

HIGHLY ABSORBENT TRACK SIDE WALLS FOR RAILWAY NOISE CONTROL

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Abstract: *The railway is the most environmental friendly and sustainable public transport mode, being in the same time a noise generator due to wheel-rail contact, traction power and wind-car interaction. Noise emission reduction actions depend on the sound propagation from the origin point to the receiving point, involving combined actions in order to be efficient. Absorbent track side walls together with track improvements such as welded tracks instead of jointed track, disk brakes, rail and wheel maintenance can lower the noise impact generated by traffic. The aim of this study is to determine the noise reduction for railway traffic on current tracks and on railway stations for implemented solutions with track side walls along the lines.*

Key words: *railway noise, noise barriers, rolling noise.*

1. Introduction

Noise is considered a polluting factor, which, if permanent, adversely affects the level of professional performance, often being the cause of fatigue, nervousness, quantitative and / or qualitative diminution of the activity performed, fracture of buildings, windows, etc.

Sounds definition, according to physics, is: „vibrations of the particles of an environment, capable of producing an auditory feeling”. The sound propagates in the form of elastic waves only in substances (air, liquids and solids) and does not propagate in the void. When we hear something, the ear is actually touched by vibrations of the atmospheric pressure. The ear transforms the sound waves into electrical impulses which it passes on to the brain, which decodes the signals. The ear gradually becomes accustomed to the sounds and in time, we learn their meaning. [1]

According to the legislation in the acoustic environment field, STAS 10009-88, Urban Acoustics - Acceptable Limits of Noise Level, it is stipulated that at the boundary of an industrial construction, the maximum noise level is 65 dB (A), and according to STAS 6161 / 1-79 inside civil buildings, a lower value than the maximum of 50 dB (A). In general, European legislation stipulates limits close to 50 dB (A).

For the big cities, the main cause of pollution is the ever-increasing road traffic, the

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result being that motorways, the noise levels often exceed 80 dB [2].

Noise and vibrations are the result of propulsion motors, transmission parts and air resistance for buses, as for the railway vehicles, the sources are different: breaks and accelerations in stations, rail-wheel interaction, maintenance level both for the rail and for the wheels.

The admissible noise levels according to the current legislation, are presented in Table 1, for urban areas and different types of locations:

Admissible exterior sound levels [3]

Table 1

Urban area	Admissible limit for equivalent sound levels dB(A)
Parks	50
Markets, commercial spaces, outdoor restaurants	65
Schools, nurseries, kindergartens, playgrounds for children	75
Industrial premises	65
Stadiums, outdoor cinemas	90
Car parking	90
Underground car parks with service stations	90
Railway areas	70

2. Traffic Noise Limitation Methods

Various studies have been made over time with various solutions adopted to reduce traffic-noise, generated both from roads but also from railway lines, as follows:

- Redirecting traffic outside city areas;
- Using underground or overground passages;
- Interdictions for certain vehicle categories on specific roads, or at certain hours;
- Bicycle lanes to reduce the number of cars in crowded areas;
- Synchronization of traffic lights, one way streets, speed restrictions on certain roads;
- Porous asphalt pavements with noise absorption characteristics;
- Green noise barriers or sound absorbing panels, where possible;
- Proper maintenance of the railway embankment and tram lines;
- Innovation of railway and tramway vehicles;
- Rails and wheels maintenance;
- Introduction of composite brake blocks for freight railway wagons;
- Installing noise barrier panels along the railway tracks

3. Noise Barrier Panels

There are different types of noise barrier panels used today for limiting noise generated by traffic. They can be classified by materials, size, insulation, absorption characteristics, etc.

The most common noise barrier panels are:

- Wood and concrete panels;
- Wood panels;
- Steel/aluminium panels;
- Glass panels;
- PMMA (compact polymethyl methacrylate) panels.

3.1. Wood and concrete noise barriers panels

This type of panels is made out of a 12.5 cm thick reinforced concrete support layer and a 9.0 cm mineralized crushed wood and cement layer. A mineral wool layer is interconnected between the two layers, as sound-absorbing material.

3.2. Wood noise barriers panels

Wood panels are usually made of softwood, protected by autoclave impregnation. The tanalith E3492 is used as an impregnating substance. Between the two layers of wood, it is placed a layer of mineral wool as a sound absorbing material, on the exterior faces being applied green or black polyethylene net UV resistant.

3.3. Steel/aluminium noise barriers panels

This type of panels have front steel/aluminium perforated sheet and standard steel/aluminium sheet on the back side. The sound absorbing material used is mineral wool with a minimum density of 90 kg /m³.

3.4. Glass noise barriers panels

Panels made of protected glass with a minimum thickness of 8 mm, with metal frame and gaskets on the four sides.

3.5. PMMA (compact polymethyl methacrylate) noise barriers panels

Panels made of 15 mm thickness polymethyl methacrylate, with metal frame and gaskets on all four sides.

Noise barriers are placed between the noise source and the receptor, forming an acoustic shadow behind them, the result being a reduction of noise levels. This reduction depends on barrier height, placement and form in relation with the road or railway lines. Normal values for noise reduction in areas near noise barriers are:

- 5 dB: relatively easy to obtain
- 10 dB: obtainable for barriers with considerable height
- 15 dB: difficult to obtain [4].

Noise reduction effect depends on several characteristics of noise barriers, such as: barrier's height, distance between source and barrier, distance between barrier and receiver, barrier's length and thickness, materials used.



Fig. 1. *Noise barriers on the IV Railway Corridor*

In the railway sector (Figure 1), the main noise source is the freight traffic, especially due to its night operation and noisy cast iron brake blocks. A solution would be replacing the old breaks with low noise brake blocks, that on the current situation, for the Romanian Railway Company is nearly impossible.

Railway maintenance is critical for noise generation but also for train speed and safety. With an old and insufficient maintained rail superstructure, romanian rail lines generate noise also due to large numbers of joints that are sensitive points in noise generation, although the speed is adapted on railway superstructure condition.

Rail vehicles such as trams (Figure 2), circulating in urban areas, must be proper maintained in order to limit traffic noise. For this particular case, the garage and turnouts areas have to be placed outside residential areas, being a high noise level generator due to large number of turnovers with wearied flanges and guidance moves [5].



Fig. 2. *Freight railway traffic*

4. Case Study

In order to determine how the noise barriers reduce the traffic generated noise, sound measurements were made for various types of traffic vehicles in an open space and sound measurements behind noise barriers.

For the open space sound measurements it was used the area Piața Gării in Cluj Napoca city (Figure 3), Romania. This location has various traffic types, from light trams, auto vehicles, buses and trains. The purpose of these measurements was to determine the sound levels that are perceived by the city's inhabitants.



Fig. 3. Sound measurements in Cluj Napoca

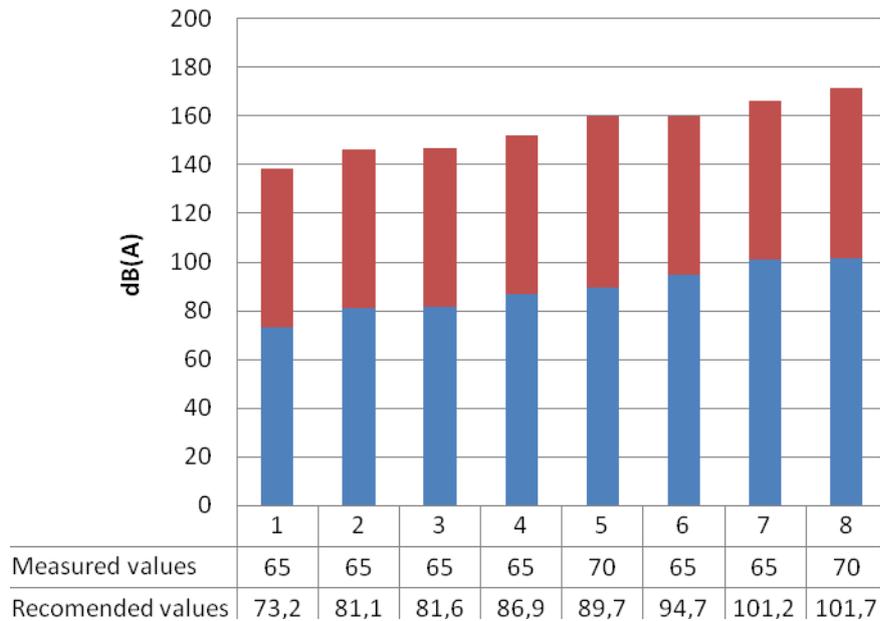


Fig. 4. Noise levels for different types of transport

Figure 4 shows sound measurements for: new trams (1), buses (2), auto vehicles (3), old trams (4), railway platform (5), trucks (6), ambulances (7) and trains (8), with maximum values measured in 12 hours interval, between 7.00 and 19.00 hours.

To compare the open space noise measurements without any absorbent noise walls, green barriers or embankments, measurements were made on a railway track with sound absorbent barriers installed, the value of the noise measured at 1,5 m from the noise barrier when the train was passing was 93,2 dB(A), representing a reduction with 7,8 dB(A) compared to open air measurements with a passing train.

5. Conclusions

Noise barriers can be applied for new railway lines or existing lines, the main noise source being rail-wheel contact. This system is effective if it is correctly placed regarding noise source and receptor, if the barriers have the proper height (usually between 1 and 4 m), their geometry and if the material used is highly absorbent. Not only noise barriers are important, but also track geometry and maintenance, rail vehicle's wheels profile and train speeds.

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