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NOISE AS ASPECT OF LIFE QUALITY AT URBAN AREAS

Abstract: *In this paper noise is considered as aspect of life quality at urban areas. Noise pollution at urban area become more important and it is considered related to its major sources. Traffic, especially road one, is identified as primarysource of noise at urban area. On the basis of measured noise levels at typical urban area, the analysis of methods for reduction of urban population exposure to high level of noise is done. Implementation of sound engineering is implicated in the processes of motor vehicles design so as in urban planning. Long term exposure of urban population to high level of noise can significantly decrease quality of life and cause serious health damages, the noise at urban area must be efficiently reduced.*

Keywords:*noise, urban area, quality of life, noise reduction*

1.INTRODUCTION

Environmental noise at urban areas relates to noise and sound beyond allowed levels that is caused by traffic, industrial, and other activities associated to life at urban area. Noise as pollutant can cause serious direct health defects such hearing damages or sleep and on long-term even mental disorders. The long-timeeffects to health is much dangerous, but still not clear due to number and complexity of influential factors. The effects of environmental noise cannot be related only to psychological state and sleep disturbance, but to serious illnesses, increasing blood pressure, increase of stress and so on. From the other side, Europe is one of the most populated regions of the world and around 75 % of total population lives in urban areas. Despite general improvements and global trends for reduction of noise at urban areas, importance of this environmental factor and its complex impact to quality of life case that noise become most important environmental factor at urban areas.

The level of noise is regulated by The Environmental Noise Directive (2002/49/EC) that is implemented in National standard of Republic of Serbia. In presence, actions for reduce environmental noise at urban area have lower priority compared to other environmental factors as air and water pollution. The present EU regulations related to noise are set on harmonization of noise limits for motor vehicles, house appliances and other noise sources. As more data and informations about effects of noise to health became available, it has become clear that urban population must be efficiently protected from noise exposure.

2. IDENTIFICATION OF NOISE GENERATORS AT URBAN AREAS

Noise and sounds are natural

consequence of society, but however, can have major effects to quality of life, human health,environment and even economy.Identification of major sources of sound and noise at urban area must be done in order to propose possible actions for reducing population exposure to it. This identification must be done on the basis of relevant soundmapping of urban area taking into account of principles that exist in present legislation and regulation.

It should be noted that the noise maps of urban areas are formed on the basis of wide range of input data including traffic and its composition, building configuration, surface topography, weather parameters and other factors. On the basis of literature overview and analysis of sound and noise maps of urban areas it is concluded that road traffic is major noise generator [1]. Estimation of population at urban areas in EU, expressed in millions, exposed to noise higher then allowed levels by different sources are presented at Figure 1.

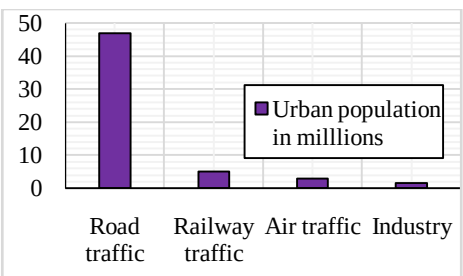

Figure 1 - Reported exposure of urban population to noise over allowed levels by different sources.

As road traffics is dominant source of high level noise at urban area this paper is focused on noise generated by road traffic at urban areas.

3. MEASURING AND ANALYSES OF NOISE

Sounds and noises are compositional elements of environment with very significant and complex influences to quality of life, especially in urban areas. The term noise is related to high intensity sound, monotonous sound, and sound of unpleasant frequencies or related to combinations of sounds mentioned above.

From the technical aspect, sound (noise) is generated as consequence of local pressure variations from the direction of sound source. Spreading of sound from the source can be compared to spreading of spherical weaves of liquids caused by impact of rigid body into it. Acoustically, sound pressure superimposed with environmental atmospheric pressure that is around 10^5 Pa [2].

The analysis of noises and sounds present very important source of relevant information and data that are done for different causes, among which the most important are listed:

- Noise can point out to potential problem that could cause damage and failure of technical systems,
- To evaluate the influence of noise to humans that are exposed and to estimate the risk of hearing damage,
- Present standards and regulations order that during development of new product, constructional solution that generate lowest level of noise must be selected,
- To estimate if noise levels are outside define limits,
- To evaluate the influence of noise to quality of human life and
- In order to identify and insolate sources of noise.

For ordinary human, hearing diapason is between 20 μPa to 200 Pa, when pain occurs, so diapason is in range of $1:10^6$. As intensity of sound is proportional to square of pressure, the diapason is in range of $1:10^{12}$. With existing ranges, it is implicated to define amplitude of sound pressure at logarithmic scale. For measuring of noise, sound pressure level (SPL) is used and it is expressed in units called decibel (dB) and it is defined as [2]:

$$L_p = 10\log_{10}\left(\frac{p_1}{p_0}\right)^2 = 20\log_{10}\frac{p_1}{p_0}, \quad (1)$$

Where are: Lp, dB – sound pressure level; p_1, Pa – amplitude of sound pressure and p_0= 20 μPa – referent pressure.

As unit decibel (dB) is based on logarithmic scale, two levels of noises can be added arithmetically.According to above mentioned, the resultant level of sound pressure L_{pr} that resulted as interaction of noses generated by different sources, L_{p1}, L_{p2}... can be calculated by following relation [1]:

$$L_{pr} = 10\log_{10}\left[\left(\frac{p_1}{p_0}\right)^2 + \left(\frac{p_2}{p_0}\right)^2 + ...\right], \quad (2)$$

While by addition of two identical noises, when is L_{p1}= L_{p2}=$L_{p,}$ it is:

$$L_{pr} = 10\log_{10}\left[2\left(\frac{p_1}{p_0}\right)^2\right] =$$

$$= 10\log_{10}\left(\frac{p_1}{p_0}\right)^2 + 10\log_{10} 2 = \quad (3)$$

$$= L_p + 1.3.$$

Duplication of sound intensity rise level of sound pressure by 3 dB. That means, for example, that to identical sounds of 90 dB act as one sound of 93 dB.

Human ear, fundamentally, react on sound pressure with sensitivity that very with sound frequency, so the highest sensitivity is within frequency range of 1÷5 kHz, while the sensitivity decrease at lower and higher frequencies. This fact provoked development of filtering frequency functions that simulate sensitivity of human ear at different frequencies. Also, response of human ear to time dependent signals and impulses caused development of instruments with defined time dependent estimation functions. As result of presented characteristics of human ear the measuring device for sound pressure level phonometers were developed. Phonometers uses specific filters that correspond to characteristics of human ear and regulated by International standard IFC 651.

Phonometer measures characteristics of sound that is registered by microphone. Signal is amplified and filtered before the measured value of sound level is displayed at analog or digital display. In dependence of device characteristics and properties, different filters can be used (1/1 or 1/3 octave) with different scales A, B or C for balance. Those tree balance scales simulate the response of human ear to low, middle and high frequency sounds, respectively. The dynamic of response of measuring device can be also selected as fast or slow. Phonometers must be calibrated to standardized sources of sound. Producers of phonometers usually use calibration instruments that are placed at phonometer microphone. Calibration instruments generate sound with defined intensity (usually 94 dB and/or 114 dB) with defined frequency (usually 1 kHz).

4.NOISE LEVEL AT URBAN AREA - EXPERIMENTAL RESULTS

Measuring and analyses of noise level were done in City of Kragujevac at selected locations along two of streets, one in living are with houses and one with heavy traffic in typical urban area. The measured values are compared to related noise levels allowed by regulations. Measuring of noise in environment was done according following regulations: Norm for indicators of noise, allowable limits, methods for estimation and evaluation of noise indicators, disturbance and damaging effects of noise in living environment (Republic Serbia, Official Periodical No. 75/10), National standard SRPS ISO 1996-2: Definition, measure

and evaluation of noise in living environment and Law of protection from noise in environment (Republic Serbia, Official Periodical No. 36/09) [3].

Measuring and evaluation of noise levels during day and night ware done by using of define methodology. For the measuring of noise level precise device, phonometer that is presented, sound level meter – Brüel & Kjær Type 2270 was used with 1/3 octave filter set. Calibrations ware done before and after measuring.

Results of noise measuring with allowed levels during day and night with allowable limits are presented at Fig. 2 and Figure 3, respectively [1 and 4].

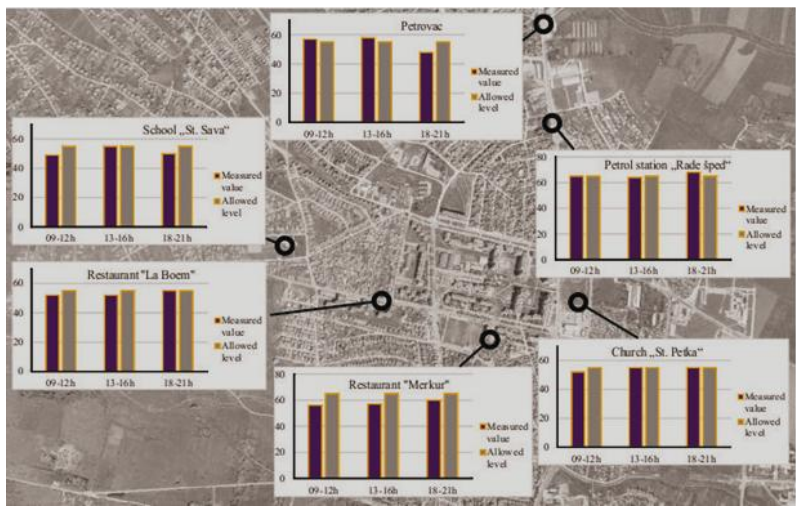

Figure2 - Measured value and allowed level of noise during day

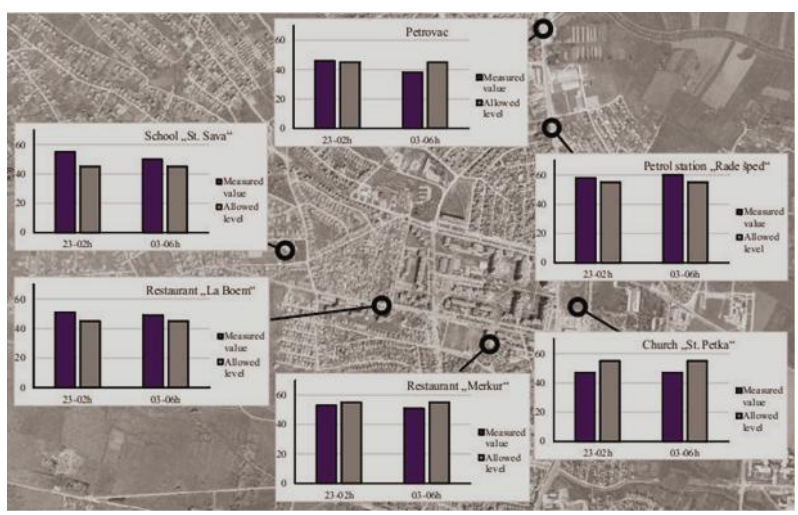

Figure 3 - Measured value and allowed level of noise during night

On the basis of the obtained results at measuring position it could be concluded that at places classified as main roads, main streets and big crossroads, the noise level during day do not overcome related allowable levels. Noise levels during evenings do not overcome limits at measuring positions classified as

residential area. Noise levels during nights do not overcome limits at measuring position at residential area away from busy streets but do at measuring position near streets with heavy traffic. Analysis of the obtained results can provide relevant information and data for future research in the area. Those results can be used to identify effective procedures for reduction of noise level so as to protect urban population from exposure to high level noise.

5. METHODS OF NOISE REDUCTION AT SOURCE

Noise pollution get higher priority due to estimation that about 20% of Europe population is exposed to noise levels that are consider unacceptable. It means that close to 80 million people in EU being irritated and getting sleep disturbed.

Aircraft, motor vehicles, transportation systems and also industry are major sources of noise not only at urban, but also, at whole environment. Even with methods for reduction of noise pollution at urban area that are include through urban and traffic planning the levels of noise cannot be efficiently reduced. It is implicated to act at sources of noise and sounds. This approach, implicate usage of vehicles with lower noise emission. Furthermore, sound engineering must be include in the process of new vehicles development and design. The present noise emission limit for heavy trucks in EU is 80 dB. The manufactures of present vehicles continuously measure noise and vibration characteristics of its engines and driving systems. At present vehicle design, sound insulation and alternative design solutions are used to reduce noise at every source, as engines and transmissions to axles, air intakes and fans. But, reducing noise at specific elements of motor vehicles is very complex due to fact that dominant noise source also depend on vehicle speed. For, example, it is estimated that tires, trailer and body are dominant noise sources at speed of over 50 km/h.

Use of low noise road and street surfaces become increasingly widespread, especially for new roads and streets or when wear surfaces need to be replaced on existing.

Methods of noise reduction at sourceinclude traffic managementmethods, such as re-routing of traffic, restrictions on specific type of traffic, for example, heavy trucks. Those restrictions can be related to area or time period. Also, speed restrictions can provide lover noise levels.

Usage of noise barriers alongside of roads and streets or other similar methodsare also widely used to reduce noise.

6. URBAN PLANNING FROM ASPECT OF NOISE EXPOSURE PROTECTION

Noise management, primarily management of traffic noise, is important factor of urban planning. Traffic noise levels at streets in urban area show large variations. The noise levels near streets with heavy traffics are high, while those levels are low at noise protected areas and areas away from busy streets. On the other side, traffic is closely related to the infrastructure of the urban area.

Influence of traffic to noise exposure is also very complex [5 and 6]. In general, noise levels at living area depend on its distances from streets and traffic. Design and material of buildings have also significant influence. The sides of buildings may absorb, screen or reflect sound waves generated by traffic. Furthermore, the configuration of building blocks have significant influence.

The presented facts imply that there are close relations between population exposure to traffic noise and planning of

urban area, especially planning of new building blocks and streets. Interactions of factors of traffic noise exposure at urban area are illustratively presentedat Figure 4.

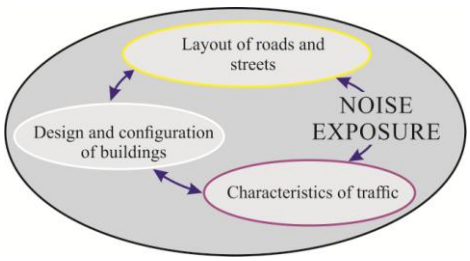

Figure 4 - Interactions of factors of traffic noise exposure at urban area

Influence of traffic to noise exposure is very complex. In general, noise levels at living area depend on its distances from streets and traffic flow. Design and material of buildings have also significant influence. The sides of buildings may absorb, screen or reflect sound waves generated by traffic. Furthermore, the configuration of building blocks have significant influence.

7. CONCLUSION

The presented facts imply that there are close relations between population to traffic noise and noise generation and planning of urban area, especially planning of new building blocks and streets. Reduction of noise levels can be done at sources, but also exposure can be lowered by implementing sound engineering in the process of urban planning. Furthermore, it is implicated that cities should involve plans and methods for reduction of population exposure to noise as important part of urban development planning. On the other side, developments of cities are related not only to traffic noise, but to wide range of aspects of life. Factors have complex interactions and related to each other. Public health [4] is affected by noise and air pollution mainly caused by traffic. But, traffic is inevitably and provide also many positive effects. Urban planning [5, 6] requires optimum balance between those elements and factors. By reduction of noise levels at sources altogether with methods for protect urban population from noise exposure effective actions can be done.

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