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Management of Traffic Noise on Express Highway-An Ergonomic Approach

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Abstract

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. Noise health effects are both health and behavioural in nature. Noise can damage physiological and psychological health of Human being. Noise pollution can cause annoyance and aggression, hypertension, high stress levels, hearing loss, sleep disturbances. Amravati is second largest and very important city in Vidharbha region. 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 problem that uncomforts 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 objective of this study is to present 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. In the present study for recording the various noise parameters digital sound meter was used. Traffic volume data was also collected on the express highway. The variation in the noise level and traffic volume data are studied and presented in the graphical form for the selected location.

Keywords: Ergonomic Approach

Introduction

The word "noise" is derived from the Latin word "nausea" meaning seasickness. Noise, defined as unwanted or excessive sound, is an undesirable by-product of our modern way of life. We experience noise in a number of ways. The environmental effects of transportation projects have come under close scrutiny in recent years out of which noise is one of the inevitable part. In the city, the main sources of traffic noise are the motors and exhaust system of autos, smaller trucks, buses, and motorcycles. This type of noise can be augmented by narrow streets and tall buildings, which produce a canyon in which traffic noise reverberates. Roadway noise is the collective sound energy emanating from motor vehicles. It contributes more to environmental noise exposure than any other noise source, and is constituted chiefly of engine, tire, aerodynamic and braking elements. The major factors which influence the generation of road traffic noise are:

a) Traffic flow.
b) Traffic speed.
c) Proportion of heavy vehicles.
d) Gradient of the road.
e) Nature of the road surface.
f) Attenuation of sound waves due to distance between source and receiver and also due to ground absorption.
g) Obstruction due to noise barriers.

The slightest unwanted sound can become very annoying if it continues for any length of time. While some nearby residents may ignore the continuous hum of a busy freeway, others will never be able to ignore it and increasingly will find it irritating.

Harmful Effects of Noise

Noise is considered a serious threat to the environmental health. Some of the adverse effects of noise pollution are given below:

1. It interferes with speech. In the presence of noise we may not able to follow, what the other person is saying.
2. Noise leads to emotional and behavioral stress. A person may feel disturbed in the presence of loud noise such as produced by heating of drums.
3. Noise may permanently damage hearing. A sudden loud noise can cause severe damage to the eardrum.

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4. Noise increases the chances of occurrence of diseases such as headache, blood pressure, heart failure, etc.
5. Noise leads to increased heart beat, constriction of blood vessels and dilation of pupil.
6. Noise is a problem especially for patients who need rest.
7. Noise may cause damage to liver, brain and heart.
8. 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.
9. The physiological features like breathing amplitude, blood pressure, heart-beat rate, pulse rate, blood cholesterol are affected.
10. The working performance of workers/human will be affected as they will be losing their concentration.
11. It causes pain, ringing in the ears, feeling of tiredness, thereby effecting the functioning of human system.
12. It affects the sleeping there by inducing the people to become restless and lose concentration and presence of mind during their activities
13. The buildings and materials may get damaged by exposure to infrasonic / ultrasonic waves and even get collapsed.

Ergonomical Impacts of Noise

It has been traditionally difficult to establish a direct correlation between noise and illness, much scientific literature linking noise to numerous health effects. Noise is generally considered to be very loud at 70dB (A). Repeated exposure at levels of, or above, 85dB (A) can cause hearing loss. Effect of Noise on Human Hearing may be classified as Hearing disability, Hearing impatient, Noise-Induced Hearing Loss and Occupational Hearing Loss. Whereas effect of noise on human activity are Sleep Disturbance, stress, cardiovascular and immunological effects, reduction in Performance and productivity and heighten social conflicts.

Ambient Air Quality Noise Standards (AAQNS)

Most of the countries, keeping in view the alarming increase in environmental noise pollution, have given the permissible noise standards. These are depending on the location and period of day. Industrial areas obviously have somewhat higher acceptable sound levels than those prescribed for residential areas. The collected night standards are stringent than the daytime standards.

Standards by Law in India

Noise has been recognized as ambient air pollutant. Standards in this regard are laid down under Environment (Protection) Rules, 1986 and under the Model Rules of the Factories Act, 1948.The Central Pollution Control Board constituted a Committee on Noise Pollution Control. The Committee recommended noise standards for ambient air and for automobiles, domestic appliances and construction equipment, which were later notified in Environment (Protection) Rules, 1986 as given below in Table-1.

Table 1-Noise Standards for Different Category of Area

Area Code	Category of Area	Limits in dB(A), Leq	
		Day time	Night time
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Silence Zone	50	40

Recommended noise levels by the Bureau of Indian Standards (BIS)

Bureau of Indian Standards has recommended acceptable noise levels in residential areas, injury range and safe range are as given in Table-2.

Table-2 Acceptable noise levels in Residential Areas

Sr. No.	Location	Acceptable Noise Level in Residential Areas, dB(A)
1	Rural	25-35
2	Suburban	30-40
3	Residential (urban)	35-45
4	Urban (Residential and Business)	40-45
5	City	45-50
6	Industrial Areas	50-60

Materials and Methods

The study was divided into three main divisions Literature Study, Observation and analysis of data and Suggest Remedial Measures for management of noise. Out of which the collection of data and analysis forms the major part of the research topic. Five points where selected in order to establish the observation station In front of Hotel Gauri Inn (Location Code-01), At MIDC Crossing (Location Code-02), At Kondeshwar Crossing (Location Code-03), In front of PRMITR, Badnera (Location Code-04), At Badnera Highway (Location Code-05). In the present study, a noise sample size of 5 minute in each hour at a particular selected distance from the edge of the pavement was taken. Noise sample were collected in dB (A) scale at every 60 second interval or total 5 reading in one sample size. Instrument used for

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recording the noise level was 8928 digital sound level meter having measurement frequency 31.5 Hz to 8000Hz. The traffic volume survey was also carried out during the observation.

Experimental Investigation

In the present study, a noise sample size of 5 minute in each hour at a particular selected distance from the edge of the pavement was taken. Noise sample were collected in dB (A) scale at every 60 second interval or total 5 reading in one sample size. Also, the traffic volume survey was also carried out during the observation. The number of vehicle passing through the observation station where counted for 5 minutes duration in an Hour. The vehicles were divided into the sub categories such as 2 wheelers, 3 wheelers and 4 wheelers (light and heavy). The observation readings are taken at a distance 2.2 meter from the edge of road and at right angle to the centerline of road. Each location was observed for a week during the study.

Analysis and Results

Collected was graphically presented and analyzed for parameters such as the equivalent continuous sound level (Leq), Noise pollution level (LNP), Traffic noise index (TNI) and Noise Climate (NC). Noise parameter Leq, TNI, LNP and NC were calculated by

i) Equivalent Sound Energy Level (Leq) = $L_{50}+[(L_{10}-L_{90})^2/56]$ dB(A)

ii) Noise pollution level (LNP) = Leq + $(L_{10}-L_{90})$ dB(A)

iii) Traffic Noise Index (TNI) = 4 $(L_{10}-L_{90})+L_{90}$-30 dB(A)

iv) Noise Climate (NC) = $L_{10} - L_{90}$ dB(A)

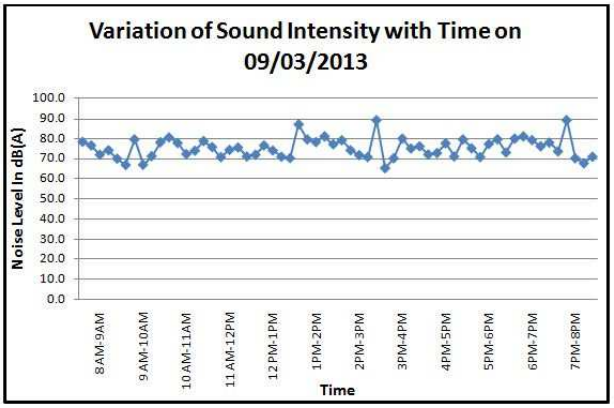

Fig.: Variation of Sound Intensity with Time on 09/03/2013

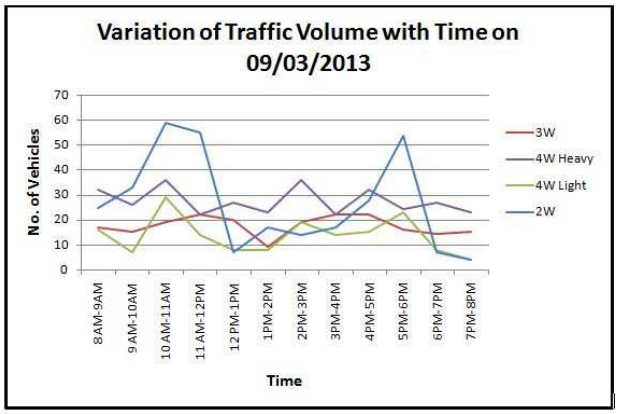

Fig: Variation of Traffic Volume with Time on 09/03/2013

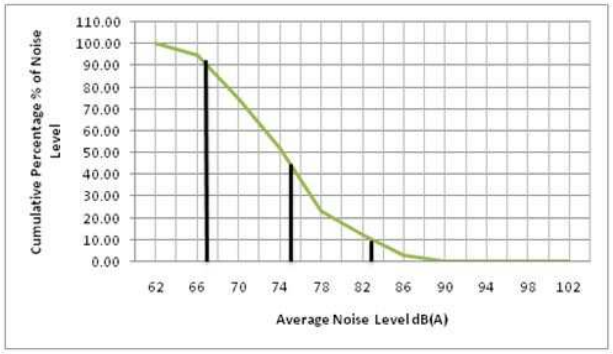

Fig: Variation Average Noise Level with Cumulative Percentage of Noise Level for Location 04

It was found that at location 01, the average of noise level (Leq) was found to be 76.6 dB(A). The average of L_{10}, L_{50}, L_{90}, TNI, LNP, NC, Lmax, and Lmin values were found to be 85.0 dB(A), 76.0 dB(A), 67.0 dB(A), 109.0 dB(A), 94.6 dB(A), 18.00 dB(A), 99.9 dB(A),and 64.7 dB(A), respectively.

It has been found that at location 02, the average of noise level (Leq) was found to be 75.6 dB(A). The average of L_{10}, L_{50}, L_{90}, TNI, LNP, NC, Lmax, and Lmin values were found to be 83.0 dB(A), 75.0 dB(A), 65.0 dB(A), 107.0 dB(A), 93.6 dB(A), 18.00 dB(A), 99.8 dB(A),and 64.5 dB(A), respectively.

It has been found that at location 03, the average of noise level (Leq) was found to be 81.4 dB(A). The average of L_{10}, L_{50}, L_{90}, TNI, LNP, NC, Lmax, and Lmin values were found to be 86.0 dB(A), 81.0 dB(A), 75.0 dB(A), 89.0 dB(A), 92.4 dB(A), 11.00 dB(A), 94.8 dB(A),and 70.9 dB(A), respectively.

It has been found that at location 04, the average of noise level (Leq) was found to be 75.6 dB(A). The average of L_{10}, L_{50}, L_{90}, TNI, LNP, NC, Lmax, and Lmin values were found to be 83.0 dB(A), 75.0 dB(A), 67.0 dB(A), 101.0 dB(A), 91.6 dB(A), 16.00 dB(A), 90.2 dB(A),and 64.3 dB(A), respectively.

It has been found that at location 05, the average of noise level (Leq) was found to be 71.4 dB(A). The

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average of L_{10}, L_{50}, L_{90}, TNI, LNP, NC, Lmax, and Lmin values were found to be 78.0 dB(A), 71.0 dB(A), 66.0 dB(A), 84.0 dB(A), 83.4 dB(A), 12.00 dB(A), 89.5 dB(A),and 65.2 dB(A), respectively.

Remedial Measure for Management of Noise

Since the fact that public health has been matter of great concern for us control of noise pollution is necessary. The techniques employed for remedial measure for noise pollution can be broadly classified as control at source, control in the transmission path and using protective equipment. The noise pollution can be controlled at the source of generation itself by reducing the noise levels from domestic sectors, Maintenance of automobiles, Control over vibrations, Low voice speaking, Prohibition on usage of loud speakers and optimum selection of machinery, tools or equipment reduces excess noise levels. The change in the transmission path will increase the length of travel for the wave and get absorbed/refracted/radiated in the surrounding environment. The noise pollution can be reduced during transmission path by Vegetation, Installation of barriers and design of the building incorporating the use of suitable noise absorbing material for wall/door/window/ceiling will reduce the noise levels. Protective equipment usage is the ultimate step in noise control technology i.e., after noise reduction at source and after diversion or engineer control of transmission path of road. The usage of protective equipment and the worker's exposure to the high noise levels can be minimized by Job rotation, Exposure reduction, Hearing protection, use of 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.

Conclusion

From the observations taken at the selected station, it was found that the sound exceeds permissible limit for all the location except for location 05. This variation of sound from 60dB to 110dB may have moderate to very sever effects on human health such as, poor concentrations, stress, cardiovascular illness and many more. It is very essential to control noise at source, along the transmission path and at receivers end by using the various techniques mentioned in the chapter Remedial measures for measurement of noise.

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