ISSN: 2250-3676
Volume-3, Issue-4, 148-154

IMPACT OF NOISE ON HUMAN AND ITS CONTROL MEASURES

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Abstract

As noise pollution in our environment becomes an increasingly dramatic topic, more effective forms of noise control are required to satisfy the quality of life for the population that is encompassed by the undesirable noise sources. Original methods of noise control were inexpensive, non-technical, and grossly ineffective. We now have advanced to using extensive engineering and robust designs to increase the overall effectiveness and aesthetics of physical noise abatement equipment.So this paper gives a detail description regarding the various source of noise and its controlling measure.

Index terms*: noise, sound, impact, decibel.*

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1. INTRODUCTION

Almost everyone has had one experience of being temporarily "deafened" by a loud noise. This "deafness" in not permanent, although it is often accompanied by a ringing in the ears, and one can hear anotherperson if he raises his voice. Likewise, normal hearing comes back within a few hours at most. This sortof partial hearing loss is called Temporary Threshold Shift (TTS). Most of society is now aware that noise can damage hearing. However, short of a threat that disaster would overtake the human race if nothing is done about noise, it is unlikely that many people today would become strongly motivated to do something about the problem. Yet, the evidence about the ill effects of noise does not allow for complacency or neglect. If no steps are taken to lessen the effects of noise, we may expect a significant percentage of future generations to have hearing damage. It would be difficult to predict the total outcome if total population would suffer hearing loss.

2. WHAT IS NOISE?

In simple terms, noise is unwanted sound. Sound is a form of energy which is emitted by avibrating 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 audibilityare from 20 HZ to 20,000 HZ.A noise problem generally consists of three inter-related elements- the source, thereceiver and the transmission path. This transmission path is usually the atmospherethrough which the sound is propagated, but can include the structural materials of anybuilding containing the receiver

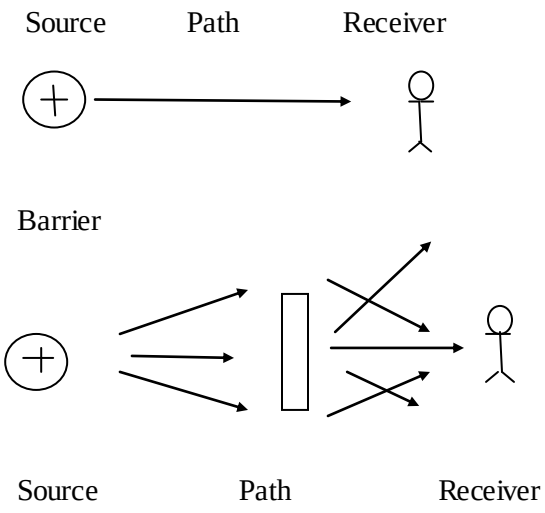

Figure1.Inter-relationship between the elements of noise

Noise may be continuous or intermittent. Noise may be of high frequency or of lowfrequency which is undesired for a normal hearing. The discrimination and differentiation between sound and noise also depends upon thehabit and interest of the person/species receiving it, the ambient conditions and impact ofthe sound generated during that particular duration of time. Sounds of frequencies less than 20 HZ are called **infrasonics** and greater than 20, 0000 HZare called **ultrasonics.**

3. HOW TO COMPUTE IT?

The intensity of sound is measured in **sound pressure levels (SPL)** and common unit ofmeasurement is

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decibel, dB. The community (ambient) noise levels are measured in the A
- weighted SPL, abbreviated dB(A). This scale resembles the audible response of humanear. Sounds of frequencies from 800 to 3000 HZ are covered by the A - weighted scale. Ifthe 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)..... (1)

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

Lp = 20 Log10 (P/Po) dB (A)..... (2)

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

Day-night equivalent noise levels (Ldn)
The day night equivalent noise levels of acommunity can be expressed as -
Ldn, dB (A) = 10 x log10 [15/24 (10Ld/10) + 9/24 (10(Ln + 10)/10)]..... (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., 15hrs) and night hours from 9 PM - 6 AM (i.e., 9 hrs). A sound level of 10 dB is added to Lndue 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 measurements which give us apurposeful act of comparing noises under different conditions for assessment of adverseimpacts of noise and adopting suitable control techniques for noise reduction. The variousequipment used for noise level measurement are summarised at Table 1. The principleand 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 microphoneconverts the sound signal to an equivalent electrical signal. The signal is passed through aweighting 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 whileusing 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 unsteadysounds using "slow" response. When measuring long-term noise exposure, the noise levelis 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 thesame total energy as the actual level over the given time. It is denoted as **Leq**. The displayof Leq facility is also available in certain models of sound level meters. This is the desiredparameter for assessment of ambient noise levels.

Sr.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 analysers	For detailed design and engineering purpose using a set of filters.
4	Graphic recorders	Attached to sound level meter. Plots the SPL as a functionof 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.

Table 1. Equipment used in the measurement of noise levels

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5. SOURCE OF NOISE

The sources of noise may vary according to dailyactivities. They sources may be domestic (movement of utensils, cutting and peeling offruits/vegetables etc.) natural (shores, birds/animal shouts, wind movement, sea tidemovement, waterfalls 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.

Aircraft Noise

The noise of aircraft is described in terms of Perceived Noise Levels (PNL), a scale ofnoisiness, expressed in pNdB. There is no simple relationship between the dB (A) valueand pNdB value for all noises. However, a useful statement is that, the pNdB value for anoise is approximately **13 units** greater than the dB(A) value for the noise.

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 Chiselling	118	Jet takeoff	120

Table 2. Typical noise levels of some point sources

6. IMPACT OF NOISE

Often neglected, noise induces a severe impact on humansand 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, bloodpressure, heart-beat rate, pulse rate, blood cholesterol are affected.

Loss of hearing:

The effect of noise on audition is well recognized. Mechanics,locomotive drivers, telephone operators etc. All have their hearing impairment as a result of noiseat the place of work. Physicians & psychologists are of the view that continued exposure to noiselevel above. 80 to 100 db is unsafe, loud noise causes temporary or permanent deafness.

Human performance:

The working performance of workers/human will be affected asthey'll be losing their concentration.

Nervous system:

It causes pain, ringing in the ears, feeling of tiredness, therebyeffecting the functioning of human system.

Sleeplessness:

It affects the sleeping there by inducing the people to becomerestless and lose concentration and presence of mind during their activities

Damage to material:

The buildings and materials may get damaged by exposure toinfrasonic / ultrasonic waves and even get collapsed.

Lack of concentration:

For better quality of work there should be concentration, Noise causes lack ofconcentration. In big cities, mostly all the offices are on main road. The noise of traffic or theloud speakers of different types of horns divert the attention of the people working in offices.

Fatigue:

Because of Noise Pollution, people cannot concentrate on their work. Thus they have to givetheir more time for completing the work and they feel tiring.

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Abortion is caused:
There should be cool and calm atmosphere during the pregnancy. Unpleasant sounds make a lady of irritative nature. Sudden Noise causes abortion in females.

Causes Blood Pressure:
Noise Pollution causes certain diseases in human. It attacks on the person'speace of mind. The noises are recognized as major contributing factors in accelerating the alreadyexisting tensions of modern living. These tensions result in certain disease like blood pressure ormental illness etc.

7. CONTROL OF NOISE POLLUTION

Noise generation is associated with most of our daily activities. A healthy human earresponds 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 adverseimpacts of noise on humans and environment,

noise should be controlled. Thetechnique or the combination of techniques to be employed for noise control depend uponthe extent of the noise reduction required, nature of the equipment used and the economyaspects of the available techniques.

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

The techniques employed for noise control can be broadly classified as:
1) Control at source
2) Control in the transmission path
3) Using protective equipment

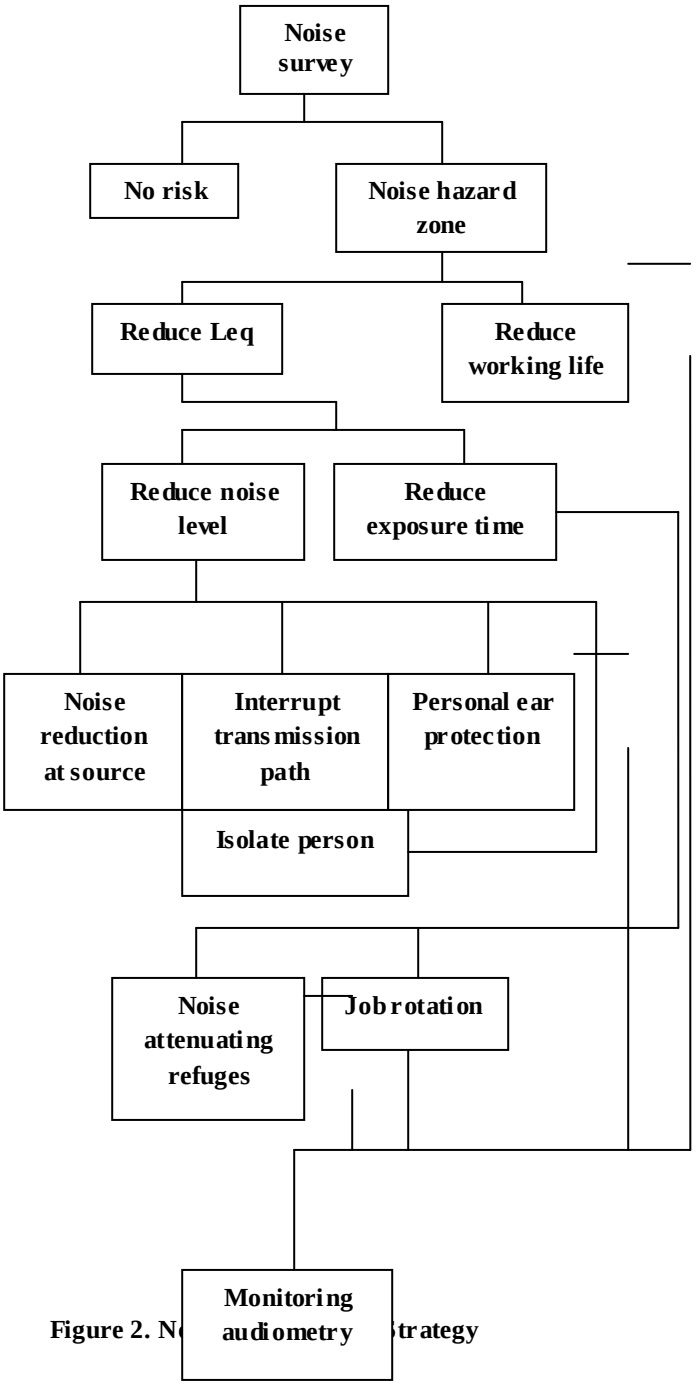

Figure 2. N trategy

A) NOISE CONTROL AT SOURCE

The noise pollution can be controlled at the source of generation itself by employingtechniques like-

Reducing the noise levels from domestic sectors:
The domestic noise comingfrom radio, tape recorders, television sets, mixers, washing machines, cookingoperations can be minimised by their selective and judicious operation. By usage ofcarpets or any

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absorbing material, the noise generated from felling of items in housecan be minimised.

Maintenance of automobiles:

Regular servicing and tuning of vehicles will reduce thenoise levels. Fixing of silencers to automobiles, two wheelers etc., will reduce the noiselevels.

Control over vibrations:

The vibrations of materials may be controlled using properfoundations, rubber padding etc. to reduce the noise levels caused by vibrations.

Low voice speaking:

Speaking at low voices enough for communication reduces theexcess noise levels.

Prohibition on usage of loud speakers:

By not permitting the usage of loudspeakersin the habitant zones except for important meetings / functions. Now-a-days, the urbanAdministration of the metro cities in India is becoming stringent on usage ofloudspeakers.

Selection of machinery:

Optimum selection of machinery tools or equipment reducesexcess noise levels. For example selection of chairs or selection of certainmachinery/equipment which generate less noise (Sound) due to its superior technology etc. is also an important factor in noise minimisation strategy.

Maintenance of machines:

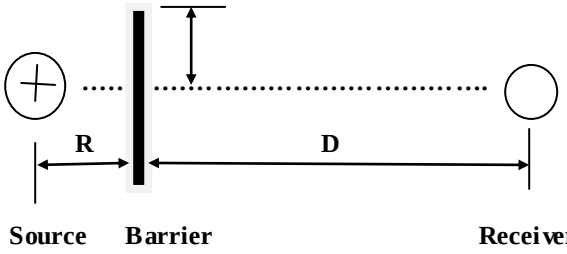
Proper lubrication and maintenance of machines,vehicles etc. will reduce noise levels. For example, it is a common experience that,many parts of a vehicle will become loose while on a rugged path of journey. If these
loose parts are not properly fitted, they will generate noise and cause annoyance tothe driver/passenger. Similarly is the case of machines. Proper handling and regularmaintenance is essential not only for noise control but also to improve the life ofmachine.

B) CONTROL IN THE TRANSMISSION PATH

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 availabletechniques are briefly discussed below.

I)Installation of barriers

Installation of barriers between noise source and receiver canattenuate the noise levels. For a barrier to be effective, its lateral width should extendbeyond the line-of-sight at least as much as the height. 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 forthe sound wave. It should also be noted that, the presence of the barrier itself can reflectsound back towards the source. At very large distances, the barrier becomes less effectivebecause of the possibility of refractive atmospheric effects.



Barrier close to source

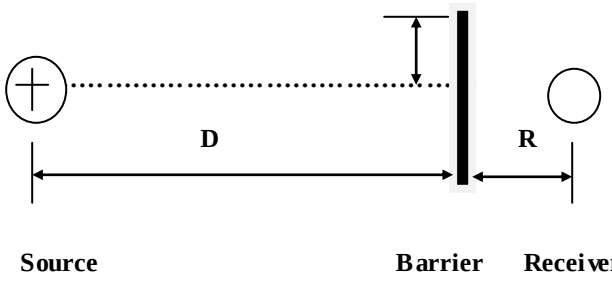


Figure 3.Barrier close to receiver

II) DESIGN OF BUILDING

The design of the building incorporating the use of suitable noise absorbing material for wall/door/window/ceiling will reduce the noise levels. Theapproximate reduction of outside noise levels using typical exterior wall construction is given at Table 3.

Frequency(Hz)	A	B	C	D	E	F	G	H
63	0	9	13	19	14	24	32	21
125	0	10	14	20	20	25	34	25
250	0	11	15	22	26	27	36	30
500	0	12	16	24	28	30	38	37
1000	0	13	17	26	29	33	42	42
2000	0	14	18	28	30	38	48	44
4000	0	15	19	30	31	43	53	45
8000	0	16	20	30	33	48	58	46
Approx dB(A)	0	12	16	24	27	30	38	33

Table 3.Approximate reduction of outside noise provided by typical exterior wallconstruction

A: No wall; outside conditions.
B: Any typical wall construction, with open windows covering about 5% of exterior wall area.

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C: Any typical wall construction, with small open air vents of about 1% of exterior wall area, all windowsclosed.
D: Any typical wall construction, with closed but operable windows covering about 10-20% of exterior wallarea.
E: Sealed glass wall construction, 1/4-in glass thickness over approximately 50% of exterior wall area.
F: Approximately 20 lb./ft2 solid wall construction with no windows and no cracks or openings.
G: Approximately 50 lb/ft2 solid wall construction with no windows and no cracks or openings.
H: Any typical wall construction, with closed double windows (panes at least 3/32" thick, air space at least 4in.) and solid-core gasketed exterior doors.

III) Green belt development

Green belt(trees and shrubs) development can attenuate the sound levels.
The degree of attenuation varies with species of greenbelt. The statutoryregulations direct the industry to develop greenbelt four times the built-up area forattenuation of various atmospheric pollutants, including noise.

C) USING PROTECTION EQUIPMENT

Protectiveequipment usage is the ultimatestep in noise control technology, i.e. after noise reductionat source and/or after the diversion or engineered control of transmission path of noise.The first step in the technique of using protective equipment is to gauge the intensity of theproblem, identification of the sufferer and his exposure to the noise levels.

The usage of protective equipment and the worker's exposure to the high noise levels canbe minimised by

Job rotation:
By rotating the job between the workers working at a particular noisesource or isolating a person, the adverse impacts can be reduced.

Exposure reduction:
Regulations prescribe that, noise level of 90 dB (A) for morethan 8 hr continuous exposure is prohibited. Persons who are working under suchconditions will be exposed to occupational health hazards. The schedule of theworkers should be planned in such a way that, they should not be over exposed to thehigh noise levels.

Hearing protection:
Equipment like earmuffs, ear plugs etc. are the commonly useddevices for hearing protection. Attenuation provided by ear-muffs vary widely inrespect to their size, shape, seal material etc. Literature survey shows that, an averagenoise attenuation up to 32 dB can be achieved using earmuffs.

8. CONCLUSION

Whether knowingly or unknowingly, everyone of us contribute to noise pollution, because most of our day-to-day activities generate some noise. Often neglected, noise pollution adversely affects the human being leading to irritation, loss of concentration, loss of hearing. Identify the sources of noise pollution. Once identified, the reason(s) for increased noise levels to be assessed.

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ISSN: 2250-3676
Volume-3, Issue-4, 148-154

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Myself Jay Patel pursuing Master of Engineering in Structural Engineering, my area of interest are concrete design, finite element method, environmental engineering.

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Myself Priya Patel pursuing Bachelor of Engineering in Civil Engineering, my area of interest are environmental engineering, water resource engineering.