicles road traffic on Branimirova street. Retkovec settlement is close to Branimirova Street, which represents one of the major traffic routes of the eastern part of Zagreb. The street has two roadways, one for each direction, with two lanes each. Parallel to the roadways is a double track railway line Zagreb – Vinkovci situated at the south side of Branimirova Street, Figure 2.

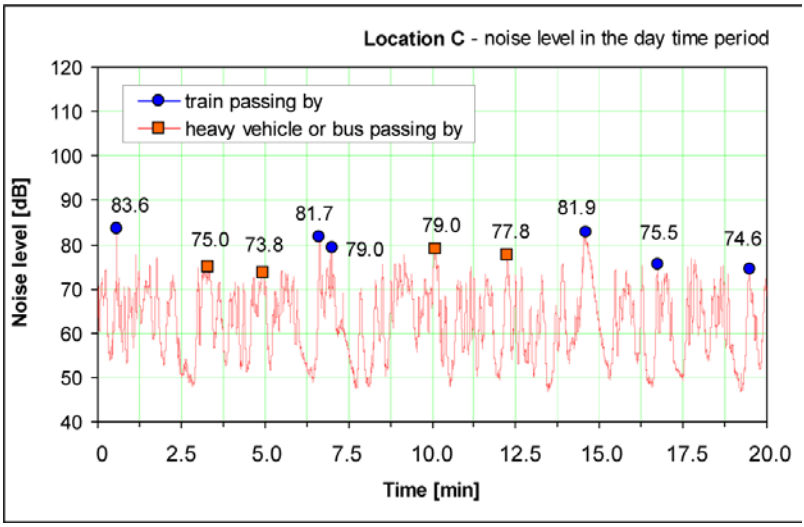

Figure 1 Characteristic indication of the noise level time change (Retkovec settlement, Zagreb)

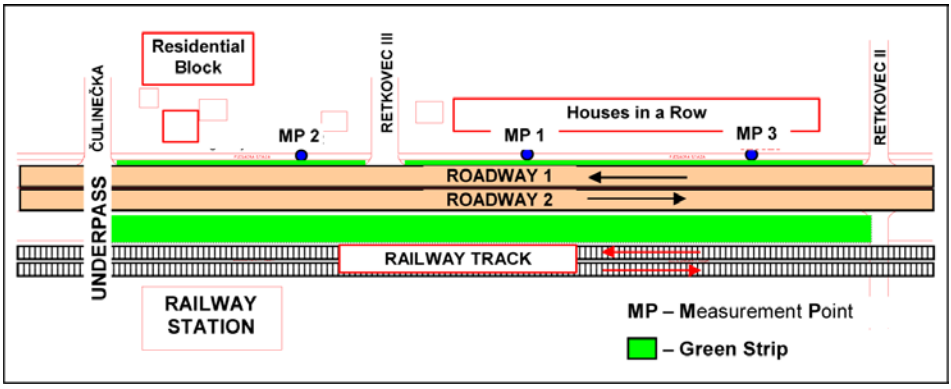

Figure 2 Schematic overview of Branimirova Street – Retkovec settlement

The researches on the trial section would be carried out within the framework of scientific projects financed by the Ministry of Science, Education and Sport of the Republic of Croatia and conducted at the University of Zagreb, more precisely at the Faculty of Civil Engineering and at the Faculty of Electrical Engineering and Computing. At the track trial section the effect of several noise and vibration reduction measures would be implemented and controlled: elastic pads under concrete sleepers, rail web dampers and use of noise protection walls.

The schematic diagram of the planned trial section is shown in Figure 3. In order to establish the effect of every implemented measure, the results of measurement recorded on the track where one of the measures was implemented (pads under the sleepers, rail dampers) would be compared and the construction of noise protection walls near the tracks with the results of measurement on the ordinary track construction.

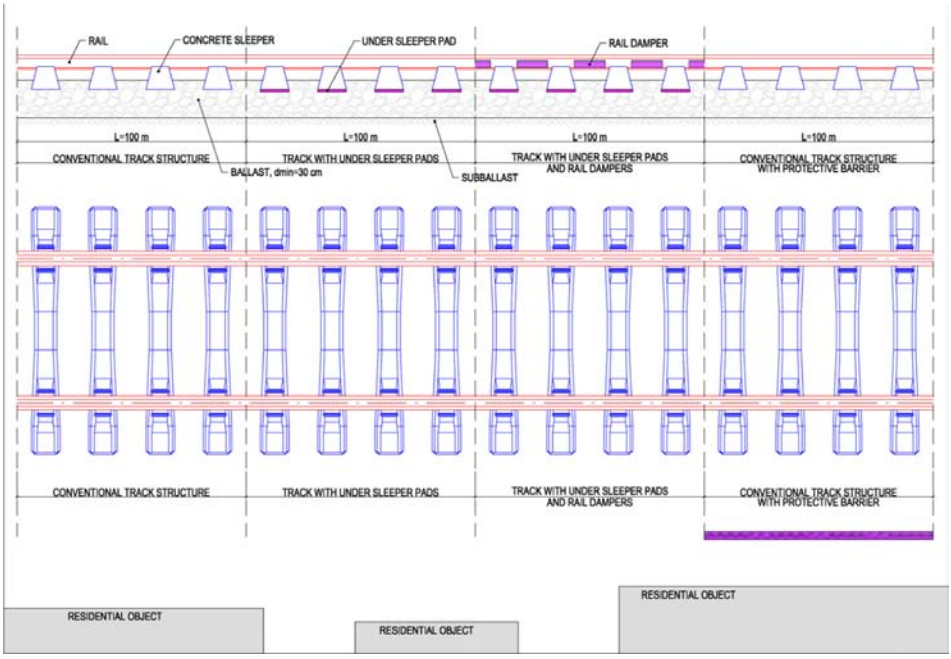

Figure 3 Schematic overview of the trial test track section

From the available results of researches conducted in the last couple of years on the European railways network, the possibilities of the aforementioned measures that are planned to be observed on the trial section are well known. However, on this section the materials that would be completely produced in Croatia would be examined. First of all, it refers to the sleepers which are fitted with built-in elastic pads on their lower seat. Currently, such sleepers are not produced in Croatia. By the same token, neither the rail web dampers are produced In Croatia, although these products can entirely be produced in Croatian factories, especially in those specialised in recycled materials.

On the basis of measurements and tests performed on the trial section, the recommendations will be given for the implementation of some of the measures for noise and vibrations reduction on Croatian Railways tracks and first of all, on those sections against which complaints were brought by the people who live next to railway tracks. This is of particular interest for the railway stations that are situated mostly nearby the business-residential complexes as well as for those railways that are passing through populated residential areas.

5 Conclusions

The increased levels of noise and vibrations due to railroad traffic represent a big problem to which Croatia did not paid much attention until a few years ago. By harmonizing the Croatian legislation with that of the European Union, the legal frame for solving this problem was created. In order to be able to answer the question which measure or a set of measures for noise level reduction is the most appropriate one, it is necessary to register the environmental condition on the said site, to analyse the possibility of implementing the individual measures and to reach a pertinent decision. The costs of methodical researches as well as the costs of noise and vibrations protection measures are extremely high and therefore represent the limiting factor in their implementation. As the only successful solution to that problem, there is a need for involvement of all the parties to the process of noise and vibrations protection what also implies the responsibility and costs sharing. The creation of the trial section and the research project which will be held there would mark the good beginning of involvement and successful collaboration of all the participants in the noise and vibration protection process.

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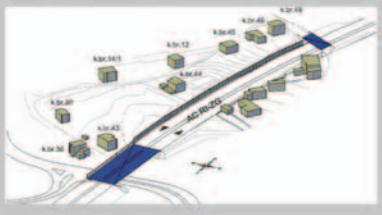

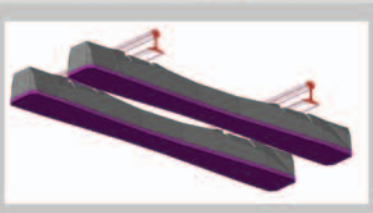

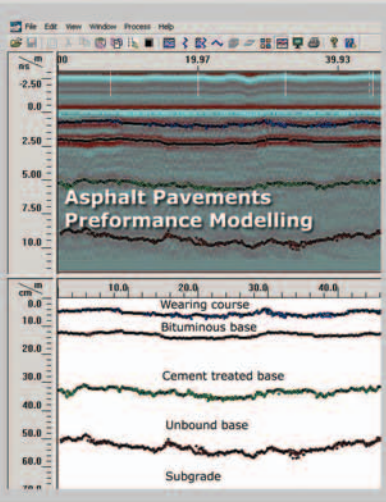

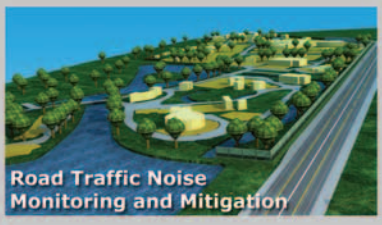

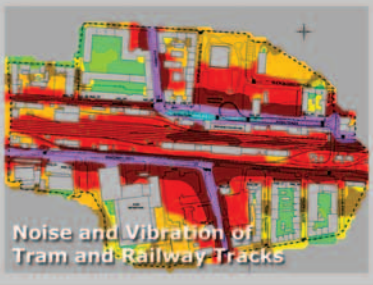

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