A Review on "Assessment of Noise Pollution Indices in India"

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Abstract

Traffic is a significant part of urban environment contributing about 55% to the total urban noise. Traffic noise is associated with adverse health effects, such as deafness, hypertension, myocardial infarction, atherosclerosis, annoyance and stress hormone disorder. For this reason inventory of road traffic noise in different cities around the world has become a popular research topic among the environmental scientists. In the recent years Transportation projects in India have created excessive Noise pollution which is displeasing the activity or balance of human and animal life. In the present study, attempts are made to evaluate the different parameters related to road traffic noise in India. The broad objective of this paper is to present the brief literature about the Road traffic noise, reason of noise pollution as well as remeady for noise pollution in Indian context.

Key words: Noise Pollution India, causes, effect, measurement, Road traffic noise

INTRODUCTION

The word noise is derived from Latin word "Nausea" implying 'unwanted sound' or unexpected' or unpleasant (Pawar et al. 2010). Noise pollution can be defined as intrusive noise that disrupts, distracts, or detracts from regular functioning. And while people mainly think of noise pollution as a problem of the big cities, with the competing sounds of more people in a smaller space, noise pollution can also be found in suburban neighborhoods (in the form of leaf blowers, lawn mowers, and home construction) and even individual homes and offices at levels that can have a negative impact on your health and productivity.

Traffic noise is one of the most immediate and identifiable environmental problem associated with rapid industrialization, urbanization and population growth. Rapid urbanization, industrialization, expansion of road network and infrastructure caused serve noise pollution problem (Pathak et al., 2007). Traffic noise is considered as one of the important sources of noise pollution that adversely affects human health (Lercher, 1995; Williams and McCrae, 1995). The increasing number of vehicles, musical instruments, small scale industries, and urbanization activities are the main source of noise pollution. (Gangwar et, al.2006). Noise effects may include annoyance, deterioration of sleep quality and stress-related ischemic heart disease (Morell et al, 1997).

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 receiver (Fig. 1)

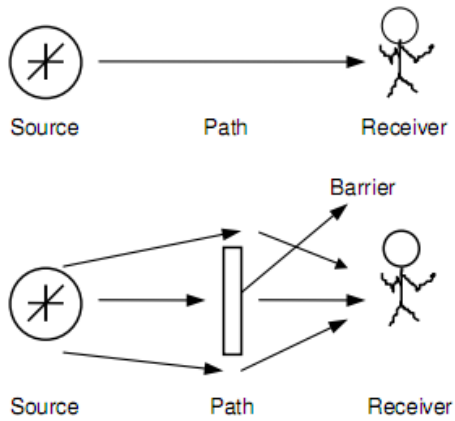

Fig. 1 Inter-relationship between the elements of noise (Source Ref)

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 infra-sonic and greater than 20, 0000 HZ are called ultra-sonic. Since noise is also a sound, the terms noise and sound are synonymously used and are followed in this module.

REVIEW ABOUT PREVIOUS RESEARCH

Rajiv B. Hunashala (et. al 2012) gives an assessment about noise pollution of Kolhapur city of India. As per his observation; Kolhapur, an ancient city of India, is rapidly emerging as industrialized and urbanized city and has started facing severe noise pollution problems. Day-time urban noise quality assessment was studied in Kolhapur for five critical zones viz. Educational, Commercial-cum-residential, Industrial-cum-residential, Recreational and Silence zone. Noise pollution indices viz. L10, L50, L90, noise climate (NC), equivalent continuous noise level (Leq), noise pollution level (Lnp) and noise exposure index (NEI) were computed for all zones. Results indicated that the highest Leq of 72.25 dBA was observed in industrial-cum-residential zone followed by 64.47 dBA in commercial-cum-residential zone, 63.71 dBA in educational zone, 53.26 dBA in recreational zone and 42.84 dBA in silence zone. For educational zone, Leq observed were above the statutory limits, while for other zones it was marginally below. The noise assessment study clearly revealed the alarming condition of noise pollution in Kolhapur.

S.U.Bande (et. al 2013) focused on "road traffic noise assessment in India" The broad analysis of that paper was to present the brief literature about the Road traffic noise in Indian context. Various topics such as Literature review, harmful effects of noise pollution, classification of noise, sources of noise pollution, noise standards, noise indicators are covered in paper.

Panda B. K.(et al. 2012) gives an estimation of noise pollution in kalinga nagar industrial complex in jajpur district of odisha, India. Baseline noise levels in Kalinga Nagar, India Industrial Complex (KNIC), a very significant and fast growing industrial area (steel hub) in Jajpur district of Odisha, India has been assessed for a period from April 2010 to October 2011. Eleven strategic locations were selected for study in and around KNIC. The characteristics of noise pollution and their effects were investigated through statistical noise levels (L10, L50 and L90), equivalent continuous equal energy level (Leq) and indices such as TNI, N.C. and Lnp.

M.P.Nawathe (et.al. Nov 2013) presented his work as "Management of Traffic Noise on Express Highway-An Ergonomic Approach" which is focused on noise problem faced by Amravati city of Maharastra state in India. As Amravati is developing area and a good education centre there is a rapid urbanization and alarming growth of population is causing serious environmental problems. Noise is one of the environmental problems that un comforts in daily life. In the present study, attempts are made to evaluate the different parameters related to traffic noise on express highway in Amravati City. The broad result of this study is to give the brief literature about the traffic noise in Indian context, to investigate the various noise parameters at selected location and to suggest the remedial measures for the management of noise.

According to The Environment (protection) act (1986) was enacted in 1986 with the objectives of providing the protection and the improvement of the environment. It empowers the central government to establish authorities [under section 3(3)] charged with the mandate of preventing environmental pollution in all its forms and to tackle specific environmental problems that are peculiar to different parts of the country. Numerous amounts of ship movements and its engines, running on unclean fuel, and also thousands of diesel trucks per day causes an array of environmental impacts. This impacts leads to increased risk of illness, such as respiratory disease. Particulate matter arising due to construction activities and daily operations causes great health hazards such as asthma, chronic lung diseases, bronchitis, heart diseases, and premature deaths.

The noise pollution may result in loss of hearing, stress, high-blood pressure, loss of sleep, distraction affecting productivity, and a general reduction in the quality of life. The effects of noise are difficult to quantify because tolerance levels among different populace and types of noise vary considerably Exposure to noise pollution exceeding 75 decibels for more than eight hours daily for a long period of time can cause loss of hearing. The hazards increase with the intensity of the noise and the period of exposure. The sound produced by a bursting cracker, exceeding 150dB, can cause a ringing sensation called 'tinnitus' and can impair hearing permanently.

Neenu K. Mathew (et.al.2014) "Study on Air and Noise Impacts at South Indian Port" worked on coastal area of south India also her analysis about the observed values of air and noise quality parameters were compared with pollution standards of

Central Pollution Control Board (CPCB). It was found that the particulate matter emission exceeds the limits assigned by CPCB. So, the obtained data was used to develop an effective Environmental Management Plan (EMP) to reduce or eliminate the potential environmental impacts of port. A detailed management plan to improve the air quality parameters in the port was formulated. In addition to this, a management plan to reduce the public health impacts due to the port activities was also developed.

More than 10% of the world population lives close to the coast, of which more than 300 million inhabit the coastal urban cities. To meet the increasing demands of population and requirements of the industries, new ports are being constructed or existing ports are being expanded throughout the world. Ports and harbour are the gateways of national and international trades. The environmental impacts of various activities in ports and harbours principally concern the estuarine and coastal water quality, contamination of the soil, degradation in sediment quality, air quality and noise generation beyond the permissible limits, and the generation of various types of other wastes.[14] A port can lead to severe pollution problem, over a large area due to the multifarious activities.

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METHODS OF MEASUREMENTS

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,

$$L2 = L1 - 20 \log10 (r2/r1) \quad \text{..... (1)}$$

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

$$L = 20 \text{ Log } (P/P) \text{ dB(A)} \quad \text{..... (2)}$$

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 (Fig. 2)

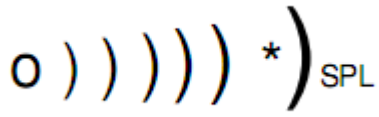

Fig. 2 Definition of sound pressure

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

$$Ldn, \text{ dB(A)} = 10 \times \log10 [15/24 (10Ld/10) + 9/24 (10(Ln + 10)/10)] \quad \text{..... (3)}$$

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.

TABLE 1

ADDITION OF SOUND LEVELS, L_1 AND L_2 (L_1>L_2)

L_1-L_2 dB	**Add to L_1**
0 or 1	3dB
2 or 3	2 dB
4-8	1dB
9 or more	0dB

FREQUENCY ANALYSIS

The frequency analysis allow to separate the main components of the signals by dividing the frequency range of interest into smaller frequency bands using a set of filters. We

may distinguish between noises that consist of regularly repeated or periodic sounds and those that consist of aperiodic sounds. The simplest periodic sound is a pure tone i.e., a pressure disturbance that fluctuates sinusoidally at a particular frequency. The lower the frequency, the longer is the wave length (wavelength = velocity of sound/frequency).

The noise produced by most sources of community noise, such as automobiles or aircraft engines, are examples of a periodic sounds. Such sounds cannot be subdivided into sets of harmonically related pure tones but can be described in terms of components extending over finite frequency bands. Such frequency analysis are often done in bands of octaves or 1/3 octaves. An octave band is a frequency band with upper and lower cutoff frequencies having a ratio of 2. The cut off frequencies of 707 HZ and 1414 HZ define an octave band, whose band centre frequency is 1000 HZ and would be referred to as the 1000 HZ octave band.

NOISE MEASUREMENT INSTRUMENTS

Noise measurement is an important diagnostic tool in noise control technology. The objective 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 Towards equipment used for noise level measurement are summarised at Table 2. 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 2 EQUIPMENT USED FOR NOISE MEASUREMENT

No.	Equipment	Specification/Area of uses
01	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
02	Impulse meters	For measurement of impulse noise levels e.g. hammer blows, punch press strokes etc.
03	Frequency analysers	For detailed design and engineering purpose using a set of filters.
04	Graphic recorders	Attached to sound level meter. Plots the SPL as a function of time on a moving paper chart.
05	Noise dosimeters	Used to find out the noise levels in a working environment. Attached to the worker
06	Calibrators	For checking the accuracy of sound level meters.

NOISE SAMPLING

Bureau of Indian Standards (BIS) has published several code books for sampling and analysis of noise pollution and guidelines for control of noise pollution from domestic and industrial sources. The reader is advised to refer to the BIS code books (table 3) for a better understanding of methods of noise sampling. For sampling of noise levels from industrial sources, noise levels in the different octave bands are measured by a sound level meter in conjunction with octave - band filters at the workers ear level or at about a distance of one meter from the source of noise.

TABLE 3

SELECTED BIS CODE BOOKS ON NOISE POLLUTION

BIS Code	Description
IS-4954-1968	Noise abatement in town planning recommendations
IS-3098-1980	Noise emitted by moving road vehicles, measurement
IS-10399-1982	Noise emitted by stationary road vehicles, methods of measurement of
IS-6098-1971	Air borne noise emitted by rotating electrical machinery, method of measurement of
IS-4758-1968	Noise emitted by machines, methods of measurements of
IS-3483-1965	Noise reduction in industrial buildings, code of practice for

The equivalent noise levels, Leq can also be calculated as

Leq = L50 + (L10 - L90)2 / 60

Noise Climate (NC): It is the range over which the sound levels are fluctuating in an interval of time NC = L10 - L90

Hence, Leq in the above example is -

Leq = 69 + (76 - 64)2 /60 = 71.4 dB. and noise climate, NC = 76 - 64 = 12 dB/sampling time.

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 summarized below.

- Annoyance: It creates annoyance to the receptors due to sound level fluctuations. The aperiodic sound due to its irregular occurrences causes displeasure to hearing and causes annoyance.
- Physiological effects: The physiological features like breathing amplitude, blood pressure, heart-beat rate, pulse rate, blood cholesterol are affected.
- 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 lose 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.

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. 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 Fig 4.

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.

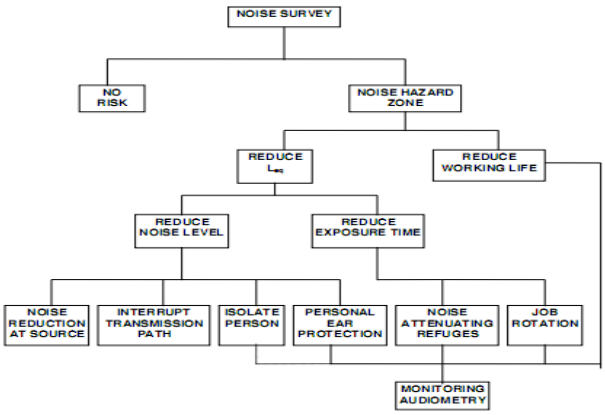

Fig. 4 Noise Management Strategy

The techniques employed for noise control can be broadly classified as

Control at source

Control in the transmission path

Using protective equipment.

NOISE CONTROL AT SOURCE

The noise pollution can be controlled at the source of generation itself by employing techniques like- Reducing the noise levels from domestic sectors:

The domestic noise coming from radio, tape recorders, television sets, mixers, washing machines, cooking operations can be minimised by their selective and judicious operation. By usage of carpets or any absorbing material, the noise generated from felling of items in house can be minimised.

- *Maintenance of automobiles*: Regular servicing and tuning of vehicles will reduce the noise levels. Fixing of silencers to automobiles, two wheelers etc., will reduce the noise levels.
- *Control over vibrations*: The vibrations of materials may be controlled using proper foundations, rubber padding etc. to reduce the noise levels caused by vibrations.
- *Low voice speaking*: Speaking at low voices enough for communication reduces the excess noise levels.

CONTROL IN THE TRANSMISSION PATH

Installation of barriers: Installation of barriers between noise source and receiver can attenuate the noise levels. For a barrier to be effective, its lateral width should extend beyond the line-of-sight at least as much as the height (See Fig. 5). It may be noted that, the frequencies, represented on the X-axis of the graph in Fig. 5, are the centre frequencies of the octave band. The barrier may be either close to the source or receiver, subject to the condition that, R <<D or in other words, to increase the traverse length for the sound wave. It should also be noted that, the presence of the barrier itself can reflect sound back towards the source. At very large distances, the barrier becomes less effective because of the possibility of refractive atmospheric effects. Another method, based on the length of traverse path of the sound wave is given at Fig. 6.

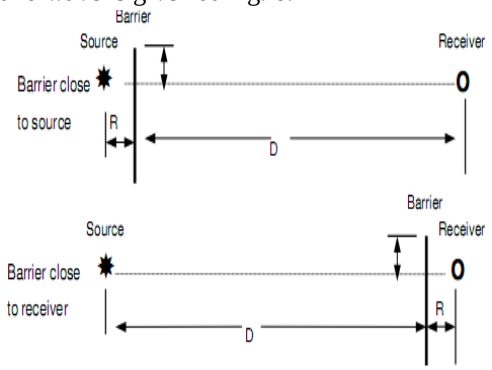

Fig. 6 Transmission path

USING PROTECTION EQUIPMENT

Before employing the use of protective equipment, please recall the Fig. 4, wherein the various steps involved in the noise management strategy are illustrated. Protective equipment usage is the ultimate step in noise control technology, i.e. after noise reduction at source and/or after the diversion or engineered control of transmission path of noise.

The usage of protective equipment and the worker's exposure to the high noise levels can

be minimized by -

- *Job rotation*: By rotating the job between the workers working at a particular noise source or isolating a person, the adverse impacts can be reduced.
- *Exposure reduction*: Regulations prescribe that, noise level of 90 dB (A) for more than 8 hr continuous exposure is prohibited. Persons who are working under such conditions will be exposed to occupational health hazards. The schedule of the workers should be planned in such a way that, they should not be over exposed to the high noise levels.
- *Hearing protection*: Equipment like earmuffs, ear plugs etc. are the commonly used devices for hearing protection. Attenuation provided by ear-muffs varies widely in respect to their size, shape, seal material etc. Literature survey shows that, an average noise attenuation up to 32 dB can be achieved using earmuffs

CONCLUSION

To evaluate the different parameters related to noise pollution in India, literature survey was carried out. The broad objective of this paper is to present the brief literature about the noise pollution in Indian context. Work regarding the noise pollution has already been done in developed countries, where as a little could be done in developing country like India. Mild noise can be annoying, excessive noise can destroy a person's hearing. The slightest unwanted sound can become very annoying if it continues for any length of time.

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