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FACULTY OF APPLIED SCIENCES

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MECHATRONICS

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ПРВА МЕЃУНАРОДНА КОНФЕРЕНЦИЈА НА ПРИМЕНЕТИ НАУКИ

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8-9 May 2015
Tetova, Macedonia

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Criteria for environmental noise assessment

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Abstract
The noise assessment generally refers to the assessment of noise impact from a specific source, such as noise originating from certain industrial plants, road traffic, and this is not always an easy task. Practically in every surrounding, a number of different sources contribute to the ambiental noise at a certain point. Standardization of noise level includes recommendations for noise level prescribed by legislation, which are enabling stay in the environment without danger to human health. Application of criteria on existing noise sources are made in case of significant modification in existing sources or in case of complaints of surrounding community.
This paper will be presented noise criteria that used to achieve the objectives of reducing the environmental noise impact as part of the policy for management and control of environmental noise.

Keywords: noise, assessment, criteria, environment

1 Introduction

In the last few decades the noise has increasingly greater impact on quality of life, as a result of improper, unplanned urbanization, intensification of land and air transport, use of obsolete vehicles and more. Many research and monitoring studies in recent decades indicate noise as environmental pollution, part of air pollution, which is a real threat to human health and quality of life [1]. Increased noise level and its adverse health effects represent a problem that is expanding both in industrialized countries and in developing countries, in which are still not clearly defined criteria for control and management of noise. Namely, according to some sources, 21 million Americans suffer from problems of hearing loss. Nearly every other American considered that posses hearing loss, and one of three respondents aged from 18 to 29 years have the same opinion. Compared with 1971, is noted 14% increasng of hearing impairments [2].

In developing countries the problem of increased noise level is mainly due to inflexible production and overcrowding of cities. These countries tend to engage in modern trends of technological and industrial development, and their governments are willing to sacrifice the environment for intensification of development and industrialization that will allow these countries to be competitive on the world market, neglecting health of the population is exposed to high noise levels [3].

Urban noise comes from different sources, but primarily including: transport equipment, construction machinery, household appliances, loud music and more. Because of growing concentration of the different types of energy, increased intensification of traffic, the use of powerful new machines and vehicles, comes to a significant increase in noise level in urban areas.

2 Identifying Noise Sources

Noise assessment is generally about evaluating the impact of one specific noise source, for example, the noise from a specific production plant. This is not always an easy task. In practically every environment, a large number of different sources contribute to the ambient noise at a particular point [4].

Ambient noise is the noise from all sources combined − industrial noise, traffic noise, birds song, running water, etc.

Specific noise is the noise from the source under investigation. The specific noise is a component of the ambient noise and can be identified and associated with the specific source.

Residual noise is ambient noise without specific noise. The residual noise is the noise remaining at a point under certain conditions when the noise from the specific source is suppressed.

This terminology derives from ISO 1996 [5] and is commonly used. The term **background** noise (not used in ISO 1996) is also a common one but should not be confused with residual noise. It is sometimes used to mean the level measured when the specific source is not audible and sometimes it is the value of a noise parameter, such as the LA_{90} (the level exceeded for 90% of the measurement time).

In the context of physical planning, the term **initial noise** is used to denote the noise at a certain point before changes, for example, the extension of a production facility or the building of barriers, are implemented. A variety of methods are used to assess specific noise. These methods can range from the drastic, such as the shutting down of a production plant to isolate the residual noise, to sophisticated systems that include simultaneous and correlated measurements at several points close to and away from the source.

Standardization of noise level includes recommendations for the size of noise level prescribed by nacional legislation, which is formed to allows staying in environment and on workplace without danger to human health. Recommendations for standardization of the permissible noise level and the criteria that should be applied are aimed assessing the harmful effects with respect to:

- protection of required intelligibility of speech and other useful sound information in terms of increased noise;
- protection from psycho- physiological effects of noise during both the working and vacation.

3 Principles underpinning the noise criteria

The criteria for permissible noise level that are set for certain noise sources are best regarded as planning tools. They are not mandatory, and an application for a noise producing development is not determined purely on the basis of compliance or otherwise with the noise criteria. Numerous other factors need to be taken into account in the determination. These factors include economic consequences, other environmental effects and the social worth of the development. The criteria help to determine consent/licence conditions because they provide information on the likely effect of any environmental noise associated with the development. The application of the criteria to existing noise sources would occur where significant modifications are made to existing developments or where complaints are received [6].

In applying the policy to existing operations it is acknowledged that the scope for applying feasible and reasonable mitigation measures to existing noise sources is usually far more limited than for new developments. Careful consideration of noise impacts and the feasible and reasonable mitigation measures available at these sites may result in less stringent noise limits than would ideally apply. Sometimes the resultant noise limits will be above the criteria.

In assessing developments proposed for ‘greenfield’ (undeveloped) areas, the policy allows controlled increases above background noise levels in a similar manner to previous policy and planning practice.

4 Noise criteria and assessment

The policy sets two separate noise criteria to meet environmental noise objectives: one to account for intrusive noise and the other to protect the amenity of particular land uses.

4.1 Assessing intrusiveness

For assessing intrusiveness, the background noise needs to be measured and its impact on the overall noise level. The intrusiveness criterion essentially means that the equivalent continuous (energy-average) noise level of the source should not be more than 5 decibels (dB) above the measured background level.

4.2 Assessing amenity

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate to industrial-type noise road, rail or community noise. The existing noise level from different noise sources is measured. If it approaches the criterion value, then noise levels from new industries and other activities need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion. For high-traffic areas there is a separate amenity criterion. The cumulative effect of noise from industrial sources needs to be considered in assessing impact.

4.3 Project-specific noise levels

For a particular project, the more stringent of the intrusive or the amenity criteria sets the project specific noise levels for that project. Generally, the intrusive criterion applies for all new industries until an area begins to become more developed, causing increased noise levels. At this stage the amenity criterion starts to take over as the applicable criterion. Where several new industries are proposed for a new area, care must be taken to ensure that equitable levels are set for each proposed industry.

The assessment procedure for industrial noise sources has two components:

• controlling intrusive noise impacts in the short term for residences;

• maintaining noise level amenity for particular land uses for residences and other land uses.

In assessing the noise impact of industrial sources, both components must be taken into account for residential receivers, but, in most cases, only one will become the limiting criterion and form the project-specific noise levels for the industrial source.

5 Intrusive noise impacts

The intrusiveness of an industrial noise source may generally be considered acceptable if the A-weighted equivalent continuous noise level (energy-average) from the source (represented by the LAeq descriptor), measured over a 15-minute period, does not exceed the background noise level measured in the absence of the source by more than 5 dB.

To account for the temporal variation of background noise levels, rating background level—RBL to be used in the assessment. Raiting background level presents any predicted or measured acoustic level to which an agjustment has been added [5]. This approach aims to result in the intrusive noise criterion being met for at least 90% of the time periods over which annoyance reactions can occur (taken to be periods of 15 minutes).

Adjustments are to be applied to the noise level produced by the source that is received at the assessment point before comparison with this criterion. Adjustment presents any quantity, positive or negative, constant or variable, that is added to a predicted or measured acoustical level to account for some sound character, the time of day, or the source type [5].

The intrusiveness criterion is summarised as follows:

$$L_{Aeq,\ 15\ minute} \leq \text{rating background level} + 5\ \text{dB}, \quad (1)$$

where **:**

$L_{Aeq,\ 15\ minute}$, represents the A-weighted equivalent continuous sound pressure level (energy average) of the source over 15 minutes.

In some rural situations, the rating background level may be the same for the day and night. In these cases, it is recognised that excursions of noise above the intrusiveness criterion during the day would not usually have the same impact as they would at night. This is due to the more sensitive nature of activities likely to be disturbed at night (for example, sleep and relaxation).

Rating background level is the background level to be used for assessment purposes.

6 Protecting noise amenity

The establishment, implementation and observance of the normative acts concerning environmental noise is a process that occurs as a need of growing noise pollution outside of the workplace, in homes, places of leisure and recreation, cultural centers and so on.

To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial, road traffic and other noise sources should not normally exceed the acceptable noise levels specified in Table 1. Meeting the acceptable noise levels in Table 1 will protect against noise impacts such as speech interference, community annoyance and, to some extent, sleep disturbance. Table 1 also includes recommended maximum noise levels for different land uses. These recommended maximum values provide guidance on an upper limit to the noise level. In all cases it is expected that all feasible and reasonable mitigation measures would be applied before the recommended maximum noise levels are referenced.

In some instances it may not be possible to achieve even the recommended maximum noise level, even after all feasible and reasonable noise mitigation has been applied. Such cases are expected to have a large adverse noise impact. Where a proposed development exceeds the recommended maximum noise levels in Table 1, substantial benefits in other areas, including a high degree of social worth, would need to be demonstrated.

According to the Regulation on limit values of the environmental noise level ("Official Gazette on Republic of Macedonia", No.147 / 08) regarding the permissible (recommended maximum) noise level, the urban areas are divided into four areas, shown in Table 1.

Table 1 Divide of urban areas and appropriate recommended maximum noise level

An area defined in accordance with the level of noise protection	**Noise level in dB(A)**		
	L_d	**L_e**	**L_n**
First level area	50	50	40
Second level area	55	55	45
Third level area	60	60	50
Fourth level area	70	70	60

L_d - Indicator for daily noise level which is A-equivalent long-term average sound level defined in ISO 1996-2:1987;

L_e - Indicator for evening noise level which is A-equivalent long-term average sound level defined in ISO 1996-2:1987;

L_n - Indicator for night noise level which is A-equivalent long-term average sound level defined in ISO 1996-2:1987;

7 Definitions to support the modifying factor corrections

Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. On the other hand, some sources may cause less annoyance where only a single event occurs for a limited duration. This section outlines the correction factors to be applied to the noise source at the receiver before comparison with the previous mentioned criteria to account for the additional annoyance caused by these modifying factors.

Tonal noise—containing a prominent frequency and characterised by a definite pitch.

Low-frequency noise—containing major components within the low frequency range (20 Hz–250 Hz) of the frequency spectrum.

Impulsive noise—having a high peak of short duration or a sequence of such peaks.

Intermittent noise—the level suddenly drops to that of the background noise several times during the assessment period, with a noticeable change in noise level of at least 5 dB.

7.1 ‘Modifying factor’ adjustments

The modifying factor corrections should be applied having regard to:

- all noise sources, that contribute to the total noise at a site; and
- the nature of the noise source and its characteristics.

Adjustment for duration—applied where a single event noise is continuous for a period of less than two and a half hours in any 24-hour period. The acceptable noise level may be increased by the adjustment shown in Table 4. This adjustment is designed to account for unusual and one-off events, and does not apply to regular high-noise levels that occur more frequently than once per day.

Maximum adjustment—the maximum correction to be applied to the criteria or the measured level where two or more modifying factors are present. The maximum adjustment is 10 dB(A) where the noise contains two or more modifying factors (excluding the duration correction).

Table 3 sets out the corrections to be applied. The modifying factor, corrections specified for tonal, impulsive, intermittent and low-frequency noise are to be added to the measured or predicted noise levels at the receiver before comparison with the criteria as shown in Table 3 . The modifying factor correction is applied (Table 2) as follows (Ki is equal to the modifying factor correction (from Table 3)):

Table 2 Application of modifying factor

Criterion	**Compare**	
	Measured or predicted	**Criterion value**
Intrusiveness	$L_{Aeq} + K_i$	Rating background level plus 5
Amenity	$L_{Aeq} + K_i$	Acceptable noise level

Table 3 Modifying factor corrections

Factor	**Assessment/ measurement**	**When to apply**	**Correction**	**Comments**
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: —**5 dB** or more if the centre frequency of the band containing the tone is above 400 Hz —**8 dB** or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive —**15 dB** or more if the centre frequency of the band containing the tone is below 160 Hz	5 dB	Narrow-band frequency analysis may be required to precisely detect occurrence
Low frequency noise	Measurement of C-weighted and	Measure/assess C- and A weighted levels over same time period. Correction to be applied if the	5 dB	C-weighting is designed to be more responsive to low-frequency

	A-weighted level	difference between two levels is 15 dB or more		noise
Impulsive noise	A-weighted fast response and impulse response	If difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB	Apply difference in measured levels as the correction, up to a maximum of 5 dB.	Characterised by a short rise time of 35 milliseconds (ms) and decay time of 1.5 s
Intermittent noise	Subjectively assessed	Level varies by more than 5 dB	5 dB	Adjustment to be applied for night time only.
Duration	Single-event noise duration may range from 1.5 min to 2.5 h	One event in any 24-hour period	0-20 dB	The acceptable noise level may be increased by an adjustment depending on noise duration
Maximum correction	Refer to individual modifying factors	Where two or more modifying factors are indicated	Maximum correction of 10 dB(A) (excluding duration correction)	

Table 4 Duration corrections

Noise duration (one event in any 24 hour period)	Increase in acceptable noise level at receptor, dB(A)	
	Day and evening (07:00-23:00)	Night (23:00-07:00)
1.0 to 2.5 hours	2	/
15 minutes to 1 hour	5	/
6 minutes to 15 minutes	7	2
1.5 minutes to 6 minutes	15	5
less than 1.5 minutes	20	10

Conclusion

Standardization of noise in urban areas is carried out taking account its psychological impact on people. Establishment of norms for environmental noise is very complex process, given that the psychological reaction of a disruption of the normal environment is different at different people and primarily depends on the mental stability of personality. As criteria are adopted optimal reactions of respondents subjected to various types of noise pollution.

The noise source can possess characteristics that increase its unsettling effect, such as: tone, impuls, low - frequency and discontinuos noise. When have such a noise source should make the adjustment (correction) at the noise level source received in estimation phase before it is comparable to the specific noise level to determine the additional annoyance caused by the above mentioned individual characteristics of the noise source.

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