

# NOISE POLLUTION & CONTROL TECHNIQUES



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## 1. Introduction

### 1.1 What is sound?

Sound is defined as any pressure variation that the human ear can detect. A wave motion is set off when an element sets the nearest particle of air into motion. This motion gradually spreads to adjacent air particles further away from the source. Depending on the medium, sound propagates at different speeds. Compared to the static air pressure ( $10^5$  Pa), the audible sound pressure variations are very small ranging from about  $20 \mu\text{Pa}$  ( $20 \times 10^{-6}$  Pa) to 100 Pa. The average person's threshold of hearing is  $20 \mu\text{Pa}$ . A sound pressure of approximately 100 Pa is so loud that it causes pain and is therefore called the threshold of pain.

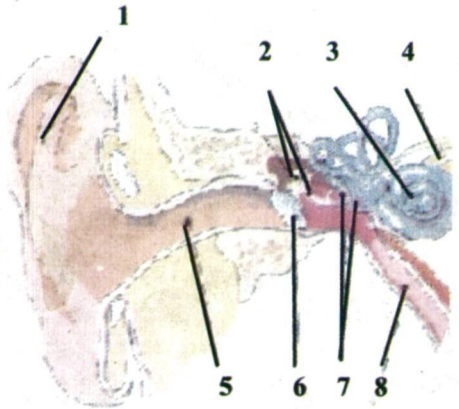
### 1.2 What is noise?

In our modern society, sound sometimes annoys us. Some sounds are unpleasant or unwanted; these are called noise. Noise, which is reckoned to be undesirable sound or unwanted sound, is a subtle pollutant that often leaves no visible evidence, but it threatens the health and well being of human beings who often are exposed to very high noise levels without consciousness. This noise can originate from numerous sources such as on the job, factories, trucks, airplanes, motorcycles, DJs, loud speakers and appliances etc. The noise usually annoys people first, before they are being subjected

to any hearing impairment. However the level of annoyance depends not only on the quality of the sound, but also our attitudes towards it. A higher level of noise is usually tolerated during the day than at night time.

### 1.3 Hearing mechanism (Audition)

The human ear is divided into 3 main regions; outer ear, middle ear, and inner ear (Fig. 1).



**Figure 1.** A longitudinal section of the ear

1. Pinna, 2. Ossicles, 3. Cochlea, 4. Vestibulo-Cochlear nerve, 5. External auditory canal, 6. Tympanic membrane, 7. Oval window and stapes, 8. Eustachian tube

This division is based on the contribution made to auditory processing. The outer ear is structured to collect and channel sound energy in the form of vibrating air molecules

to the neuronal tissue specialized to encode the information within the incident sound waves. The sound-collecting compartment of the outer ear is called the pinna. The middle ear specializes in transmitting the sound from the outer to the "oval window" opening of the inner ear via vibration of movable bones called ossicles. The inner ear conducts the same information to the receptor neurons via waves in a fluid. When hair cells in the inner ear are excited by vibration, a nerve impulse is generated in the auditory nerve. These impulses are then sent to the brain and it detects the sound.

#### **1.4 Perception of sound or noise**

The human auditory system is responsive to waveforms in the frequency range of 20 Hz up to approximately 20,000 Hz. The increasing amplitude of a sound wave, generally increases the perception of loudness. Loudness is the intensity of sound, which depends upon amplitude of a given sound wave. In general, the perception of loudness doubles about every 10 dB. For most humans, zero dB marks the threshold for perception of sound while pain threshold is 130 dB and above. Although an increase of 6 dB represents a doubling of the sound pressure, an increase of 8 to 10 dB is required before the sound subjectively appears to be significantly louder. In most instances, however, sounds are complex mixtures of multiple frequencies, resulting in the perceptual quality called timbre. Knowledge on how perceptual qualities of hearing is derived from neuro physiological events. Timbre is divided into three categories, *i.e.* pitch, loudness, and sound quality. Pitch depends on frequency, loudness depend on the amplitude while sound quality depends on overtone of a given sound. Perception of sounds depends on the vibration of different portions of the membrane formed by the

receptive cells of the inner ear.

#### **1.5 Adverse health effects of noise**

According to the International Programme on Chemical Safety (WHO, 1994), an adverse effect of noise is defined as a change in the morphology and physiology of an organism that results in an impairment of functional capacity, or an impairment of capacity to compensate for additional stress, or increases the susceptibility of an organism to the harmful effects of other environmental influences. It includes any temporary or long-term lowering of the physical, psychological or social functioning of humans or human organs. Noise-induced hearing impairment, interference with speech communication, disturbance of rest and sleep, psychophysiological health, mental-health and performance effects, effects on residential behaviour and annoyance, as well as interference with intended activities are some of the adverse health effects of noise. The impacts of noise are classified into two categories namely physiological effects, psychological effects. The physiological effects are again divided as auditory effects and non-auditory effects.

#### **Noise-induced hearing impairment**

Hearing impairment could be defined as an increase in the threshold of hearing. Hearing handicap is the disadvantage imposed by hearing impairment sufficient to affect on efficiency of a person. It has been shown that men and women are equally at risk of noise-induced hearing impairment (ISO, 1990; Berglund & Lindvall, 1995). After noise exposure, the first morphological changes are usually found in the inner and outer hair cells of the cochlea. After prolonged exposure, the outer and inner hair cells related to transmission of high-frequency sounds could be disappeared. The extent of noise-induced hearing impairment depends on the

noise level and the time of exposure. At very high instantaneous sound pressure levels, even a mechanical damage can occur to the ear (Hanner & Axelsson, 1988). Risk for noise-induced hearing impairment may increase when the noise exposure is combined with vibrations, the use of ototoxic drugs or some chemicals (Fechter, 1999). Another sensory effect that results from noise exposure is tinnitus (ringing in the ears). Commonly, tinnitus is referred to as sounds that are emitted by the inner ear itself (physiological tinnitus).

#### ***Cardiovascular and physiological effects***

Epidemiological and laboratory studies involving workers exposed to occupational noise, and general populations (including children) living in noisy areas around airports, industries and noisy streets, indicated that noise may have both temporary and permanent impacts on physiological functions in humans (Passchier-Vermeer, 1993; Berglund & Lindvall, 1995). Acute noise exposures activate the autonomic and hormonal systems leading to temporary changes such as increased blood pressure, increased heart rate and vasoconstriction. After prolonged exposure, susceptible individuals in the general population may develop permanent effects such as hypertension and ischaemic heart disease associated with exposures to high sound pressure levels (Passchier-Vermeer, 1993; Berglund & Lindvall, 1995). If the exposure is of sufficient intensity, cardiovascular and hormonal responses such as heart rate, peripheral vascular resistance, changes in blood pressure, blood viscosity and blood lipids, shifts in electrolyte balance (Mg/Ca) and hormonal levels could be increased.

Many studies in workers exposed to high levels of industrial noise for 5–30 years have increased blood pressure and statistically significant increase in risk for hypertension (Passchier-Vermeer, 1993).

#### ***Mental health effects***

Good mental health is defined as the absence of identifiable psychiatric disorders according to current norms (Freeman, 1984). Noise is not believed to be a direct cause of mental illness, but it is assumed that it accelerates and intensifies the development of latent mental disorder.

Studies on the adverse effects of noise on mental health cover a variety of symptoms, including anxiety, emotional stress, nervous complaints, nausea, headaches, instability, argumentativeness, sexual impotency, changes in mood, increase in social conflicts, as well as general psychiatric disorders such as neurosis, psychosis and hysteria. Large-scale population studies have suggested associations between noise exposure and a variety of mental health indicators such as single rating of well-being, standard psychological symptom profiles, the intake of psychotropic drugs and consumption of tranquilizers and sleeping pills. Exposure to high levels of occupational noise has been associated with development of neurosis and irritability.

#### ***Interference with speech communication***

Noise interference with speech comprehension results in a large number of personal disabilities, handicaps and behavioural changes.

Problems with concentration, fatigue, uncertainty and lack of self-confidence, irritation, misunderstandings, decreased working capacity, problems in human relations, and a number of stress reactions have been identified (Lazarus, 1998).

### ***Sleep disturbance***

Uninterrupted sleep is known to be a prerequisite for good physiological and psychological functioning of healthy persons (Hobson, 1989). The primary sleep disturbance effects are: difficulty in falling asleep (increased sleep latency time), awakenings and alterations of sleep stages or depth. Other primary physiological effects can also be induced by noise during sleep, including increased blood pressure, increased heart rate, increased finger pulse amplitude, vasoconstriction, changes in respiration, cardiac arrhythmia and an increase in body movements (Berglund & Lindvall, 1995).

### ***Effects of noise on performance***

Laboratory experiments and surveys on workers exposed to occupational noise have shown that noise adversely affects on performance of assigned tasks. Few field studies on the effects of noise on performance and safety has shown that noise may produce some task impairment and increase the number of errors in work but the effects depend on the type of noise and the task being performed (Smith, 1990).

### ***Effects of noise on residential behaviour and annoyance***

Annoyance is "a feeling of displeasure associated with any agent or condition, known or believed by an individual or group to adversely affect them." People may feel a variety of negative emotions when exposed to community noise, and may report anger, disappointment, dissatisfaction, withdrawal, helplessness, depression, anxiety, distraction, agitation, or exhaustion (Job, 1993; Fields *et al.*, 1997, 1998).

## ***1.6 Characteristics of noise***

### ***Frequency:***

It is related to the pitch of the sound. The pitch is increased when frequency increases.

### ***Amplitude:***

Amplitude gives an idea about the energy content in noise. Amplitude is related to the loudness of noise. The loudness is increased when amplitude increases.

### ***Decibel (dB):***

The dB is used widely to measure noise because the advantage is large unmanageable numbers of sound intensity/pressure are converted to a more manageable scale from 0 dB (Threshold of hearing) to 130 dB (Threshold of pain)

$$\text{dB} = 10 \text{ Log } I/I_0$$

Where,

$I$  = sound intensity

$I_0$  = Reference intensity ( $10^{-12}$ )

## ***1.7 Types of noise***

***Continuous noise*** is produced by machinery that operates without interruption in the same mode, e.g. blowers, pumps and processing equipment.

***Impulsive noise*** comes from impacts or explosions, e.g. from a pile driver, punch press or gunshot.

***Low frequency noise*** has significant acoustic energy in the frequency range 8 to 100 Hz. Noise of this kind is typical for large diesel engines in trains, ships, and power plants and, since this type of noise is hard to muffle, it spreads easily in all directions so that it can be heard for miles.

**High frequency noise** typically falls into the 100 KHz to 100 MHz range. Some of the sources of high frequency noise are switch mode power supplies, electronic lighting ballasts, photocopiers, and laser printers. In industrial and medical facilities, the additional sources would include medical equipment, variable speed drives, and computerized industrial loads.

**Residual noise** is the ambient noise remaining at a given position in a given situation when the specific noise source is suppressed to such a degree that it does not contribute to the ambient air.

**Background noise** is a weighted sound pressure level of the residual noise in decibels exceeded for 90% of a given time interval.

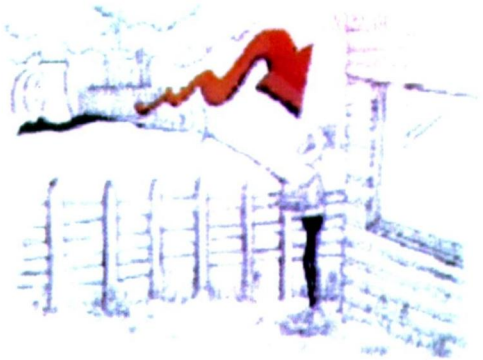
### 1.8 Types of sources of noise

**Point source:** If the dimensions of a noise source are small compared with the distance to the listener, it is known as a point source, e.g. fans and chimney stacks.

**Line source:** If a noise source is narrow in one direction and long in other compared to the distance to the listener, it is called a line source, e.g. single source such as a long pipe carrying a turbulent fluid.

### 1.9 Noise propagation

Propagation covers the traveling of noise emitted from a source to different place through any medium. Some of the important factors affecting noise propagation are types of source, distance from source, atmospheric absorption, wind, temperature, ground absorption, reflection, humidity etc.



**Figure 2.** A typical illustration of noise propagation

### 1.10 Environmental noise parameters

#### **“A” frequency weighting**

In this method, the electrical signal within a noise-measuring instrument is to stimulate the way the human ear responds to a range of acoustic frequencies. It is based on the 40 dB equal loudness curve. The symbols for the noise parameters often include  $L_{Aeq}$  to indicate that frequency weighting has been included in the measurement.

#### **Reference time interval, $T_r$**

The specified interval over which an equivalent continuous A-weighted sound pressure level is determined.

#### **Measurement time interval, $T_m$**

The total time over which measurement is taken at one measurement point.

#### **Sound Exposure Level (SEL), $L_{AE}$**

A parameter closely related to  $L_{Aeq}$  for assessment of events (aircrafts, trains) that have similar characteristics but are of different duration.



### **What is to be measured?**

Equivalent Sound Pressure Level ( $L_{Aeq,T}$ ) is being used in noise measurement activity. It is a widely used noise parameter that calculates a constant level of noise with the same energy content as the varying acoustic noise signal being measured.  $L_{Aeq,T}$  means the equivalent continuous, A-weighted sound pressure determined over a time interval T in dB. A-weighted means a process of automatic adjustments made to the output of the sound sensor in a sound level meter, so that the reading of the meter takes into account the frequency characteristics of the human ear.

### **Who is competent to measure?**

The sound level measurements are to be carried out only by a competent authority who has capability as well as facilities such as equipment and skilled personnel *etc.*

## **2.2 Measuring equipment**

### **Requirements to be met by measuring devices**

If the sound level is measured with integrating averaging sound level meter, it has to be complied with type 2 of BS 6698 : 1986 (IEC 804) or complying with standards or by means of a measuring device recommended by a competent institute.

### **Calibration of measuring devices**

Before and after each series of measurements, sound level meters should be properly calibrated using acoustic calibrator or pistonphone complying with class 2 of BS 7189 : 1989 (IEC 942) or complying with standards or by means of a measuring device recommended by a competent institute.



**Figure 4.** Typical picture of a sound level meter

It facilitates assessment of environmental noise. It also supports serial analyses in 1/1- and 1/3-octave bands as an option.

The main applications are:

1. Evaluation of environmental noise
2. Measurements of noise at workplaces
3. Assessment of product noise

## **3. Legislation aspects and legal framework**

### **3.1. Maximum permissible noise levels for industries**

The National Environmental (Noise control) regulations were gazetted on 23<sup>rd</sup> May 1996 (Gazette extraordinary No. 924/12) under sections 23P, 23Q & 23R of the National Environmental Act under the section 32 (Regulation 2).

Any person violating the above mentioned regulation could be prosecuted by the Central Environmental Authority (CEA) or the affected.

### **3.2 Other legislations**

In Sri Lanka, there are number of statutes in which there are scattered provisions for noise pollution control.

**Factories Ordinance No.45 of 1942, law No.12 of 1976**

Section 58A-prevention of Noise (26, Law 12 of 1976). This law is mainly dealing with occupational health of the workers only.

**Police Ordinance**

Ordinance No.16 of 1865, Act No. of 15 of 1949 and amendment law No.3 of 1974. This deals with regulation of use in or near public places of instruments producing or reproducing sound (section 80)

**Municipal Council (MC) Ordinance**

MC Ordinance No.29 of 1974, Act. No.16 of 1949, Law No. 38 of 1973 and Act. No. 57 of 1976. Section 272 (30) deals with the abatement of nuisance including the prohibition regulations and control of the operation of gramophones, loudspeakers, amplifiers and other instruments automatically or mechanically producing or reproducing sound.

**Urban Council (UC) Ordinance**

UC ordinance No. 61 of 1939, Act No.09 of 1950, Law No. 04 of 1975 and Act No 57 of 1979. Section 157 (by-laws 11,42 of 1979) deals with the abatement of nuisance including the regulations and control of the operation of gramophones, loudspeakers, amplifiers and other instruments automatically or mechanically producing or reproducing sound.

**Pradeshya Sabha Act No. 15 of 1987**

Section 126 (ix)-f deals with the abatement of nuisance including the regulations and control of the operation of gramophones, loudspeakers, amplifiers and other instruments automatically or mechanically producing or reproducing sound.

**Local Authorities (standards by-laws) act no. 06 of 1952**

This also deals with operation of gramophones, loudspeakers etc.

## 4.0 Noise controlling techniques

### 4.1 Environmental noise reduction

When aiming to reduce the effects of environmental noise on people, the following aspects should be considered.

- Noise sources
- Transmission path
- Types of homes in which people live

Above aspects can be covered in 3 different ways as follows.

- (1) Use of methods minimizing sound at the source
- (2) Placing of barriers in-between the source and the receiver
- (3) Use of methods that protect receivers' end

### 4.2 Methods used to minimize the noise at the source

Noise generated from the machine it self can be controlled at the source with the help of methods such as vibration isolation, noise isolation, noise absorption, damping.

**Vibration isolation:**

Isolation is used to separate high vibration areas of a structure or system from areas where significant vibration is not desired.

### ***Noise insulation:***

Reducing noise level by restricting the "magnification effect" through traveling to other parts inside machine/building is called the insulation.

### ***Noise absorption:***

Sound energy is absorbed whenever sound meets a porous material. Such material reduces sound level steadily with distance from a sound source.

### ***Vibration damping:***

One of the primary causes of noise in a manufacturing plant is the vibration produced by machinery. Damping has been effectively utilized to attenuate vibration problems. Elastic materials, such as rubber and plastic, are used to dissipate energy from vibrating surfaces with a resulting reduction in amplitude and structural stress. Vinyl polymer is a high damping material that can be applied in stiffen resonating metal panels or other substrates to reduce structure borne noise and radiated air borne noise.

### ***Engineering and administrative controls***

The primary means of reducing or eliminating personnel exposure to hazardous noise is through the application of engineering controls. Engineering controls are defined as any modification or replacement of equipment, or related physical change at the noise source or along the transmission path that reduces the noise level at the employee's ear. Engineering controls such as mufflers on heavy equipment exhausts or air release valves are required where possible. Administrative controls are defined as changes in the work schedule or operations, which reduce noise

exposure. If engineering solutions cannot reduce the noise, administrative controls such as increasing the distance between the noise source and the worker or rotation of jobs between workers in the high noise area should be used if possible. The use of engineering and administrative controls should reduce noise exposure to the point where the hazard to hearing is eliminated or at least much manageable.

### ***Active and adaptive control systems***

Active noise control uses the principle of superposition of waves to attenuate noise. Active noise control can be achieved by processing the original offensive sound and subsequently injecting it back into the sound field, but at 180 degrees out of phase, thus generating a canceling waveform.

Active noise control has been applied to one-dimensional field and duct noise, enclosed spaces and interior noise, noise in some three-dimensional spaces, and in personal hearing protection. The biggest successes have come in the area of piping and duct noise attenuation.

Active noise control has had more limited applications to broad-band noise, or noise in three-dimensional spaces, because of the principles of noncausality, stability, and spatial mismatch. Noise reduction cannot be achieved at the source, it may be useful to modify the noise propagation path. Measures including full or partial enclosures, sound barriers, room absorption, active control and changes in duct geometry, fan type, and flow characteristics can be applied to a typical plant to aid in noise control.

### **Active noise reduction technology (ANR)**

In ANR the noise wave is coupled with its mirror image to cancel the noise. The technology is particularly effective against low frequency noise, which interferes with intelligibility of speech and causes fatigue.

blem because of the panel's lighter weight and the lower damping produced.

### **Noise killer spray**



**Figure 5.** Application of a noise killer

Noise killer spray is being used as a spray-on sound and vibration controller (liquid sound deadening). It literally removes unwanted noise and vibrations by converting them into low-grade heat.

## **4.3 Controlling noise generated from machinery and processes at the source**

### **Tuned Vibration Absorbers (TVAs)**

The TVA is a resonant-tuned mass that can change the modal response of a structure and reduce the dynamic deflections. The technology works best when the structural response at the specified frequency is tonal (within  $\pm 15\%$ ) and about 15 dB (or more) higher than the noise floor.

### **Vibration Isolators**

Isolators are rugged cast iron housed devices with oil tempered steel springs for all-purpose applications. Isolators are available with external or internal adjustment and also feature adjustable or non-adjustable resilient snubbers for varying degrees of damping and to limit oscillation. All isolators are provided with a bottom sound pad for maximum noise reduction. These isolators are also available with chrome vanadium springs for shock applications.

## **4.4 Minimization of noise in-between the source and the receiver**

### **Transmission Path**

Outdoor noise levels usually decrease with increasing distance from the source because of geometrical spreading of the noise energy over a bigger surface and absorption of the noise by the atmosphere and by the ground. Barriers work effectively when placed between a noise source and a receiver. These specially designed walls reflect sound waves away from the receiver resulting in a noise shadow behind the barrier.

### **Sound absorbers**

Placement of sound-absorbing materials on the walls of a room diminishes the reverberation of sound waves off of hard surfaces. Typically, retrofitting ventilation with silencers, insulation within ducts, and active noise control also has been successful for noise abatement. Barriers can achieve additional reduction of noise levels.

### **Interior Panel Mounts**

Any vibration from devices such as motors, generators, and pumps will be fed through the panels and easily converted into acoustic energy because the flat panels tend to be efficient noise propagators.

### **Floor Panels**

Floor panels behave similarly to interior panels in that stiff attachments can transmit structural vibration that does the panel radiate interior noise. The growing use of composite structures furthers the noise pro-

Since the moving away of people from the noise is impossible, additional attenuation in the form of noise barriers can be applied. The barrier height and the position of the source and/or receiver to it are crucial to the amount of noise reduction that can be achieved.

Effective barriers with heights from 1.5 - 10 m have been reported. In addition, the frequency spectrum of the noise source will affect the achievable reduction. Low frequencies, compared to high frequencies, are poorly attenuated by barriers. In some cases, the performance of barriers can be improved by applying sound absorbing material, avoiding parallel reflective surfaces and shaping or angling barriers to avoid multiple reflections.

#### ***4.5 Technologies used to minimize sound in-between the source and the receiver***

##### ***Noise control enclosures***

Sound enclosures can be used to enclose noisy mechanical equipment or provide in-plant offices. Enclosures for noise sources or for employees in a noisy environment can significantly decrease noise levels reaching the employee. The effectiveness of an enclosure is dependent on the transmission loss of the enclosure.

Acoustic performance may be affected by leaks, use of varying noise absorbent and damping materials, and rigidity of the underlying structure of the enclosure.

##### ***Sound-proof sheds***

Soundproofed sheds are buildings designed to contain noisy technological plant. They are used to insulate compressed air production centers, heating/refrigerating plant, and electrical energy plant: generators operated by diesel, turbogas or steam and

combination cycles. Acoustic absorbers are soft, porous materials that absorb sound waves and are described in terms of an absorption coefficient.

Material composition and thickness, mounting styles, and sounds frequency all effect the absorbent coefficient. When noise is estimated on a subjective scale in the form of an annoyance scale, reduction of reverberation time was perceived to be more effective than noise source reduction. Improvements in speech intelligibility, decreased risk of accidents, and improved control of machinery failure were some of the benefits of this technology.

##### ***Sound-proof cladding for interiors***

The technique of Sound-proof Cladding makes it possible to attain considerable reductions in environmental noise, since the reflected or reverberated acoustic energy is almost completely eliminated.

The operation consists of installing special sound-proofing elements, which guarantee a high coefficient of absorption on the walls and ceiling. The elements used for thecladding of the walls have an external layer in steel with various finishes (stainless steel, aluminum, zinc coated, pre-painted, etc.) 6 - 10 cm thick. These systems are widely used in the food industry, panel beating, and the packing industry and carpentry shops. The ceiling cladding includes sound-proofed elements known as baffles.

##### ***Industrial silencers***

"Silencers" are the equipment which, fitted along a flow of noise, noticeably reduce its volume. Essentially industrial silencers consist of a metal casing containing noise reduction elements and noise reducing cavities through which the flow of air is channeled.

## ***Sound Curtains***



**Figure 6.** A typical sound curtain

Industrially sewn sound curtains provide an inexpensive, flexible approach to block and contain plant noise. The Sound Curtains are rugged and durable and are easily installed by ceiling or floor mounted hardware.

### ***Sound-proofing panels & baffles***

The sound-proofing and noise reduction elements are of 300 mm standard width, various lengths and are 66 mm thick. It can be easily washed and sterilized guaranteeing maximum hygiene. Panels hung from the ceiling, covered in material on both sides, used to absorb noise and help acoustically tune a room. Ceiling suspended baffles are an affordable way to add absorption to highly reflective spaces. Typically manufactured in 2' x 4' panels, these baffles provide excellent sound absorption for large spaces.

### ***4.6 Technologies used to minimize sounds at the receiver***

#### ***Sound Insulation of Buildings***

The sound insulation of buildings is the final barrier to the sound control. The final stage

of ensuring that people are not disturbed by environmental noise in their homes is to provide sufficient sound insulation from the external noise levels. This is called Façade sound insulation, and is measured in terms of a standardized levels difference or the Sound Reduction Index.

#### ***Acoustical wall panels***

Panels are hung on walls for absorbing sound and acoustically tuning a room. Wall Panels allow you to create an effective sound control treatment that is distinctly appropriate for your environment.

#### ***Doors and Gates***

These are built in very thick steel with one or two doors. The doors are padded with sound-proofing materials and fitted into a very strong frame bolted to the brick walls of the chamber.

## **5.0 Noise management programme in industry**

The noise management programme contain the main elements that are necessary to meet the requirement of the national legislation. In some cases, a company can define its own limits better than the national legislation. The objective is to minimize the cost (both direct and indirect) of implementing a package of measures that will be effective in a given company. It is important to pay attention on noise at the stages of selecting a land for a factory building and at the stage of designing a factory building. It is not economical or hassle free to implement a noise management programme while the production is going on in a factory. To make best use of a limited budget and resources, planning and proper knowledge on noise control methods are required.

## **5.1 Elements of noise management programme.**

### **Defining criteria**

Noise criteria of a company should be drawn up. Company may declare its noise policy and how it is going to achieve targets in short term and long term basis. Company should have a noise buying policy for its new equipment and plant.

### **Noise buying policy**

Probably the single more cost effective long-term measure that a company can take is to order new equipment and plant with a noise buying standards.

Normally, in the process of purchasing new equipment and plant, the standard procedure is to prepare specifications (Power input, output rates etc). But in such specifications it is rare to see specifications with regard to noise. Once the plant is installed, noise reduction at the source is more effective as well as it will reduce the cost involvement for the noise reduction. Once the plant is installed, the noise reduction programme may cost much higher amount compared to cost involved in noise reduction programmes at previous stages.

### **Training**

The company should provide necessary training in the areas of noise management programme and control for its safety engineers, factory managers, maintenance engineers etc. The advantages of such training are:

- i) The staff can implement most of noise reduction measures with their own without consulting outside parties.
- ii) The staff will familiarize how to tackle problems related noise even it is beyond their level (Such training packages are available especially in some government institutes).

### **Noise Surveys**

Noise surveys should be carried out both inside and outside the premises on a regular basis (Usually once a year). The noise surveys should be carried out with the help of a recognized institute having required equipment and expatriate.

### **Main elements of a noise survey**

- i) Contact a suitable institute and give details about the existing problem (along with factory layout and machinery details)
- ii) Make a work programme to measure noise levels giving more attention to the areas where problem is predominant.
- iii) Determine both noise levels and frequency analysis in the above areas.
- iv) Identify the main noise sources of within the factory and carry out the frequency analysis for the predominant noise sources.
- v) If the measured noise levels exceed appropriate standards, some corrective measures should be taken to control noise. Noise should be reduced reasonably as far as possible.

## **5.2 Noise Management Programme at designing stage of buildings**

- i) Select the factory land having required buffer zone depending on the types of machinery, which are going to be used.
- ii) Locate the noisy machinery in suitable places, probably centre part of the building floor.
- iii) Design the building including necessary noise control measures (*i.e.* Not to face doors and windows towards residential areas).
- iv) All the machinery should be purchased accordance with standards in the noise buying policy.
- v) Contact a consultant on noise at the stages of selecting a land and designing the building.

## **Local institutions engaged in measurement and consultancy on noise**

### ***Industrial Technology Institute (ITI)*** 363, Bauddhaloka Mw, Colombo 7.

Tel: 011-2682936

Contact: Mr. A. S. Pannila/Manager,  
Metrology Group

E-mail: [pannila@iti.lk](mailto:pannila@iti.lk)

### ***University of Moratuwa***

Katubedda, Moratuwa.

Tel: 011-2650567 or 0777-320590

Contact: Dr. M. Jayaweera/Senior Lecturer,  
Dept. of Civil Engineering

E-mail: [mahesh@civil.mrt.ac.lk](mailto:mahesh@civil.mrt.ac.lk)

### ***National Building Research Organization (NBRO)***

No. 99/1, Jawatte Road, Colombo 5.

Tel: 011-2588946

Contact: Mr. H. D. S. Premasiri/ Scientist

E-mail: [nbro@sltnet.lk](mailto:nbro@sltnet.lk)

### ***National Engineering Research & Development Centre (NERD)***

2P/17B, IDB Industrial Estate, Ekala, Jaela.

Tel: 011-5354374.

Contact: Eng. D. D. Ananda Namal/Head,  
Energy & Environmental Management Centre

### ***Ministry of Environment and Natural Resources***

No. 82, Sampathpaya, Rajamalwatta Rd.,  
Battaramulla.

Tel: 011-2887453

Contact: Ms. L. P. Batuwitige/ Director,  
Environmental pollution control

### ***Central Environmental Authority***

“Parisara Piyasa”

P.O. Box 104, Robert Gunawardena Mw.,  
Battaramulla.

Tel: 011-2872606

Contact: Mr. Susiripala/ Director

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4. [www.who.int/docstore/peh/noise/Comnoise-3.pdf](http://www.who.int/docstore/peh/noise/Comnoise-3.pdf)
5. [www.medscape.com/viewarticle/439298\\_2](http://www.medscape.com/viewarticle/439298_2)