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APPLICATION OF SELECTED MEASURES TO ELIMINATE NOISE SOURCES IN THE SELECTED MUNICIPAL LOCALITY

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Abstract: Currently, we are raising the rise in traffic noise levels to one of the significant problems solved in residential areas. The above-mentioned noise load acts to a person negative. The permissible values for determining the noise level from ground transport in a protected area are determined by Government Regulation. The subject contribution concerns the application of noise reduction measures in the selected location. It discusses the possibilities of anti-noise measures, measures to reduce the effects of traffic noise. The paper presents the different types of noise barriers and their basic requirements in the design. Noise barriers are the perfect solution to reduce noise problem due to traffic, industry sources and other. The primary benefits of a noise barrier are the acoustical qualities and traits which directly relate to the barrier's ability to absorb and eliminate noise once installation is complete. The aim of the article was on the basis of the available information, to propose possible noise measures in selected locality. Noise barriers are often used for reducing the noise propagation in outdoor area. Nowadays are widely used different types of materials. Paper also provides the proposal of new constructions of noise barriers with application of recycled materials.

Keywords: Watson street, noise barriers, traffic, model, buildings

1. INTRODUCTION

The issue of traffic noise is increasingly urgent and requires targeted action in order to reach or maintain a suitable environment for the population in larger urban areas. [12] Due to the increasing intensity of road transport, appropriate measures are needed to reduce traffic noise intensity. [10] For people who live in the vicinity of roads and motorways, excessive noise has become almost unbearable. Long and repetitive the stay has a disruptive effect on the human being, it has an unpleasant effect on the hearing and also on the whole organism, especially on its central and vegetative nervous system. In order to be able to effectively defend against ever-increasing noise, we need to know its process and functioning. [9] Protection of the environment against traffic noise requires a conceptual solution of the project documentation of the road communication. [13] Exceeding the available values for determining the noise level in the considered protected environment is the main reason for the proposal of noise abatement measures. [11] By positioning noise barriers, it is possible to reduce traffic noise intensity. The aim of the contribution was to analyse the location of Watson Street in the city of Kosice – Sever and to propose appropriate noise abatement measures based on the intensity of road traffic noise.

2. THE PROBLEM ANALYZED, TRAFFIC NOISE, METHODS AND MATERIALS

— Analysis of the current state of the problem

Road transport, as in the past decades, has an increasing trend in the present. Along with rising traffic, negative effects such as air pollution, road damage, traffic accidents, dust and traffic noise also increase. Excessive noise and vibrations have a disruptive effect on the life of the human being, causing unpleasant damage to their health, reducing quality, productivity and job security. One of the solutions for reducing the noise intensity in the environment is noise barriers. At present, they already exist in numerous forms. We distinguish different shapes, forms, materials and different application procedures [7]. Their biggest disadvantage is that because of their diversity there is no catalog that would include all technical solutions along with their characteristics [8]. Noise walls and barriers from the construction point of view become so as to be incorporated as much as possible into the natural landscape.

— Traffic noise

Noise is an undesirable, harassing and harmful sound. The measure of noise is a man, his physiological response, his survival, his response [1]. "Noise is defined as any sound that may be harmful to health or otherwise dangerous" [2]. Long-term and repetitive stay in a noisy environment adversely affects the hearing and also the whole organism, especially its central and vegetative nervous system. Noise reduces the possibility of speech communication, adversely affects the psyche, exhausts, stresses [3].

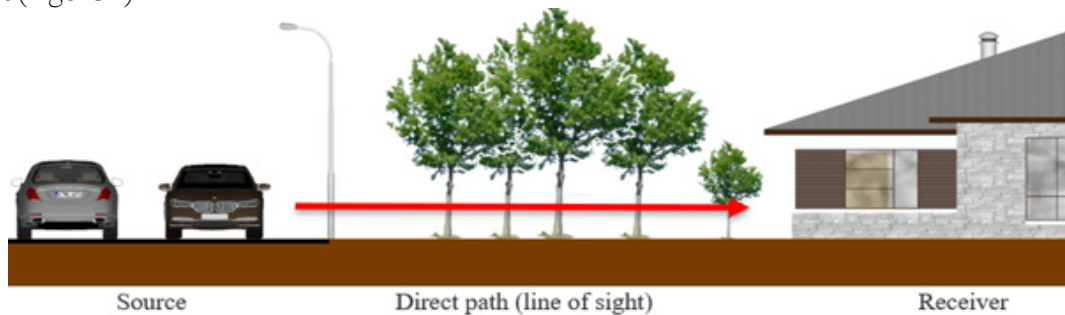
Effects of noise on humans affect three circumstances [4]:

- ≡ noise properties – time course and type of noise, its frequency composition,

- ≡ human activity at the time of noise exposure,
- ≡ the health of a person who is exposed to noise.

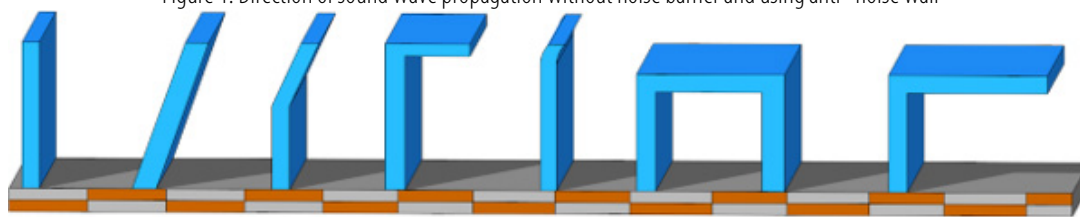
— Characteristics of noise barrier options

Protection of the environment against traffic noise requires a conceptual solution of the project documentation of the road or rail track. Exceeding the available values for determining the noise level in the considered protected environment is the main reason for the proposal of noise abatement measures. Exceeding the values can be detected by direct measurement of traffic noise or by prediction. [14] The proposed noise suppression measures must meet requirements in different respects, but according to common technical features. Noise barriers are set up to reduce the noise intensity of the traffic to the values prescribed by the relevant hygiene rules. Noise barriers must provide sufficient sound insulation, so they must dampen and absorb sound [5]. In accordance with STN EN, the noise barrier is a noise reduction device that reduces the noise load in the vicinity of roadways by creating a "shadow sound" by shielding. The illustration of the cloning of the sound source shows (Figure 1). The shapes of the noise barriers are shown at (Figure 2).



Source Direct path (line of sight) Receiver

Figure 1. Direction of sound wave propagation without noise barrier and using anti-noise wall



Vertical screen – Slanted screen – Crooked screen – Console screen – Round screen – Tunnel screen – Gallery screen

Figure 2. Shapes of noise barriers

The noise barriers are mainly used in quenched proportions. [21] Sound acoustic requirements, technical and construction properties, road safety, stability of acoustic properties during the lifetime, and their architectural appearance are essential for the choice of noise barriers. Each type of material affects the appearance and design of the walls. A significant factor in the noise barrier is their life. The noise barriers are divided into absorbent, transparent, full or partial through the wall, and reflective, which can be both transparent and opaque (Table 1) [5].

Table 1. Materials used in noise barriers

1.	<p>CONCRETE – is one of the most durable materials. It is massive, able to withstand difficult temperatures, intense sunlight, moisture, ice and salt. It can be shaped, cast into molds and modify the surface structure to have any appearance. [6]</p>	
2.	<p>WOOD – most wooden barriers are made of pressure-preserved wood, plywood and glued laminated wood products. [15]</p>	

3.	METALS – three types of metals are used: Steel, Aluminum and Stainless Steel. The advantage of metal panels is a small weight, which is useful when mounting noise barriers. The disadvantage is its compatibility with the landscape. They are used in bridges and as supporting walls. [16]	
4.	TRANSPARENT PANELS – materials are used either from glass or from a clear plastic product, such as plexiglass, lexan or acrylic material. Glass panels are commonly made from simple tempered glass or laminated tempered glass. [17]	
5.	PLASTICS – plastic barriers can be installed almost everywhere. Due to their low weight, they are especially suitable for assembled applications to construction objects. Recycled plastics, PVC, polyethylene, glass fibers, and the like are used. [20]	
6.	BRICKS and CONCRETE BRICKS – brick walls also concrete blocks can be laid either manually or pre-assembled by machine. Regardless of how they assemble, they must have a concrete foundation strip. Brick walls and concrete blocks can be built in a convenient way without leveling layers on downhill slopes up to 6%. [20]	

3. RESULTS AND DISCUSSION

— Analysis of solved problems

Watson Street was chosen for the possible application of anti-noise measures (Figure 3). The sophisticated locality is situated in the city of Kosice – North. It is located near the Technical University of Kosice, bordering the area of the botanical garden and the amphitheater. In the given location is the dominant source of road traffic noise. Noise is disturbed by the surrounding area.

According to the monitored site monitoring, Watson Street is the most unlikely from 15:30 to 16:30 p.m. At that time, the counting of the means of transport was performed in two directions (Figure 5). The following Figure 4 shows a view of the measured Watson Street. In the direction from the botanical garden to the amphitheater (direction 1), there were 777 passenger cars, 33 trucks, 12 buses and 10 two-wheeled motor vehicles. In the opposite direction (direction 2) 673 passenger cars, 13 trucks, 13 buses and 14 two-wheeled motor vehicles were counted. Together that represented 1545 vehicles. According to these data, a 3D model (Figure 7) was created using the CadnaA (Figure 6) software (DataKustik), which also provides ambient noise values in dB.

The reduction of emitted noise is especially important in front of the buildings of the East Slovak printer, the District office of Kosice – okolie and the UPJŠ building and the Institute of Experimental Physics of the

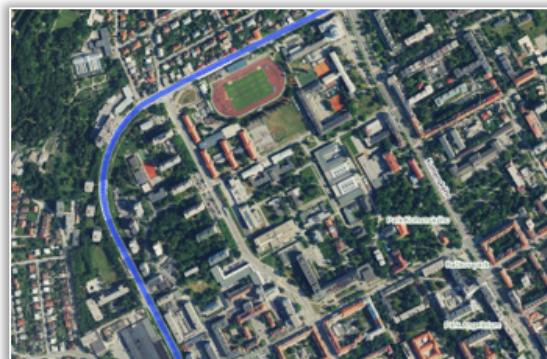


Figure 3. Watson Street on the Map



Figure 4. A view of the measured road

Slovak Academy of Sciences in Kosice on the grounds that these buildings are located near the road and the employees who work here are not otherwise protection against harmful acoustic influences.

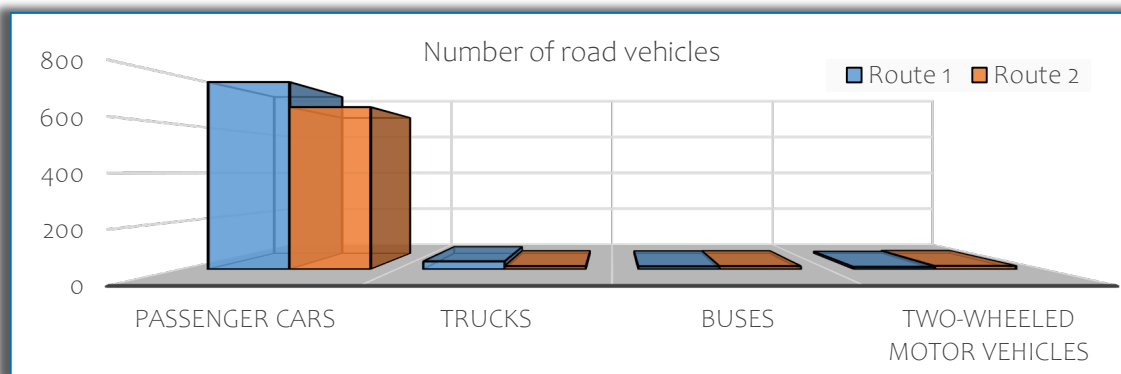


Figure 5. Graphic representation of road vehicles



Figure 6. Software CadnaA



Figure 7. 3D Watson street model with noise levels in dB

— Application of the selected noise barrier in practice

When setting anti-noise measures near traffic roads in the area concerned it is necessary to assess and to provide adequate protection on the basis of measured noise values. Measurement of traffic noise in Slovakia is dealt with in Decree No. 549/2007 Collections of laws.

— Analysis of the effectiveness of the noise barrier

A major issue today is the increase in traffic noise from the point of view of environmental protection. Noise grows not only near carriageways and by rail, but is growing more and more in cities. Because of the harmful effects of noise that affect humans, increasingly emphasis is placed on the location of noise barriers. In many places, however, there are few anti-noise walls at this time, and that is why residential areas are often exposed to high noise levels. The noise problem at Watson Street in the city of Kosice – North is mainly caused by road traffic. After creating a 3D model on the basis of road vehicles to reduce the noise emitted, it would be possible to solve the use of the noise barrier in front of the buildings of the East Slovak printer, the District Office of Kosice – surroundings and in front of the building UPJŠ and the Institute of Experimental Physics of the Slovak Academy of Sciences in Kosice. When designing anti-noise barriers, great emphasis is placed on their functionality and safety. Sufficient stability, dimensional and shape stability, resistance to deformation, impact of stones, refractoriness, frost resistance are also important conditions.

It is necessary to determine the optimum height before reaching the best possible noise protection effect and the length of the given wall, which also depends on the frequency of road traffic. The materials used are intended to meet the values of airborne sound and sound absorption. It is also important to build noise barriers so that they are as much as possible embedded in the natural landscape.

In the article, a survey was conducted on several types of soundproof walls, which are characterized by very good sound absorption values. For the noise reduction conditions of the above-mentioned buildings, the Durisol anti-noise wall was chosen on the basis of the fact that panels are made possible to create a noise level wall at different height and length. The positive side of the anti-noise elements is that they are made in different colors and different finish. Variability, different dyed design of individual elements of Durisol allows flexible, creative planning and realization of noise barriers.

Within the article, Watson Street's surround sound modeling was done using the CadnaA software (DataKustik). Reduction of emitted noise in front of the buildings of the East Slovak Printer (building 1 (Figure 8)), the District Office of Kosice – surroundings (building 2 (Figure 8)) and in front of the UPJŠ building and the Institute of Experimental Physics of the Slovak Academy of Sciences in the city of Kosice (building 3 (Figure 8)) can be achieved in the future by applying noise barriers at a height of 1.5 m (Figure 9).



Building 1



Building 2



Building 3

Figure 8. Views of individual buildings before the use of noise barriers

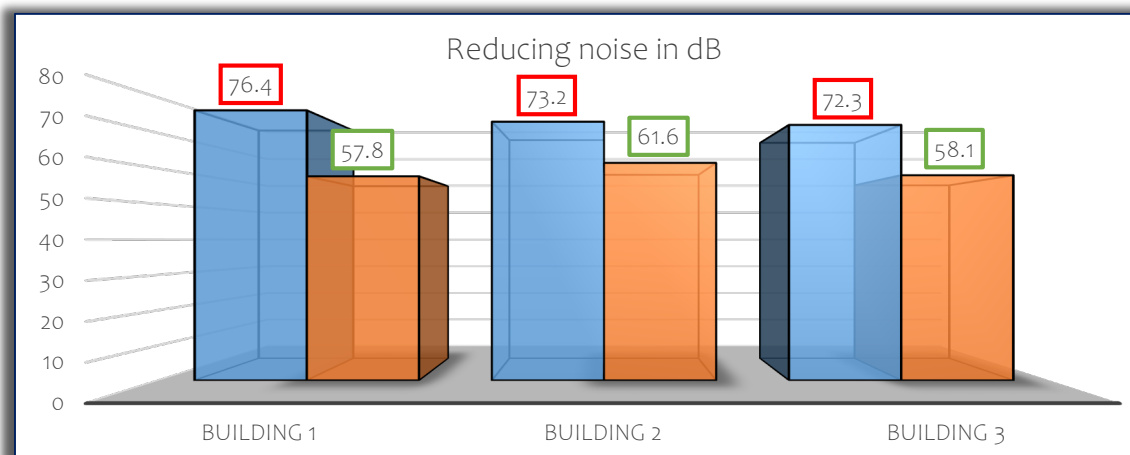


Figure 9. Graphic representation



Figure 10. East Slovak printer with designed Durisol noise barrier (Building 1)



Figure 11. District office of Kosice with the proposed noise barrier wall Durisol (Building 2)

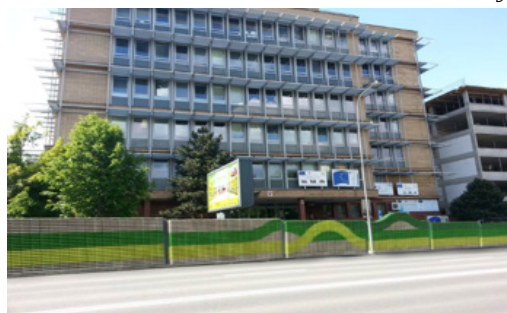


Figure 12. UPJŠ and the Institute of Experimental Physics of the Slovak Academy of Sciences in Kosice with the proposed noise barrier wall Durisol (Building 3)

— Design of the construction of anti-noise barriers using recycled materials

One of the possibilities of using bulk materials is their application in soundproofing products, such as noise barriers. Anti-noise walls are generally implemented mainly for the purpose of reducing traffic noise. In the standard type of anti-noise wall, the inserted absorption material is made up of e.g. mineral wool. The basic element is an outer perforated plate and an absorbent material is inserted in the middle. [19]

Problematic components from end-of-life vehicles, such as cut, torn old textiles, rubber crumb from worn tires (different fractions) and glass (different fractions) are suitable for the production of soundproofing elements based on the results of experimental research. Since the production of compact panels from problematic materials from end-of-life vehicles is problematic from the point of view of the availability of technological processes, and the addition of additional binders only makes the product itself more expensive and there is also a risk of environmental damage, loose materials represent a possible solution for their application in sound insulation products without adding additional binders. [18]

The advantages of bulk materials compared to commercially produced recycled panels include lower weight, greater economic efficiency, high physical and chemical stability and better sound absorption values.

Based on the acoustics properties of recycled materials we can conclude that the bulk samples show good sound absorption at higher frequencies, which is a fact that recommends these materials for application in soundproofing products. The advantages of these bulk materials compared to commercially produced recycled panels include lower weight, greater economic efficiency, high physical and chemical stability and better sound absorption values. However, these materials cannot be used separately and must be applied together with a load-bearing wall or frame.

The anti-noise panels designed by the researchers are shown in the Figure 13 to the Figure 16.

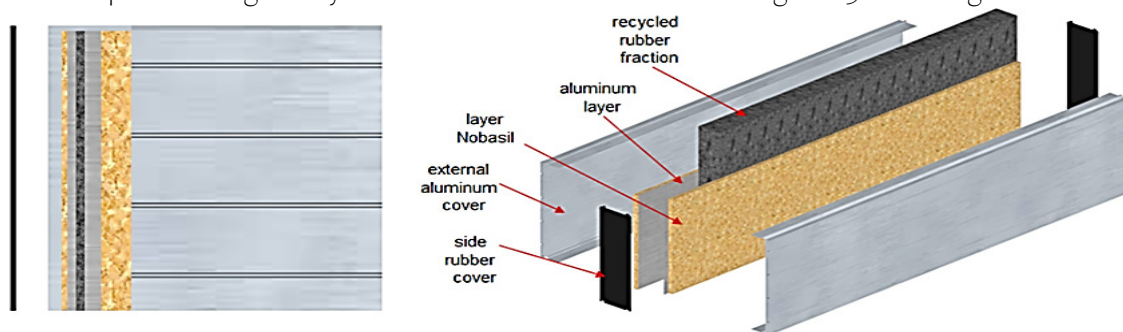


Figure 13. The first variant solutions of anti-noise walls (recycled rubber fraction)

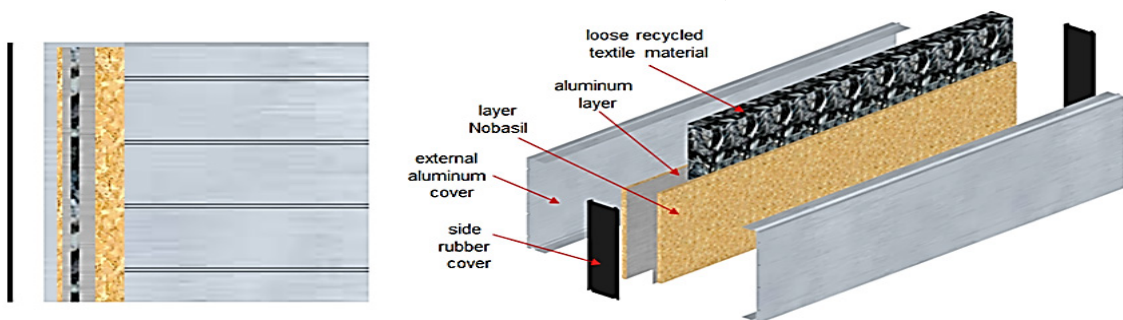


Figure 14. Second variant solutions of anti-noise walls (recycled bulk textile material)

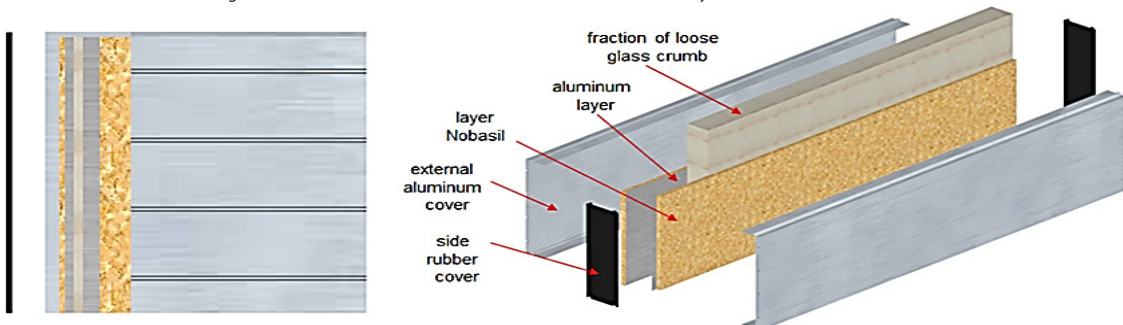


Figure 15. The third variant of the anti-noise wall solution (bulk crushed glass fraction)

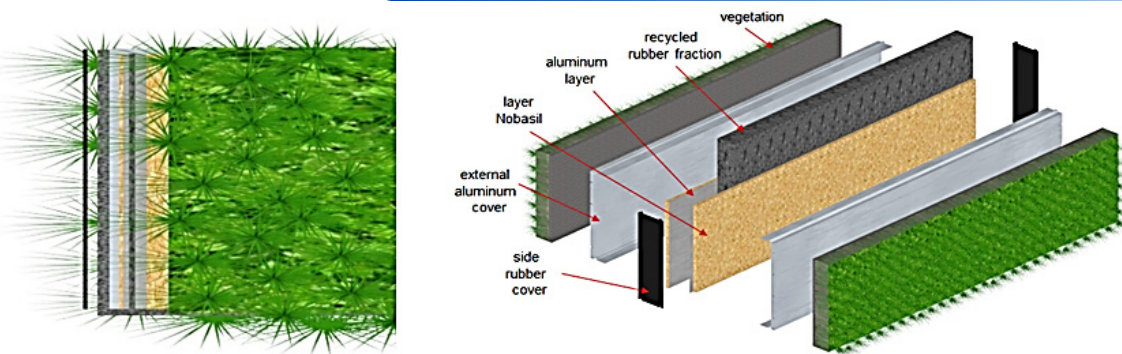


Figure 16. The fourth variant of the anti-noise wall solution (green wall)

CONCLUSIONS

The aim of the paper was to propose an anti-noise measure in the chosen locality. For the purpose of the survey, Watsonova Street, which is located in the city of Kosice – North, was chosen. In this location, road transport is the primary source of noise. Watson Street is the busiest between 15:30 and 16:30. Vehicle addition has been done in two ways. Depending on the number of vehicles being driven, a 3D model was created in the CadnaA software, which also lists the noise levels in decibels. In order to eliminate noise, this paper proposes the use of an anti-noise barrier in front of the East Slovak Press Office and the District Office of Kosice – okolie and in front of the UPJŠ building and the Institute of Experimental Physics of the Slovak Academy of Sciences in Kosice. Based on the 3D model, by designing a 1.5 m noise barrier, we can greatly reduce traffic noise. For the possible realization of the construction of the soundproof wall, the Durisol noise barriers were selected for its versatility and versatility.

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