NOISE POLLUTION

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L-40 Introduction to Noise Pollution

Meaning of Noise:-

- Noise is defined as **unwanted sound.**
- It is **part of our environment.**
- Noise is a **normal phenomenon** of life

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Meaning of Noise:-

- and is one of the most effective alarming systems

- in man's physical environment.

- It has short decay period.

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- The word ‘noise’ is derived from the Latin word’ nausea’ which means

- a feeling sickness at the stomach with
- an urge to vomit.

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definitions –

"Noise is any sound independent of loudness which can produce

- an undesired physiological or
- psychological effect in an individual."

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"Noise is nothing but unwanted sound".

Intense Noise for long duration can cause

- temporary or permanent hearing loss.

- Noise is a significant environmental pollutant and potential hazard.

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- Sound consists of wave motion in
- an elastic medium and caused by
- the vibrations of molecules.
- Sound is periodical disturbance in matter.
- Noise radiates from vibrating surfaces.

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- Noise also grows rapidly,
- with an increase in machine power and with
- increase in the speed of exhaust gases.

- Nature of sound waves depends upon the following factors:

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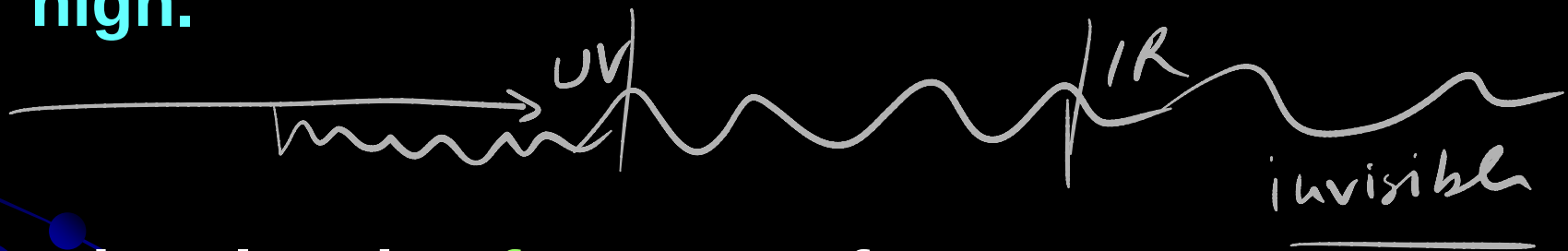
- **Pitch:- [frequency]**
- **“The attribute of auditory sensation which sounds” may be**
- **ordered on a scale extending from low to high.**



- **It is related to frequency from**
- **about 20 to 20,000 vibrations per second. [cycles/sec].**

Audible region range

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- **Amplitude or Magnitude:-**
- **The distance that a vibrating object i.e.,**
- **musical instrument string moves as**
- **it vibrates is called**

- **the amplitude of vibrations.**
- **Sound waves have different amounts of energy.**

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- The greater the energy used in producing the sound greater the amplitude
- Bigger object will produce a sound of greater intensity and loudness than
- a smaller vibrating object.

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Loudness:-

- Loudness may be described as a listener's auditory impression.
- Loudness is the intensity of sound waves
- combined with the reception characteristics of the ear.

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Loudness:-

- **Annoyance results from both the loudness and the frequency of a noise.**
  - **Loudness' unit is SONE.**

"One sone equals to 40 dB sound pressure at 100 cycles/sec".

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- **1 SONE = 40 dB.**
- **Generally 35 dB loudness,**
- **may be regarded as**
- **the critical level for ear damage.**

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- **Modern life** has given rise to a new form of pollution i.e.,
- **Noise pollution**

- when noise becomes **harmful** to **health** and
- **diminishes the quality of life.**

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- On the **basis of Nature**, noise pollution can be classified in the following types-

(a) Natural **(b) Biological**

(c) Artificial

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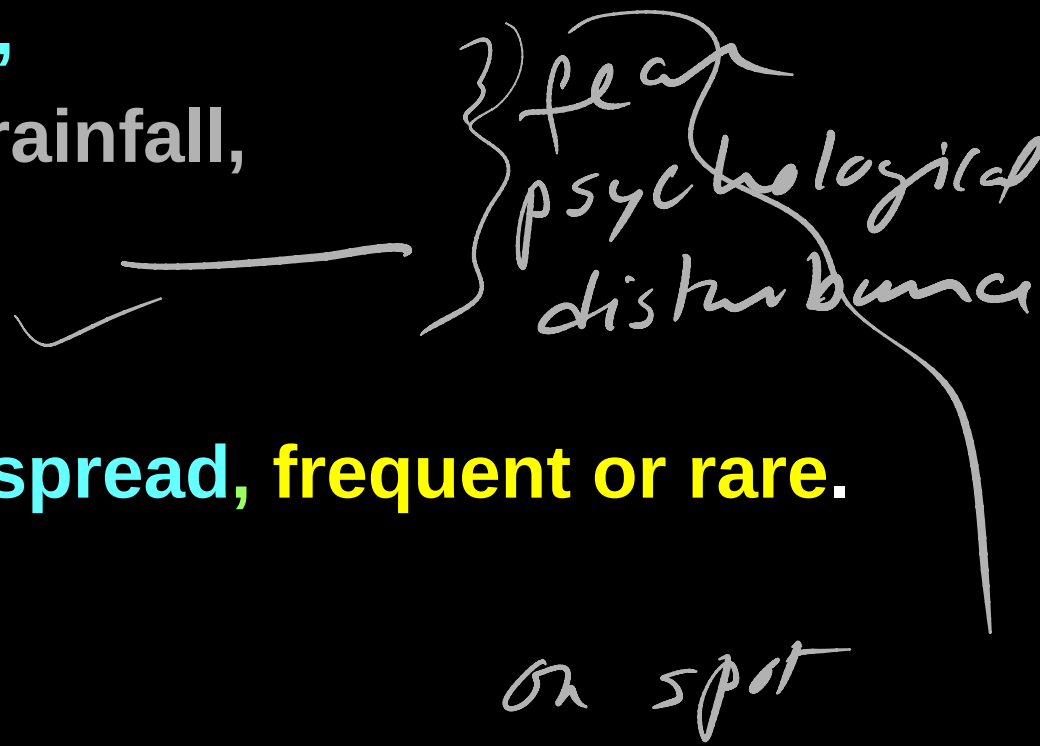
- **Natural noise pollution** arises from Natural sources such as
- cloud thunder,
- high intensity rainfall,
- hailstorms,
- waterfalls etc.
- it may be widespread, frequent or rare.



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- **Biological noise pollution can be due to sounds of of wild and tame animals such as**
- **roars of lions in circus cages,**
- **street dogs are perpetual sources of noise pollution.**

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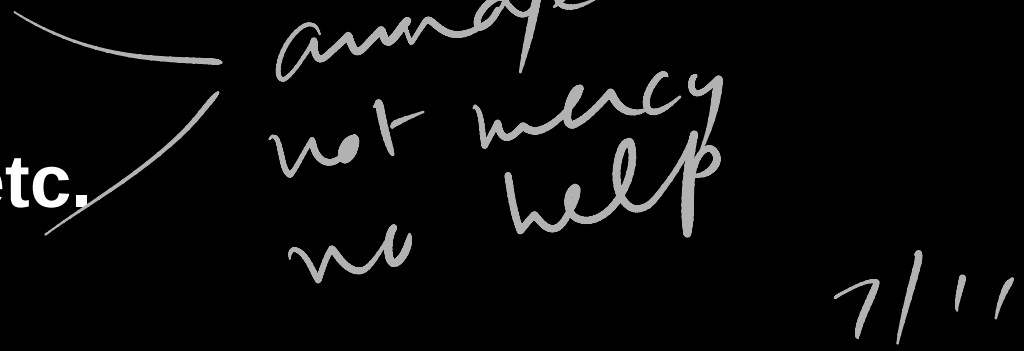
- Man also creates different types of sounds and noise such as during

- laughing,
- crying,
- sighing,
- weeping etc.



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- Whereas **artificial or man – made** noise pollution is due to
- high intensity sound created by **human activities** such as
- **Industrialization,**
- **aircraft** etc.

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- With progress in industrial growth, noise pollution is continuously increasing.
- Noise pollution cannot be carried far away and spread from
- its source area like other pollutants.

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Measurement of Noise:-

- The sound becomes louder as the pressure increases and at about
- 20 N/m^2 the sound felt which is called threshold or beginning of feeling.
- This is not simple and can not be easily described.

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- The **universal** measure of loudness is called '**Bel**' but it is too large.
- **In practice decibel (dB)** is used which is equal to **1/10th of Bel.**

- Decibel is **not an absolute** physical unit but

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- Decibel is not an absolute physical unit but
- it is a ratio expressed as a logarithmic scale relatively to
- a reference sound pressure level.

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1 Decibel (dB) =

$$10 \log_{10} \frac{\text{Intensity measured (I)}}{\text{Reference intensity}}$$

- **Noise can be measured by the following three ways:-**
- **(1) Intensity**
- **(2) Pressure**
- **(3) Decibel**

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Intensity (Wm^{-2})	Pressure (Nm^{-2})	dB	Sound source
100	200.000	200	Saturn rocket take Off
1.0	20	120	Boiler shop
10^{-2}	2.0	100	Siren at 5 mts
10^{-4}	0.2	80	Heavy machinery Workshop
10^{-6}	0.02	60	Normal conversion at 1 m
10^{-8}	.002	90	Public library
10^{-12}	$2 \times 10\text{-}5$	0	Threshold of hearing

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- Decibel (dB) is also a measure of sound pressure level (SPL), it is defined as:
- $$dB = \log \frac{P^2}{P_0^2}$$
- Where P is root – mean – square sound pressure in Pascal (N/m^2) and
- P_o is reference r – m – s sound pressure

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- For all the standard atmospheric conditions **sound intensity level** and sound pressure level are **equal** in magnitude to each other.

- The **dB-scale** begins from **zero**, which represents the **faintest sound** that is **audible to a normal ear.**

Threshold

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- In the decibel-scale, **each ten fold** increase is **represented 10 dB. e.g.**

- **Faintest** sound is 0 dB

$I = I_0$

$$\because \quad \mathrm{dB} = 10 \log \left(\frac{I}{I_0} \right)$$

or $10 \times 0 = 0$

dB

- Ten times more intense sound is 10 dB.

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- Ten times more intense sound is 10 dB.

$$\because \quad \mathrm{dB} = 10 \log\left(10 \times \frac{I}{I_0}\right) = 10 \times 1 = 10.$$

- 100 times more intense sound is 20 dB

$$\therefore \quad \mathrm{dB} = 10 \log_{10}\left(100 \times \frac{I}{I_o}\right) = 10 \times 2 = 20 \text{ and so on.}$$

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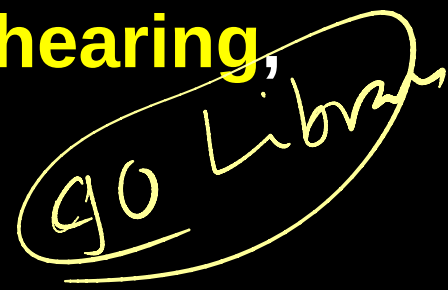
- **Zero decibels is the threshold of hearing, while**



- **85 dB is usually considered loud enough to cause ear damage.**
- **The pain threshold is about 140 dB.**

L-41 Sources & Effects of Noise…

Sources of Noise:-

The main sources of noise are different means of transport such as

- motorized vehicles,
- aeroplanes,
- railroads etc.

The diverse noise arising from the environment by

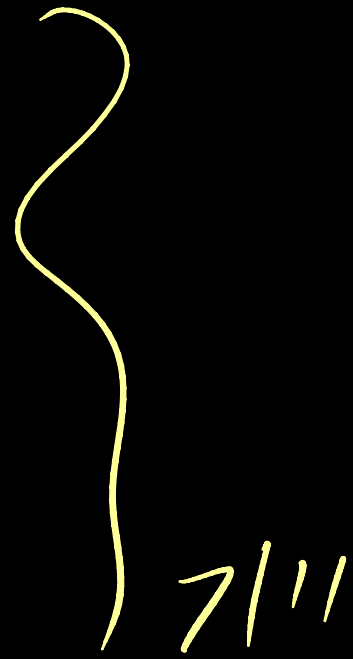
- factories,
- Loudspeakers…..

L-41 Sources & Effects of Noise…

Sources of Noise:-

The noise arising by the

- factories,
- loudspeakers,
- places of entertainments,
- restaurants,
- radios, record players,
- television sets,
- household equipments and appliances etc



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Sources of noise are also classified on the basis of the area such as-

- **Rural sources of noise pollution.**
- **Urban sources of noise pollution.**
- **Industrial sources of noise pollution.**

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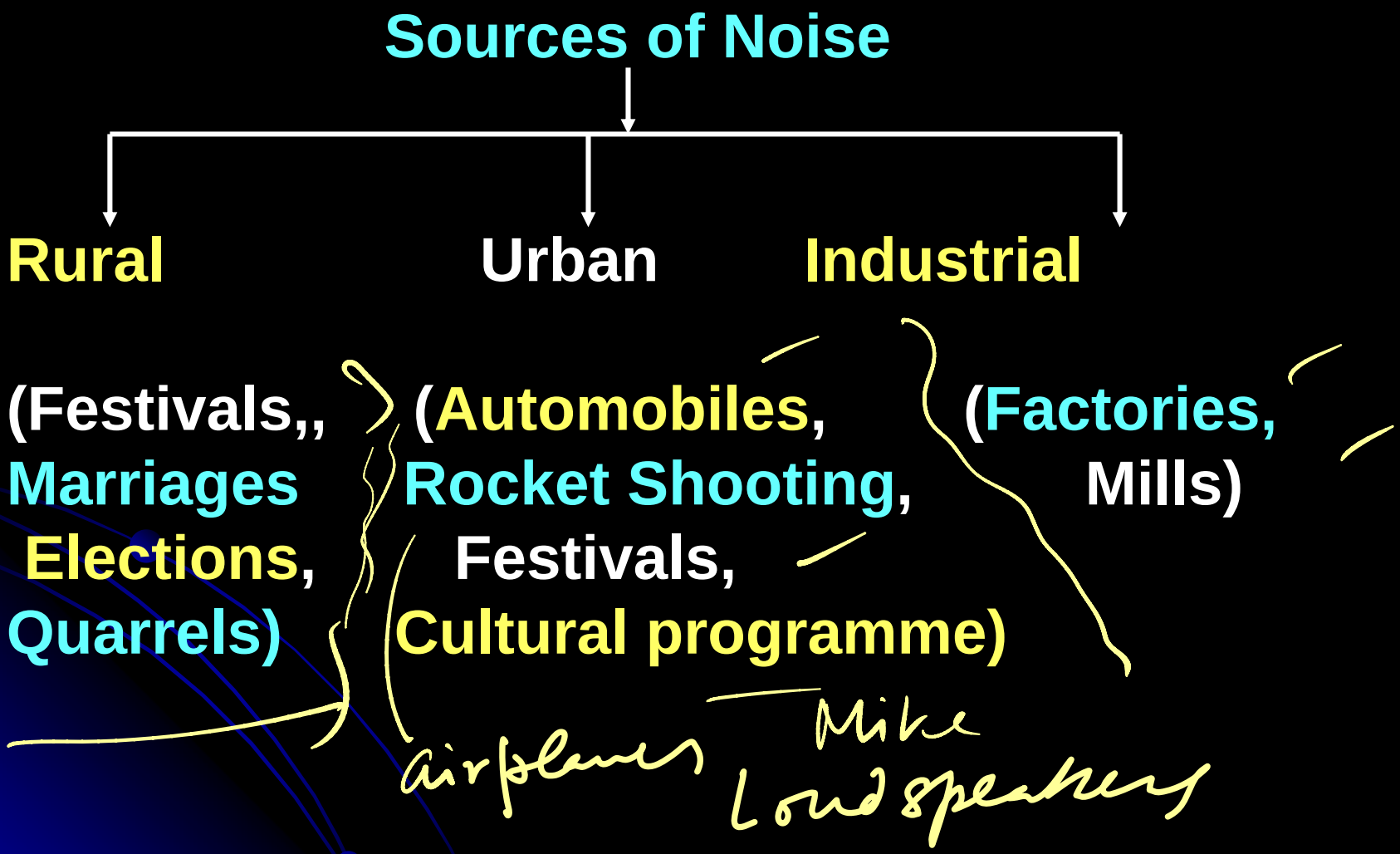

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- Rural source generates least noise pollution.
- There are certain occasions when the noise crosses
- normal permissible level (25 to 35 dB.).

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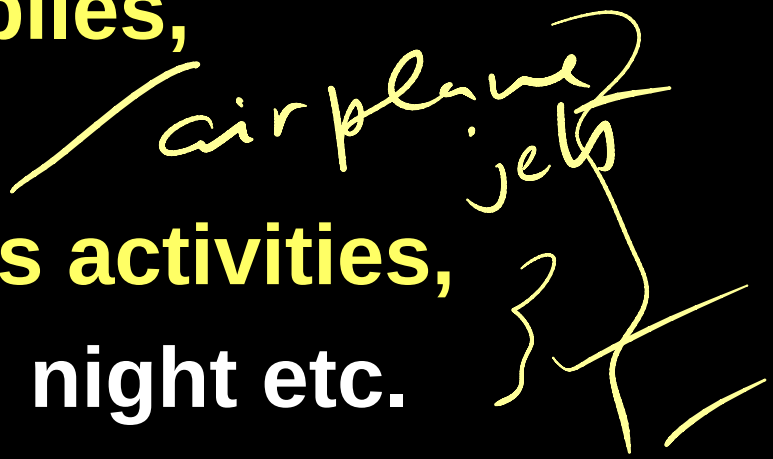
Urban noise pollution produced from

- automobiles,
- rocket,
- religious activities,
- musical night etc.



- Loud speakers are the most significant noise pollutants.

L-41 Sources & Effects of Noise...

- **Industrial noise pollution includes noise produced from**

  - **factories,**
  - **defense establishment,**
  - **mining operations etc.**

L-41 Sources & Effects of Noise…

- **World Health Organization (WHO) has fixed**
- **45 dB as the safe noise level for a city,**
- **Mumbai, New Delhi, Kolkata and Chennai usually register**

L-41 Sources & Effects of Noise…

- the street noise level above, 95 dB.
- Near airports it is between
- 80 to 85 dB.
- With increase of 20 to 25 dB during take off and landing.

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- Near rail tracks the noise of 90 dB at a distance of 10 metres.
- Noise level in public hospitals ranges from 50 to 75 dB
- against the permissible level of 35-40 dB.
- During Diwali noise levels go up.

L-41 Sources & Effects of Noise…

- During Diwali noise levels go up.
- from the normal 50 dB during evening hours to 0 – 100 dB.

loudspeakers produce

- 55-75 dB noise in the morning,
- 70-90 dB in the afternoon and
- 80-95 in the evening.

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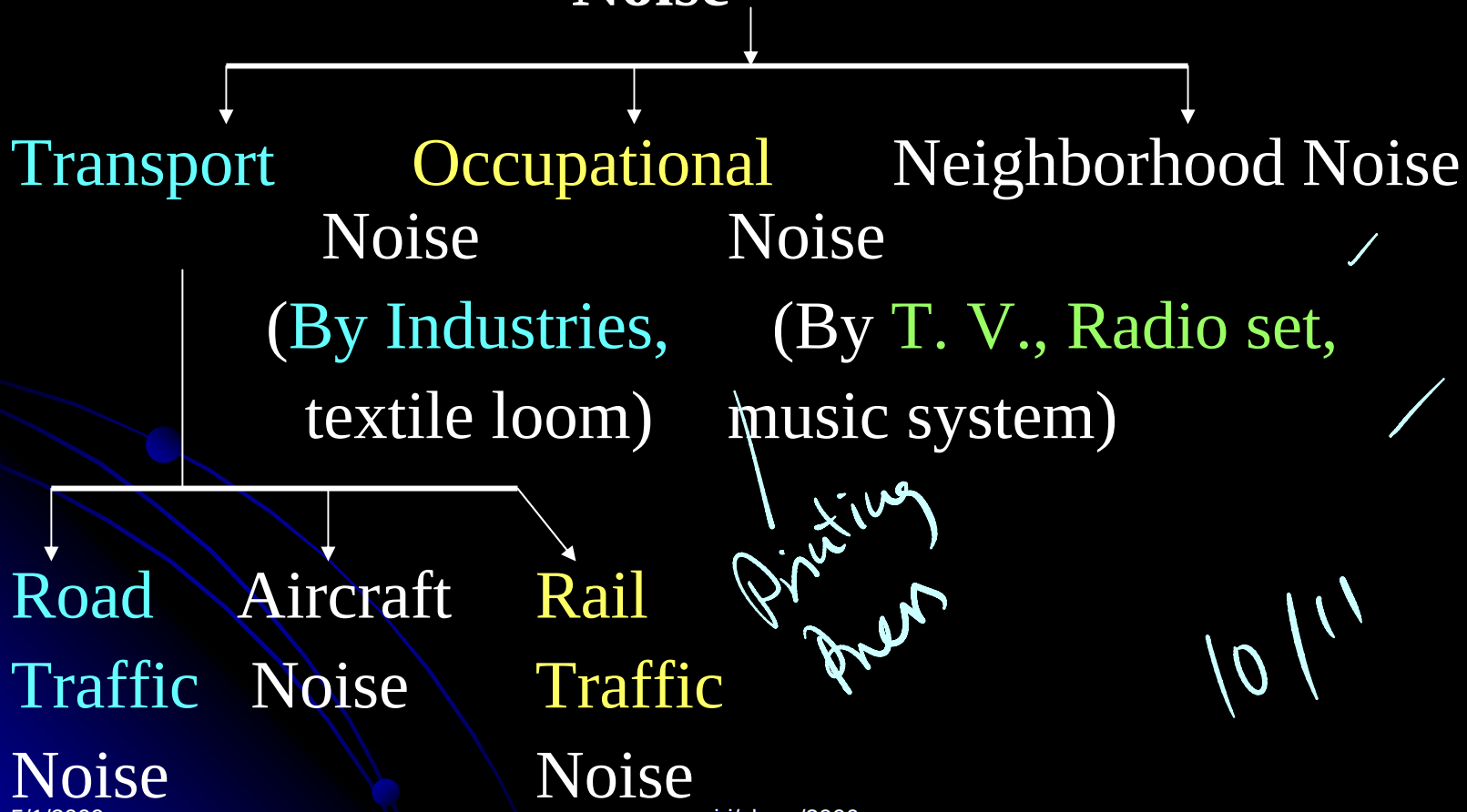
Noise Classification:-



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1. Transport Noise:- This is again classified into the following types:

a) Road Traffic Noise

b) Aircraft Noise:-

c) Rail Traffic Noise:-

L-41 Sources & Effects of Noise…

(Transport Noise)

a) Road Traffic Noise:-

- Different vehicles on road produces irritating noise,
- increasing continuously with the increase in number of road vehicles,
- due to increase in traffic density and speed of vehicles.

L-41 Sources & Effects of Noise…

b) Aircraft Noise:-

- This type of noise is **not continuous** but **intermittent.**
- There are peak noise levels when **aircrafts take off and land.**
- The **peak frequency** varies with..

L-41 Sources & Effects of Noise…

b) Aircraft Noise:-

- The **peak frequency** varies with
- the **number and type of aircraft operational height.**

The big noise – makers are the

- **supersonic aircrafts-** noise level is
- about **120 dB to 150 dB.**

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- Aircraft noise is now a sensitive issue in developed countries.
- Laws have been introduced by the Government and local authorities.

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c) Rail Traffic Noise:-

- Rail traffic noise is generally of **lower frequency**
- than that of **street vehicles.**
- Most of the railway tracks run **through rural areas.**

L-41 Sources & Effects of Noise…

(Rail Traffic Noise)

- Buildings beside the railway tracks are
- exposed to this noise menace.
- The introduction of diesel and all – electric locomotives
- has greatly reduced rail traffic noise.

L-41 Sources & Effects of Noise…

2. Occupational Noise:-

- This is mainly produced by **industrial machines,**
- domestic gadgets such as **washing machine etc.**
- Noisy industrial processes cause **hearing loss to the workers.**
- Noise reduction is **essential** especially **for the workers.**

L-41 Sources & Effects of Noise…

Occupational Noise

Industrial Source	*Noise Level dB.*
Textile loom	112
Farm tractor	103
News paper press	101
High speed drill	85
Super market	60

L-41 Sources & Effects of Noise…

3. Neighbourhood Noise:-

- This includes a **variety of noise which disturbs**
- and **annoy the public,** interfere with
- their **comfort, and welfare.**

L-41 Sources & Effects of Noise…

(Neighbourhood Noise)

- **Loud TV, radio,**
- **cassette player,**
- **loudspeakers,**
- **disco music and dance etc.,**

cause noise nuisance to nearby residents.

L-41 Sources & Effects of Noise...

Neighbourhood Noise:-

Source	*Noise Level dB.*
1. Door slamming	70-90
2. Domestic generator	80-85
3. Radio/Tape	76
4. Television	65-67
5. Pressure cooker	65
6. Air conditioner	61.

L-41 Sources & Effects of Noise…

- Noise is harmful and has
- physical or physiological effects on human beings.

- Harmful effects of noise pollution may be classified into two ways-

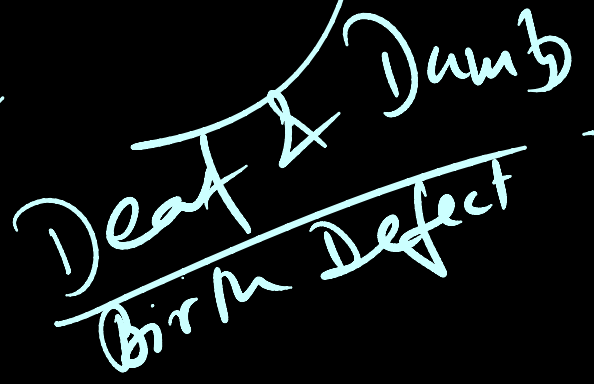
  - auditory effect and
  - non – auditory effects.

L-41 Sources & Effects of Noise…

- The most acute effect of noise pollution is **impairing of hearing**
- leading to **auditory fatigue or deafness.**

Non – auditory effects may also cause

- **interference with**
- **speech communications,**



L-41 Sources & Effects of Noise…

Non – auditory effects also cause

- interference with
- speech communications,
- annoyance leading to ill temper.
- Violent behaviour,
- loss of working efficiency etc.

L-41 Sources & Effects of Noise…

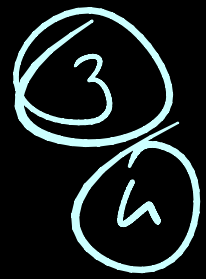
- Noise is air-borne mechanical energy striking the human eardrum.

- Ear damage is brought about by
- continuous periods of

- high intensity noise level

L-41 Sources & Effects of Noise…

- exceeding 90 dB
- for a few minutes.



Noise pollution can also cause

- pathological or psychological disorders.

L-41 Sources & Effects of Noise…

- High frequencies of ultra sonic sound can affect internal ear whereas
- very low frequency noise can reduce heart beat,
- change in blood pressure and lead to
- breathing difficulties.

L-41 Sources & Effects of Noise…

- Mid-audible frequencies can affect the
- brain and nervous system,

- severe vibration results in
- damage to bones and joints.

- It is difficult to assess non-pathological or psychological noise effects on man.

L-41 Sources & Effects of Noise…

Sound Intensity	*Effect*
0 – 23	No disturbance
30 – 60	Stress, tension, psychological (illness, heart attack) effects.
60 – 90	Health damage, Psychological, vegetative and gastro intestinal disorders, muscle pain, high B.P. disturbed sleep.
90 – 120	Damages to health. Psychological, vegetative and ear diseases
140 – 150	Feel burning.
150 – above	Painful effects on long run.

L-41 Sources & Effects of Noise...

Different frequencies of noise results in

- lower efficiency,
- reduced work rate and a
- higher potential for accidents.

In residential areas noise..

L-41 Sources & Effects of Noise...

In residential areas noise

- affects sleep.
- By this body strain, weakness etc. happen.

Excessive noise show

- disorderness in children also.

10/11/06

L-41 Sources & Effects of Noise...

This is the major factor for

- chronic exhaustion and
- consequent tension.

- Migratory birds also show impact of noise pollution

L-41 Sources & Effects of Noise...

- Different evidence show that
- noise pollution not only affect the biotic environment but also
- affect non-biotic environment.

Buildings, Statues

- Some of the important effects of noise pollution are given below:

L-41 Sources & Effects of Noise...

1. Noise pollution affects
   - human health,
   - comfort and
   - efficiency.

2. It causes
   - high blood pressure,
   - contraction of muscles and
   - blood vessels.

L-41 Sources & Effects of Noise…

3.Noise changes hormone content of blood, increased heart- beat, dilation of pupil of eye.

4. Excessive noise also causes psychological and pathological disorders.

L-41 Sources & Effects of Noise...

5. Psychological disorders causes

- neurosis,
- Hypertension,
- increased sweating,
- gastro intestinal disturbances,

stress etc.

L-41 Sources & Effects of Noise...

6.Noise pollution causes

- **frustration,**
- **physical and**
- **mental fatigue.**

- **Low frequency noise cause disturbance in sleep.**

L-41 Sources & Effects of Noise...

7. Noise pollution produces

- emotional disturbances,
- behaviour changes,

Psycho

- causes nervous breakdown,
- tension and even insanity.

madness

L-41 Sources & Effects of Noise...

8. The most harmful effect of noise pollution is

- impairment of hearing and
- eardrum damage.

Deafness

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9. Auditory fatigue produced with

- whistling and buzzing in ears.

- This causes temporary deafness whereas

- 100 dB noise causes permanent deafness.

L-41 Sources & Effects of Noise...

10. Ultrasonic sound can affect the

- digestive, respiratory,
- cardio vascular system and
- semicircular canals of the internal ear.

L-41 Sources & Effects of Noise...

11. Brain is also adversely affected by loud and sudden noise such that of

- jet and aeroplane noise.
- It is also injurious to health of
- pregnant women and fetus.

L-41 Sources & Effects of Noise...

12. According to recent reports Noise causes
- eosinophilia,
- hypoglycaemia etc.

13. Noise is responsible for disturbing the
- whole biological system.

L-41 Sources & Effects of Noise...

14. Noise also causes

- irritation,
-
- dissatisfaction,
- disinterest and
- affect work performance.

Psycho

L-41 Sources & Effects of Noise...

15. The noise of

- crackers during Diwali are too loud and
- unbearable for health and
- causes serious air pollution.

L-41 Sources & Effects of Noise...

16. **Non living things** such as buildings undergo

a-biotic

- **physical damage** by cracks,
- broken windows, glasses etc. by
- **sudden and explosive sounds.**

L-41 Sources & Effects of Noise…

17. Excessive noise causes
- chronic **headache and irritability**
- It affects health efficiency.

19. Noise affects **the autonomous nervous system.**
- It causes **annoyance** to people,
- those do close works in factories etc.

L-42 Standards of Noise Pollution

Sound Unwanted Form of Noise:-

Musical Noise :

The sound waves which are

- periodic
- regular and of
- long duration and
- produce a pleasant effect
- called musical noise.

Music

high pitch

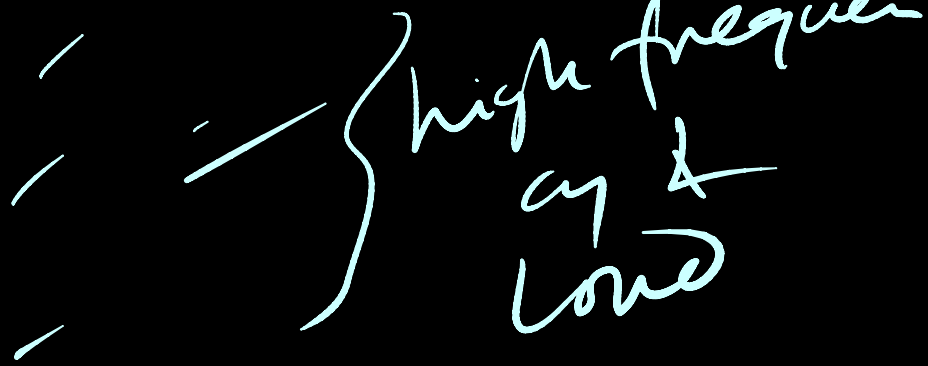
Noise

L-42 Standards of Noise Pollution

Sound 'Unwanted Form' of Noise:- Noise

When sound waves are

- non periodic,
- irregular and
- short duration



they produce an

- irritating effect called noise.

L-42 Standards of Noise Pollution

- Sound becomes **louder with** more **pressure** , upto **20 N/m^2** .

- Noise is the **unwanted and undesired form of sound.**

L-42 Standards of Noise Pollution

Modern civilization creates more and more noise because of the development of

- industry,
- machinery and
- technology.

Unwanted sound i.e. noise has increased

- in hospitals,
- in colleges,
- in theatres, factories etc.

L-42 Standards of Noise Pollution

Permissible Noise Levels (Standards):-

Many people work and live in where the noise level is not hazardous.

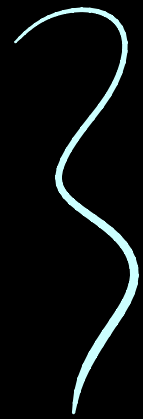
- The maximum level of noise which will
- neither irritate the occupants

- nor damage the acoustics
  (Noise from sound wave of building is known as)
- acceptable noise level inside the building.

L-42 Standards of Noise Pollution

- **acceptable noise level** inside the building. This depends upon the

- **nature of the noise,**
- time of fluctuation of noise,
- **background noise** etc.



But over the years they suffer from

L-42 Standards of Noise Pollution

But over the years they suffer from

- progressive hearing loss and
- psychological hazards
- including tension.
- The maximum permissible noise levels are

summarized in the table.

L-42 Standards of Noise Pollution

Maximum Permissible Noise, dBA

S.No.	*Situation*	*Permissible noise dBA*
1.	Road traffic near residential areas	70
2.	Ear protection to be worn	85
3.	Factory work for 8 hour day	90
4.	Prolonged noise causing permanent damage	100
5.	Threshold of pain – duration of 30 seconds	120
6.	Absolute limit with ears protected	150
7.	Ear drum rupture	180
8.	Lung damage	195

L-42 Standards of Noise Pollution

Permissible Ambient Noise Levels

Area	*Noise Level dB*	
	Day time (6 am to 9 pm)	*Night time (9 pm to 6 am)*
• Industrial area	75	65
• Commercial area	65	55
• Residential area	55	45
• Silence zones	40	35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L-43 Control Techniques of Noise..

Control of Noise Pollution:-

- Noise is an unwanted form of sound.
- It is also known to be a nuisance.
- An awareness of the seriousness of the problem of noise pollution has become important.

L-43 Control Techniques of Noise..

(Control of Noise Pollution)

- Preventive measures and methods of
- reducing the noise pollution must be learnt to
- maintain the acceptable level of noise pollution.

L-43 Control Techniques of Noise..

Control of Noise Source:-

It is possible to control noise at three levels:

1. **Reducing the sound produced.**
2. **Interrupting the path of the sound.**
3. **Protecting the recipient noise.**

L-43 Control Techniques of Noise..

On the basis of the sources the controls are also different.

1. Industrial Noise Control:-

2. Community Noise Control

L-43 Control Techniques of Noise..

1. **Industrial Noise Control:-**

   Industrial noise can be controlled by

- **replacement of noise producing machinery with quiet alternative.**

- **Interrupting the path of the sound by using insulating material.**

L-43 Control Techniques of Noise..

(Industrial Noise Control)

Industrial noise can be controlled by

- Protecting the recipient by distribution of ear muffs to the employee and
- by the application of engineered control techniques.

L-43 Control Techniques of Noise..

2. Community Noise Control:-

The main sources of community noise are:

- aircraft,
- Road traffic and
- construction.

- Aircraft noise is maximum at the time of
- take off and take on.

L-43 Control Techniques of Noise..

To **control aircraft noise** it is necessary that

- the **flight paths are far away** from populated areas.

Another method is

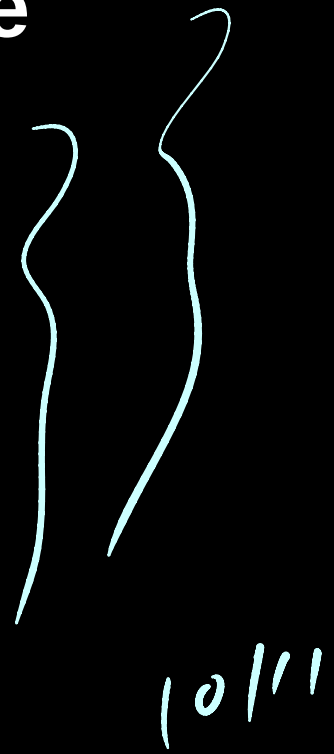
- **set the limits** on aircraft engine noise and
- **Do not allow the aircrafts exceeding** these limits.

L-43 Control Techniques of Noise..

Roadway traffic

Vehicles produce

- **exhaust noise,**
- **engine intake noise,**
- **gears,**
- **transmission and**
- **aerodynamic noise.**



L-43 Control Techniques of Noise..

Roadway traffic

- **Heavy vehicles can produce more noise than light vehicles.**
- **A number of alternatives are available for reducing highway noise.**

L-43 Control Techniques of Noise..

1. The source can be controlled by making quiet vehicles.
2. Highway could be routed away from populated areas.
3. The noise can be baffled with walls or other barriers.

L-43 Control Techniques of Noise..

4. Lowering the speed limits and designing for non-stop operation also reduces the noise pollution.

5. Green plants or vegetation is good absorber of noise pollution.

6. So greater noise pollution can be reduced by plantation by the sides of highways.

L-43 Control Techniques of Noise..

Third source of community noise pollution is construction.

It must be controlled by local ordinances and usually involves:

- muffing of air compressors,
- Jack hammers,
- hand compactors etc.

L-43 Control Techniques of Noise..

Control of Noise Source by Design:-

i) **Reduce Impact Forces:-**

to reduce noise from impact forces following steps can be taken:

- Reduce the weight,
- size or height

of fall of the impacting mass.

L-43 Control Techniques of Noise..

- Cushion the impact by
- inserting a layer of shock absorbing materials between the surfaces

- Substitute the application of a
- small impact force
- over a long time period for
- a large force over a short period.

L-43 Control Techniques of Noise..

- Smooth out acceleration of moving parts.
- Avoid high jerky motion.

L-43 Control Techniques of Noise..

- **Reduce Speed and Pressures:-** By reducing, pressure and flow velocities noise radiations can be reduced-by the following ways:
  - Fans, motors, turbines should be operated at
  - lowest blade tip speeds and maximum diameter devices should be used.
  - All other factors being equal,
  - centrifugal squirrel cage type fans are less noisy than vane axial or propeller type fans.
  - In air ventilation system 50% reduction if the speed of air flow may lessen the noise output.

L-43 Control Techniques of Noise..

- **Reduce Noise Leakage:-** These can be done by following ways:
  - **All unnecessary holes or cracks** at joints should be covered.
  - All **electric or plumbing penetrations** of the housing or cabinet should be **sealed with rubber gaskets**.

L-43 Control Techniques of Noise..

- All other functional openings should be covered with lids or shields edged.
- Other openings required for exhaust, cooling etc. should be equipped with mufflers.
- Opening should be directed away from other people.

L-43 Control Techniques of Noise..

Reducing Frictional Resistance:-

Reducing friction between

- rotating, sliding-parts in
- mechanical system frequently results in
- smoother operation and lower noise output.

A system designed for quick operation will employ the following features:

L-43 Control Techniques of Noise..

- Low flow speed.
- Smooth boundary surfaces.

- Simple layout.
- Long radius turns.

- Flared sections.
- Streamline transition in flow path.

- Remove unnecessary obstacles.

L-43 Control Techniques of Noise..

- **Isolate and Damper Vibrating Elements:-**
- **To maximize vibration damping efficiency following should be done.**

  - **Dampening materials should be applied to**
  - **most flexing, bending, vibrating surfaces.**

L-43 Control Techniques of Noise..

- **Single layer damping materials should be**
- **about two or three times as thick as the**
- **vibrating surface to which they are applied.**

- **Sandwich materials with effective vibration dampers can be used.**

L-43 Control Techniques of Noise..

- **Providing Mufflers/Silencers:-** Mufflers are of two types:

i) **Absorption mufflers** is a device which reduces noise by **fibrous or porous materials.**

ii) **A reactive muffler** is one whose noise reduction is **determined be geometry.**

- By using these, noise can be controlled to some extent.

L-43 Control Techniques of Noise..

Noise Control in the Transmission Path:-

This can be done by the following ways:

- **Separations:-**

Air absorbs high frequency sound more efficiently.

If enough distance is available noise can be reduced by absorption.

L-43 Control Techniques of Noise..

Noise Control in the Transmission Path:-

- **Absorbing Materials:-**

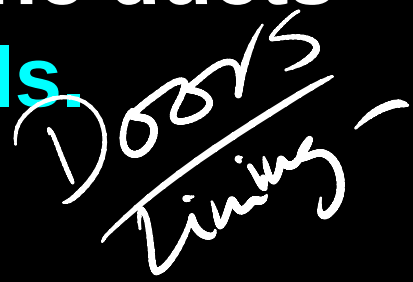
  Sound absorbing materials can be used to reduce noise level.

- **Acoustical Lining:-**

  In noise transmitted through ducts pipe, Noise can be reduced by…

L-43 Control Techniques of Noise..

by lining the inner surface of the ducts with sound absorbing materials.



- **Barriers and Panels:-**

In the noise path placing screens can be an effective way of reducing noise.

Barrier size depends upon the noise frequency.

L-43 Control Techniques of Noise..

- **Protect the Receiver:-**

  The following two techniques are commonly employed:

i) Alter Work Schedule:-

Limit continuous exposure to high noise levels.

The intensely noisy operation should be done for a short interval of time.

L-43 Control Techniques of Noise..

(Protect the Receiver)

ii) Ear Protection:-

- Molded and pliable earphone,
- cup-type protectors and
- helmets

are commercially available as hearing protectors.

L-43 Control Techniques of Noise..

Many industrial countries of the worlds have enacted legislation to control and abate noise.

India has recently declared noise pollution as an offense through the promulgation of Air Pollution Act 1986.

Accordingly the recommended noise levels for various areas have been fixed by Central Board of Pollution Control.