

## THE IMPACT OF NOISE FROM THE ASPECT OF ENVIRONMENTAL PROTECTION IN TRAFFIC AND TRANSPORT

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### Abstract

In this paper, based on the investigations carried out, for the type of noise derived from different sources, it was found that the highest percentage of as much as 81% is noise caused by traffic and transport, while only 19% of the noise is the result of other sources of noise (industry, construction, and noise from recreational activities). In particular, work deals with noise caused by traffic and transport as a result of movement of vehicles along the roads, including the combination of all possible sound sources from vehicles, its measurement with appropriate measuring instruments with particular reference to the legislation in the countries of the European Regulation in the countries of the European Union and the Republic of North Macedonia.

*Keywords:* vehicles, barriers, noise, sound, environmental protection

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### 1. Introduction

Noise is defined as loud, unexpected or unpleasant sound. Environmental contamination with noise refers to noise levels in the human environment that are higher than the limit values - an acceptable level.

Noise can have serious direct or indirect effects on human health, such as hearing loss. Over time, noise can lead to increased blood pressure and mental disorders.

The reasons for the high level of traffic noise are:

- Increased number of different motor vehicles as participants in traffic (heavy and light vehicles)
- speed of movement of vehicles, the noise generated by the friction force of the tires and the surface is the dominant source at speeds above 30 km / h
- The quality and condition of the carriageway, and
- The intensity of traffic.

### 2. Noise caused by Transport and Traffic

Transport noise is the result of all the sounds heard as a result of vehicles moving on the roads - highways, including a combination of all possible vehicle sound sources.

Based on the conducted studies, for the type of noise resulting from different sources, it was found that the largest percentage of even 81% is due to traffic noise. "Traffic - transport" noise, while only 19% of the noise is a result of other sources of the noise (industry, construction, and noise from leisure activities). Shown in Figure 1.

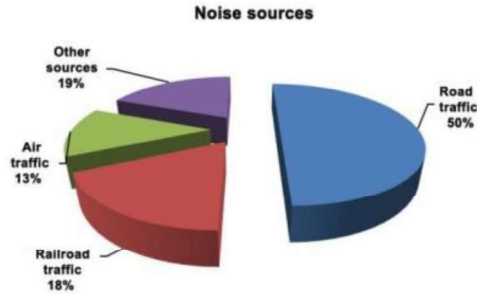


Figure 1. Diagram of percentage representation of different types of sources of transport noise

Figure 1 can be ascertained two important things:

- First, that most of the noise in the environment is a result of traffic as a source (up to 81%), compared to other sources of noise (construction, sports and music events, housing, shooting ranges, etc.) and
- Second, most of the noise of up to 50% is the result of road traffic noise, with which this kind of noise becomes dominant and the biggest source of noise.

### 3. Sources of transport noise

As said before, there are several different types of the noise source. Of interest in this paper is the noise caused by road motor traffic called "transport noise", which is the result of the interaction between motor vehicles and roads, ie their road surface. (1)

Changes in that interaction result in changes in noise levels. It depends on the intensity, type, structure and speed, and on the type of road the condition of the road surface and the longitudinal slope.

Noise caused by motor vehicles on the move, we can divide it into:

- Noise generated by the engine of the vehicle at work (engine noise)
- Noise generated by the interaction of the tires between the vehicle and the drive surface, as the vehicle passes through the air-medium (rolling noise), and
- Noise resulting from the turbulence of the air that occurs when the vehicle is moving (aerodynamic noise). Shown in Figure 2.

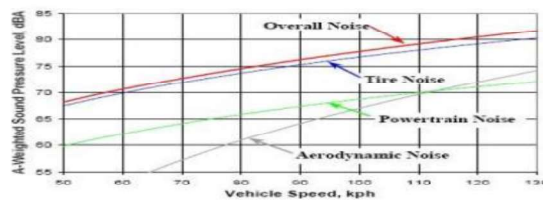


Figure 2. Types of traffic noise

As it can be seen in Figure 2 the highest noise is the rolling noise generated by the interaction between the tires on the vehicle and the drive surface as the vehicle passes through the air-medium.

This type of noise depends directly on the speed of movement of the vehicles. Each sound source can be described thanks to associated spectra, amplitudes, and time history. The spectrum detects the frequency of the sound content. (1)

#### 4. Impacts on transport noise

Transport noise has several factors, the most significant of which are:

- The impact from the driving surface
- Influence on the speed of movement
- Category impact
- Type of motor vehicle
- The impact of the geometric elements of the roads
- Tire impact and
- Distance impact - distance from the place of source.

The impact of each of these factors is significant for the magnitude of the noise generated (1). It is particularly important to point out that these actors do not act individually - separately, but act together - in synergy, as can be seen from what is written in the next few sub-chapters. The results of noise measurements when driving on an asphalt concrete driving surface show that the tire rolling noise at direct speed is a source of noise that prevails in both light and heavy vehicles.

This shows that such noise primarily depends on the structural characteristics of the driving surface (micro and macro depth) and unevenness, that is, the plane of the driving surface expressed by International Equity Index IRI (IRI [m/km])

It is important to note that when driving at low-speed vehicles, the engine noise is greater than the noise generated by the interaction between the vehicle and the driving surface. When moving vehicles, for cars with a top speed of 30 km / h and trucks with a top speed of 40 km/h, noise as a result of rolling of tires on the road becomes significant and is dominant for speeds greater than 50 km/h.

The type and category of vehicles have a great impact on transport noise. For this purpose, it is necessary to have a database not only of the size of the traffic but also of the category of vehicles traveling along with the road network or the particular road being monitored for adequate transport noise protection measures. That's why more accurate calculations are performed when we divide the vehicles into several categories, and not just into two categories (light and heavy vehicles).

According to regulations in some countries (Germany and Austria), the slope of the road has an impact on the noise increase, ie if the route is uphill or downhill. The increase in noise is also affected by the proximity of intersections, traffic lights or places where there is any interruption in traffic flow, which increases the noise level.

The high impact of the tires on the noise is also shown by the fact that with worn tire straps due to the larger contact area, the tires in conjunction with the driving surface create more noise. It is important to note that the tire noise is higher in trucks, while in cars it becomes dominant at high speeds.

Distance from source, as well as traffic density along roads (depending on their rank: highways, national or regional), too significantly affects the noise reduction (1).

If we have heavy traffic - continuous, by doubling the distance from the source the noise decreases by 3 dB. If we have less traffic - individual vehicle passes, by doubling the distance from the source site the noise is reduced by as much as 6 dB (Figure 3) (1).

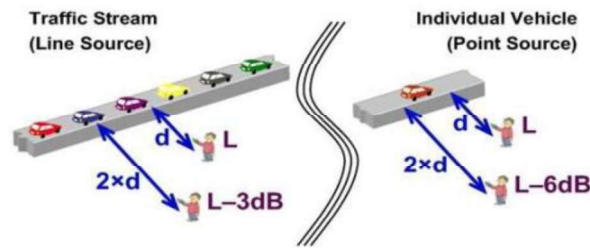


Figure 3. Spread of transport noise from different types of sources

**5. Measurement of noise by the way**

The most common case of measuring transport noise is on the spot, by the road. Technically these measurements are called lateral measurements and can be made:

- At a certain distance from the road (usually 7,5 or 15 m) or
- The location of the noise recipients (for example: houses, apartments, schools, playgrounds, etc.).

These types of noise measurements (Figure 4) include measurements of noise levels using microphones, as well as speed measurement and traffic classification (1).



Figure 4. Parts of lateral measurements

All lateral tests to a certain degree are subject to different impacts. For example, the presence of objects that may affect or block the sound should be considered.

The weather should also be monitored, especially the wind which can affect the sound level.

A least, they must be identified as so-called 'Polluting sources' such as aircraft noise and road noise (mowing grass, trains, etc.). If these impacts are significant, the measurements must be discontinued.

**6. Types measurements of noise**

In addition to the source sound measurements, some measurements can be performed in the vehicle using a microphone mounted inside space for passengers. Data is collected while the vehicle is in motion, but without the influence of other potential noise sources, such as the state of the air or the radio.

The noise inside a vehicle is usually much lower than the outside noise. All collected measurements should be considered with caution, as the effects on the type of vehicle and its condition are significant.

### 6.1. Measuring apparatus

The basic instrument for measuring the noise level is a phonometer (Figure 5). On sale are available more phonometers of different types. In choosing the instrument for measuring noise we need to know the typology of the measures so that we are not mistaken in choice. The basic feature of phonometers is that they are calibrated according to the pressure height equation. The microphone as a basic part of the phonometer aims to convert the variable sound pressure into an appropriate change in the electrical voltage.



Figure 5. Measuring instrument - Phonometer CR: 832C

## 7. Legislation in the countries of the European Union and the R. N. Macedonia

### 7.1. Overview of EU legislation

To calculate the noise level of road traffic as the biggest noise emitter at the emission site, there are several methods:

- German method
- English method
- Scandinavian method (Denmark, Finland, Norway, and Sweden)
- Swiss method
- Austrian method and
- French method

In other countries, depending on the experience and the data banks at their disposal, different methods are used. For example, in Croatia and Slovenia, the German method is used, while in Poland the French method is used.

It is noticeable that there is a wide range of different methods of calculating noise using different indicators, but it is important to note that there are no scientific or technical reasons for this, but that it is a result of the fact that most countries independently developed their methods.

From the side, the European Union has made a recommendation on the adoption of a unique method of calculation of noise to use the French method.

### 7.2. Overview of the regulation in R. N. Macedonia

The Law on Environmental Noise Protection was adopted by the Assembly of the Republic of Macedonia on 14 June 2007 [5].

The main purpose of this law is to provide:

- Creating healthy living conditions for people and protecting the environment from noise
- Taking measures and activities to avoid, prevent or reduce noise
- Undertaking noise protection measures imposed by the immediate surroundings causing discomfort and disturbance
- Removing or reducing the harmful effects resulting from exposure to noise in the media and the environment; and
- Providing a basis for developing noise abatement measures that the larger sources emit, in particular road, rail and water vehicles and infrastructure, aircraft, equipment used in open spaces in the industry as well mobile mechanical means for work.

This law provides definitions of the terms "Noise in the environment" and "agglomeration". Thus, "environmental noise" is understood unwanted or harmful external sound, created by human activities, which is imposed by the immediate surroundings and causes discomfort and distress, including the sound emitted by vehicles, road, rail, and air traffic and from places of industrial activity.

"Agglomeration" is understood as part of the territory of the Republic N. Macedonia, designated by the Government of the Republic of North Macedonia, having a population of more than 100,000 persons and/or population density, due to which is considered an urban area.

## 8. Conclusion

Noise has a great impact on the environment and is increasingly a serious problem as it contributes to a significant reduction in people's quality of life. According to the negative environmental impact, noise is at the very top, together with air and water pollution. Except for the impact on the environment, it is important to emphasize that noise has a detrimental effect on the driver as well and passengers in the vehicle.

In the order of pollution, noise is at the very top, together with air and water pollution. The negative impact of noise on environmental pollution is very big, by its significance it is one of the most serious environmental problems as it contributes to a significant reduction in people's quality of life.

Studying noise is as physical as sound and psycho-physiological as an element of life, which is received through the human hearing sense with all the consequences for the human body.

The noise is all around us, so we say that in everyday life and work people are exposed to the impact of noise. Because noise sources are varied and numerous, they can be related to space where one resides, where one works and lives. The noise that the traffic generates is usually characterized as "traffic or transport noise". Transport noise is the result of all the sounds heard as a result of vehicles moving on the roads - highways, including a combination of all possible sources to the sound of vehicles.

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