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Noise Map - A Necessity

In contrast to many other environmental problems, noise pollution continues to increase thanks to industrial, social and transportation field development. The paper analyze specific aspects on the impacts of noise on health, to identify areas for priority action and remediation measures.

Keywords: *urban road, traffic, noise, level, map*

1. Introduction

Noise pollution is a priority on the list of citizens' concerns and noise reduction has increasingly become a focus for EU legislation and a priority for research initiatives. Research should cover aspects such as the assessment of noise exposure and perception, health impacts of exposure to noise, noise abatement including cost benefit aspects, new technologies and system approaches for improved noise control at source and the further development of legislative standards.

2. What is noise?

In simple terms, noise is unwanted sound. Sound is a form of energy which is emitted by a vibrating body and on reaching the ear causes the sensation of hearing through nerves. Sounds produced by all vibrating bodies are not audible. The frequency limits of audibility are from 20 HZ to 20,000 HZ.

A noise problem generally consists of three inter-related elements the source, the receiver and the transmission path. This transmission path is usually the atmosphere through which the sound is propagated, but can include the structural materials of any building containing the receive.

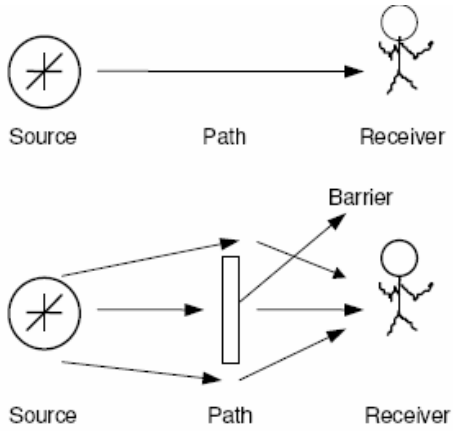

Fig. 1 Inter-relationship between the elements of noise

Noise may be continuous or intermittent. Noise may be of high frequency or of low frequency which is undesired for a normal hearing. For example, the typical cry of a child produces sound, which is mostly unfavorable to normal hearing. Since it is unwanted sound, we call it noise.

The discrimination and differentiation between sound and noise also depends upon the habit and interest of the person/species receiving it, the ambient conditions and impact of the sound generated during that particular duration of time. There could be instances that, excellently rendered musical concert for example, may be felt as noise and exceptional music as well during the course of the concert!

Sounds of frequencies less than 20 HZ are called infrasonics and greater than 20,0000 HZ are called ultrasonics. Since noise is also a sound, the terms noise and sound are synonymously used and are followed in this module.

3. How it is computed?

The intensity of sound is measured in sound pressure levels (SPL) and common unit of measurement is decibel, dB. The community (ambient) noise levels are measured in the A- weighted SPL, abbreviated dB(A). This scale resembles the audible response of human ear. Sounds of frequencies from 800 to 3000 HZ are covered by the A - weighted scale. If the sound pressure level, L1 in dB is measured at r1 meters, then the sound pressure level, L2 in dB at r2 meters is given by,

$$L_2 = L_1 - 20log_{10}\frac{r_2}{r_1}\ , \qquad (1)$$

If the sound levels are measured in terms of pressure, then, sound pressure level, LP is given by,

$$L_P = 20 log_{10} \frac{P}{P_0} \text{ dB(A)}, \quad (2)$$

The Lp is measured against a standard reference pressure, Po = 2 x 10-5 N/m2 which is equivalent to zero decibels. The sound pressure is the pressure exerted at a point due to a sound producing source.

Day-night equivalent noise levels (Ldn): The day night equivalent noise levels of a community can be expressed as –

$$L_{dn} = 10 \times log_{10} \left[\frac{15}{24} \left(\frac{10 L_d}{10} \right) + \frac{9}{24 \left(\frac{10(L_n + 10)}{10} \right)} \right] \text{ dB(A)}, \quad (3)$$

where, Ld = day-equivalent noise levels (from 6AM - 9 PM), dB (A)
Ln = night equivalent noise levels (from 9 PM - 6 AM), dB (A)

The day hours in respect to assessment of noise levels, is fixed from 6 AM - 9 PM (i.e., 15 hrs) and night hours from 9 PM - 6 AM (i.e., 9 hrs). A sound level of 10 dB is added to Ln due to the low ambient sound levels during night for assessing the Ldn values.

4. Noise measurement instruments

Noise measurement is an important diagnostic tool in noise control technology. Theobjective of noise measurement is to make accurate measurement which give us a purposeful act of comparing noises under different conditions for assessment of adverse impacts of noise and adopting suitable control techniques for noise reduction. The various equipment used for noise level measurement are summarised at Table 1. The principle and the components of noise measuring instruments is summarised below.

A sound level meter consists basically of a microphone and an electronic circuit including an attenuator, amplifier, weighting networks or filters and a display unit. The microphone converts the sound signal to an equivalent electrical signal. The signal is passed through a weighting network which provides a conversion and gives the sound pressure level in dB.

The instructions laid down by the noise level meter manufacturers shall be followed while using the instruments.

The time constants used for the sound level meter standards are
S (Slow) = 1 second
F (Fast) = 125 milli seconds

Relatively steady sounds are easily measured using the "fast" response and unsteady sounds using "slow" response. When measuring long-term noise exposure, the noise level is not always steady and may vary considerably, in an irregular way over the measurement period. This uncertainty can be solved by measuring the continuous equivalent level, which is defined as, the constant sound pressure level which would have produced the same total energy as the actual level over the given time. It is denoted as **Leq**. The display of Leq facility is also available in certain models of sound level meters. This is the desired parameter for assessment of ambient noise levels.

Table 1. Equipment used in the measurement of noise levels

S.No.	Equipment	Specification/Area of usage
1.	Sound level meter	Type-0 : Laboratory reference standard Type-1: Lab use and field use in specified controlled environment Type-2: General field use (Commonly used) Type-3: Noise survey
2.	Impulse meters	For measurement of impulse noise levels e.g. hammer blows, punch press strokes etc.
3.	Frequency analys-ers	For detailed design and engineering purpose using a set of filters
4.	Graphic recorders	Attached to sound level meter. Plots the SPL as a function of time on a moving paper chart.
5.	Noise dosimeters	Used to find out the noise levels in a working environment. Attached to the worker
6.	Calibrators	For checking the accuracy of sound level meters.

5. Sources of noise

Where does it generate from? The sources of noise may vary according to daily activities. They sources may be domestic (movement of utensils, cutting and peeling of fruits/vegetables etc.) natural (shores, birds/animal shouts, wind movement, sea tide movement, water falls etc.), commercial (vendor shouts, automobiles, aeroplanes, marriages, laboratory, machinery etc.) industrial (generator sets, boilers, plant operations, trolley movement, transport vehicles, pumps, motors etc.). The noise levels of some of the sources are summarised at table 2. Typical surveys pertaining to causes of noise pollution, reveal the various sources of noise pollution and frequency variation of their occurrences.

Table2. Typical noise levels of some point sources

Source	Noise level dB(A)	Source	Noise level, dB(A)
Air compressors	95-104	Quiet garden	30
110 KVA diesel generator	95	Ticking clock	30
Lathe Machine	87	Computer rooms	55-60
Milling machine	112	Type institute	60
Oxy-acetylene cutting	96	Printing press	80
Pulveriser	92	Sports car	80-95
Riveting	95	Trains	96
Power operated portable saw	108	Trucks	90-100
Steam turbine (12,500 kW)	91	Car horns	90-105
Pneumatic Chiseling	118	Jet takeoff	120

6. Impacts of noise

Why bother about noise? Often neglected, noise induces a severe impact on humans and on living organisms. Some of the adverse effects are summarised below.

· **Annoyance:** It creates annoyance to the receptors due to sound level fluctuations. The aperiodic sound due to its irregular occurrences causes displeasure to hearingand causes annoyance.

· **Physiological effects:** The physiological features like breathing amplitude, blood pressure, heart-beat rate, pulse rate, blood cholesterol are effected.

· **Loss of hearing:** Long exposure to high sound levels cause loss of hearing. This is mostly unnoticed, but has an adverse impact on hearing function.

· **Human performance:** The working performance of workers/human will be affected as they'll be losing their concentration.

· **Nervous system:** It causes pain, ringing in the ears, feeling of tiredness, thereby effecting the functioning of human system.

· **Sleeplessness:** It affects the sleeping there by inducing the people to become restless and loose concentration and presence of mind during their activities

· **Damage to material :** The buildings and materials may get damaged by exposure to infrasonic / ultrasonic waves and even get collapsed.

7. Control of Noise Pollution

Noise generation is associated with most of our daily activities. A healthy human ear responds to a very wide range of SPL from - the threshold of hearing at zero dB, uncomfortable at 100-120 dB and painful at 130-140 dB(3). Due to the various adverse impacts of noise on humans and environment (See LO-5), noise should be controlled. The technique or the combination of techniques to be employed for noise control depend upon the extent of the noise reduction required, nature of the equipment used and the economy aspects of the available techniques.

The various steps involved in the noise management strategy is illustrated at figure 2. Reduction in the noise exposure time or isolation of species from the sources form part of the noise control techniques besides providing personal ear protection, engineered control for noise reduction at source and/or diversion in the trajectory of sound waves.

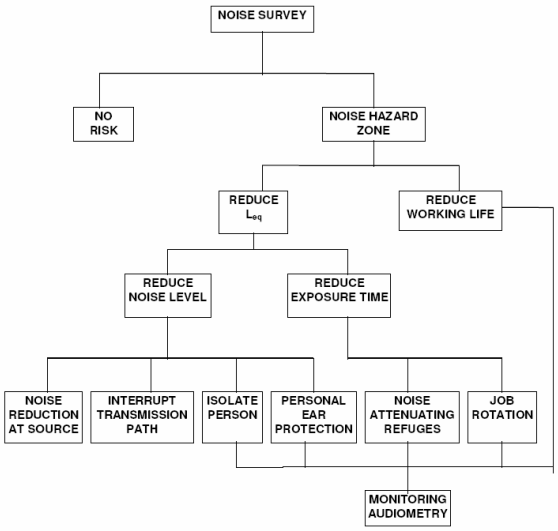

Figure 2. Noise Management Strategy

8. Noise Legislation

The most important European document about environmental noise is the well known 2002/49/EC Directive (END) [1], witch is transposed in Romanian legislation by HG nr.321/2005[2]. Although the END does not impose limit values for noise levels, it recommends to the Member States (MS) to establish their own

limit levels accordingly to the documents of the WHO.The main objectives of the END are the following:
- to assess the exposure to environmental noise using the harmonised noise indicators Lden and Lnight ,
- to inform and consult the public about noise exposure, its effects and measures considered to address noise,
- to adopt action plans based on noise mapping results, regarding the prevention and reduction of environmental noise where necessary-particularly where exposure levels can induce harmful effects on health–and preserving environmental noise quality where it is good,
- to provide a basis for developing Community strategies and measures to reduce noise emitted by the major environmental noise sources. Therefore, Romania has established (Table 4) the following limits for the noise produced by the road traffic:

Table 4. Limit permitted levels, in dB(A)

	Present permitted limits	Target for 2012
Lden	70	65
Lnight	60	55

9. Urban Noise Mapping Urgency

The EU requirements regarding the urban noise mapping are very clear: all urban agglomerations having 250,000 inhabitants or more must have a strategic noise map before 30 June 2007 and action plans before 18 July 2008. At the present time, Bucharest only has a first issue of a noise map (done in May 2007), the rest of 8 towns (Iasi, Cluj, Timisoara, Constanta, Craiova, Galati, Brasov, Ploiesti) are still working on their maps. Moreover, the EU requirements add:
"*Authorities responsible for data collection in MS will have to report data from strategic noise maps and action plans to the Commission no later than six months after the deadlines set to deliver the noise maps and action plans*."

10. Conclusion

Noise mapping become a common practice in many countries. Nevertheless, because of the technical limits and of the use of different calculation methods, any noise mapping is a unique virtual experience.

In Romania, the delay in this field must be and can be quickly recovered. Our paper is not only a sign that the problem is solvable, but its resultant noise level assessment shows that the reasonable limits are exceeded.

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