Sound insulation

Introduction

Acoustics is the study of sound. Sound is generating in the air when a surface is vibrated. The vibrated surface sets up waves of compression and rarefaction in the air and these set the ear drum vibrating. The movements of eardrum are translated by the brain into sound sensation. Good acoustical conditions promote comfortable comfortable living ,efficiency of work auditory of public building etc.

Behavior of sound propagation

Sound is a sequence of longitudinal waves of pressure which propagates through compressible media such as solid, liquid and air. It travels much faster in solid and liquid than in air. The velocity of sound in air depends upon moisture in air and temperature of air. The velocity of sound in air is 340m/sec. The velocity of sound in pure water is 1450 m/sec while in bricks and concrete is 4300 and 4000 m/s respectively. Sound cannot travel in vacuum. During their propagation, waves can be reflected, refracted, or absorb by the medium.

There are three characteristics of sound:

1. Intensity and loudness
2. Frequency and pitch
3. Measurement of sound

Behavior of sound in enclosures

When sound is generated in a room, the distance between the source and the walls is so small that there is little or no reduction due to distance. When the sound waves strike the surfaces of a room, three things happen:

1. Some of the sound is reflected back in the room.

2. Some of the sound energy is absorbed by the surfaces and listeners.

3. Some of the sound waves set on the walls, floors and ceiling vibrating and are thus transmitted outside the room.

The amount of sound reflected or absorbed depends upon the surfaces, while the sound transmitted outside the room depends upon sound insulation properties of the surfaces.

Acoustics in building

Building acoustics is the science of controlling noise in buildings. This minimizes the noise transmission from one space to another and the control of the characteristics of sound within spaces themselves. Building acoustics are an important consideration in the design, operation and construction of most buildings.

They can be particularly significant in spaces such as concert halls, recording studios, lecture theatres, and so on, where the quality of sound and its intelligibility are very important.

Acoustical defects

1. Echo: echoes are also formed due to reflection o sound when the reflecting surfaces are situated at a distance greater than about 17 m and when the shape of hall/auditorium/room is curved with smooth character. This defect can be removed by selecting proper shape of the hall and by providing rough and porous interior surfaces to the disperse energy of echoes.
2. Reverberation: The persistence of sound after its source has stopped, caused by multiple reflection of the sound within a closed space. Reverberant sound is the reflected sound, as a result of improper absorption. Excessive reverberation is one o the most common defect, with the result that sound once created prolongs for a larger duration resulting in confusion with sound created next. Clarity depends upon correct reverberation time which can be controlled by suitably installing the absorbent materials.
3. Sound foci: reflecting concave surfaces cause concentration of reflected sound waves at certain spots, creating a sound of large intensity. These spots are called sound foci. This defect can be removed by (a) geometrical designed shapes of the interior faces, including ceilings, and (b) providing highly absorbent-materials on focusing areas
4. Dead spots: Dead spots are places where destructive interference occurs from the interaction of two or more sound waves. This defect can be removed by installation of suitable diffuser so that there is even distribution of sound in the hall.
5. Insufficient loudness: This defect is caused due to lack of sound reflecting flat surface near the sound source and excessive sound absorption treatment in the hall. The defect can be removed by providing hard reflecting surface near the source, and by adjusting the absorption of the hall so as to get optimum time of reverberation. When the length of the hall is more, it may be desirable to install loud speakers at proper places.
6. Exterior noise: External noise from vehicles, traffic engines, factories, cooling plants etc. may enter the hall either through the openings (such as doors, windows, ventilators etc.) or through even walls and other structural elements having improper sound insulation. This defect can be removed by proper planning of the hall with respect of its surroundings and by proper sound insulation of exterior walls

Differences between echo and reverberation

	Echo	Reverberation
1.	Echo is a single reflection of a sound wave off a surface.	Reverberation is the sound or the pattern created by the superposition of such echoes.

2.	An echo can be heard only when the distance between the source of sound and the reflecting body is at least 17 m.	A reverberation can occur when sound wave is reflected by a nearby wall also.
3.	An echo is usually clear and can be clearly distinguished.	A reverberation is not a clear replica of the original sound sample.
4.	Echo can be used to determine the distance of a reflecting object such as a large building or a mountain.	Reverberation cannot be utilized for distance measurement applications.
5.	An echo can be heard both in open and closed spaces.	Reverberation is usually experienced in closed spaces with multiple reflecting objects.
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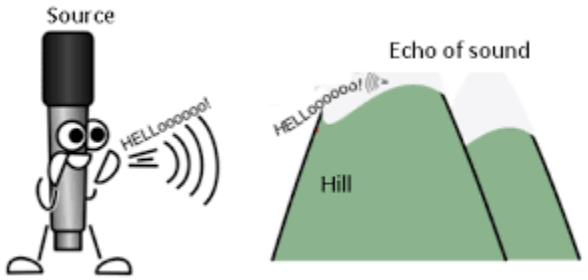
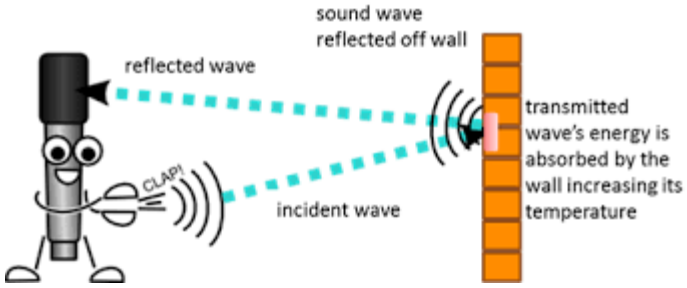
7.		

Methods of correction

Absorption

When a sound wave strikes a surface, a part of its energy is absorbed by friction. The sound generated in an auditorium or hall is absorbed in four ways:

1. Absorption in air
2. Absorption by the audience
3. Absorption in furniture and furnishings
4. Absorption by boundary surface

1. Absorption in air: The absorption of sound in the air is mainly due to friction between the oscillating molecules when sound wave travels through it. However, this absorption is extremely small.
2. Absorption by the audience: Sound energy absorbed by the clothing of the audience. Room acoustics change perceptibly by the number of audience present. Also, absorption is more in winter, than in summer because o heavy clothings.
3. Absorption in furniture and furnishings: furniture, curtains, carpets, etc, also absorb sound energy to a also fairly good extent.
4. Absorption by boundary surface: when sound waves strike the boundary surfaces such as walls, floors, ceiling(treated or otherwise), absorption takes due to the following factors: (a) Penetration o sound into porous materials, causing resonance within air pockets in the pores until energy is dissipated (b)

Resonant vibration of panel materials (c) Molecular damping in soft absorbing materials and (d) Transmission through structures.

Absorbents

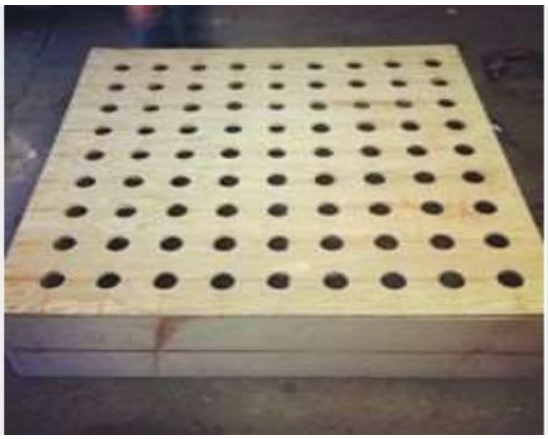
Special materials used on boundary surfaces to increase the absorption are known as absorbents. Absorbents can be broadly classified as follows:

1. Porous material: Basic acoustical characteristic of all porous materials is a cellular network of minute interlocking pores. These materials absorb sound mainly in the higher frequencies their efficiency depends upon porosity, the resistence to air low through the materials and the thickness. Fibreboards, mineral wools, insulation blankets, etc. are some of the example

Rock wool

Glass Wool

2. Resonant panels: These panels absorb the sound by damping the sympathetic vibrations in the panels, caused by sound pressure waves of appropriate frequency, by means of air space behind the panel. These panels absorb sound only at lower frequencies, over a comparatively narrow frequency band ranging from 50 to 200 cycles. The frequencies at which panels vibrate depend upon their weight and depth of air spaces behind them.
3. Cavity resonators: A cavity resonator is virtually a container with a small opening and it functions by the resonance of air in it. They can be designed to absorb sound of any frequency.



4. Composite absorbers: These are a comparatively recent development, combining the functions of all the above three absorbents. It consists of a

perforated panel fixed over an air space containing porous absorbent. The perforations in the panel should form at least 10 percent of the total area to allow the sound at higher frequencies.

Following are the sound absorbing materials commonly used:

i. Acoustic plaster(a plaster which includes granulated insulation material with cements).
ii. Compressed cane or wood fibre board, unperforated and perforated
iii. Wood particleboard.
iv. Compressed wood wool.
v. Mineral/glass wool quilts and mats
vi. Mineral/compressed glass wool tiles.
vii. Composite units of perforated hard board backed by perforated fibreboard.
viii. Composite units of perforated board (hard board, asbestos board, or metal sheet) backed by mineral or glass wool quilt or slab
ix. Special absorbers constructed of hard board, teak ply, etc., backed by air.
x. Wall Panelling
xi. Floor Tile •
xii. Ceiling Tile
xiii. Curtains
xiv. Carpet or Rug

Requirements of a good acoustic material

1. It should have high coefficient of absorption.
2. It should be efficient over a wide range of frequencies.
3. It should be relatively cheap and easily available
4. It should give pleasing appearance after fixing
5. It should be self supporting, and should afford easy fixing.
6 It should be fire resistant.
7. It should have sufficient structural strength
8. It should be heat insulating and non-hygroscopic.
9 It should be durable, and should not be liable to attack by insects, varmits, termites

Acoustics in auditorium

The auditorium, as a place for listening developed from the classical open-air theaters.

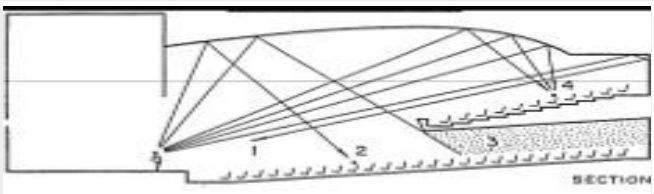
An auditorium includes any room intended for : -

Listening to music including theaters , churches , classrooms , meeting halls

The design of various types of auditoriums has become a complex problem, because in addition to its various, sometimes conflicting, aesthetics, functional, technical, artistic and economical requirements, an auditorium often has to

accommodate an unprecedentedly large audience. Hearing conditions in any auditorium are considerably affected by purely architectural considerations like: - Shape, Layout of boundary surfaces, Dimensions, Seating arrangements, Volume, Audience capacity

Defects: 1. Echo 2. Delayed Reflection 3. Sound Shadow

4. Sound Concentration 

Acoustics in conference halls

A conference hall, conference room, or meetingroom is a room provided for singular events such as business conferences and meetings. It is commonly found at large hotels and convention centers though many other establishments, including even hospitals, have one.

Acoustic Treatments

• We use acoustical absorbing materials on the walls.

• We add treatment on the ceiling above the conference room table.

• If there is a drop tile ceiling with an open plenum cavity, we have plenum rated ceiling barrier and return silencers to reduce noise from other rooms and mechanical equipment above. • Acoustical door seal kits (ADA approved) can be placed around your doors to seal out leakage, around the door.

List of Acoustical Defects

• Reverberation • Formations of echo • Dead Spot

• Exterior Noise

Acoustics in studios

A recording studio is an assemblage of equipment, spaces and persons such that a performance in sound may be created and recorded onto a medium for later reproduction. Reverberation is the collection of reflected sounds from the surfaces in an enclosure like an auditorium. The desired acoustic properties of a recording studio are in many ways the opposite of those of an auditorium. Instead of enhanced reverberation, it is usually desirable for the recording studio to be acoustically "dead", having a very short reverberation time.

IMPORTANCE

• Not only does this require the enclosure itself to be very absorbent of sound, but soundproofing becomes very important.

• In order to prevent the passage of low frequency sounds such as traffic noise, aircraft noise, etc., the recording enclosure is often isolated from the main structure with a double wall. • Since low frequency sounds are much more efficiently borne by solid structures than high frequencies, the suspended "room within a room" strategy minimizes the structural linking of the recording room to the foundation of the building.

• Careful sealing of the enclosure and careful design of the heating and air-conditioning system are necessary.

• Sometimes additional bass traps are employed to further reduce low- frequency background.

SHAPES OF STUDIOS

Many shapes in control rooms are varying depth and types of acoustic treatments. The boundaries are rectangular. Shape may be a real advantage for performance rooms .Studios just need to sound good. • A good studio has varying acoustical character throughout the room providing different ambience for recording flexibility. • Line-of-sight, shape in the studio often provides better eye contact. Control rooms are best when the view is stable at the mix position. Often rectangles and squares are divided on the diagonal for efficiency of space. The diagonal line is a longer dimension.

HEAT, VENTILATION AND AIR CONDITIONING(HVAC)

Behavior of heat propagation

- Conduction: Conduction is the direct transmission of heat through a material The amount of heat transfer by conduction depends upon temperature difference, thickness of solid medium, area of exposed surface, time for which heat flow takes place, conductivity of the medium and density of the medium.
- Convection: Heat is transmitted by convection in fluids and gases, as a result of circulation. Air movement causes the heat insulator, it is preferable to ensure that excessive air change is avoided.
- Radiation: Radiation occurs through a vacuum or and transparent medium (solid or fluid or gas).when the radiation strikes an object, some of the energy is absorbed and transformed into heat. One of the ways of reducing heat absorption from radiation is to introduce a suitable reflecting surface.

Thermal insulating material

1. Slab or block insulation
2. Blanket insulation
3. Loose fill insulation
4. Bat insulating materials
5. Insulating boards
6. Reflective sheet materials
7. Light weight materials

Heat propagation Coefficient of thermal conductivity

The heat transfer coefficient has SI units in watts per squared meter kelvin: $W/(m^2K)$.Often it can be estimated by dividing the thermal conductivity of the convection fluid by a length scale.

General methods of thermal insulation

Thermal insulation also be achieved by the following methods:
Heat insulation by orientation: The orientation of a building with respect to the sun has a very important bearing on a thermal behavior. Minimum transfer of solar heat is desired during the day in summer, while maximum heating rooms by solar heat is required during winter.
Heat insulation by shading: When the altitude angle of the sun is quite high during the period of peak heat gain in afternoons. Raising the parapet walls can help only when the altitude angle of the sun is low, but the cost may not be equal to the effect obtained.
Heat insulation by proper height of ceiling: While the surface temperature of the ceiling does not vary with it its height, the intensity of long wave radiation, emitted by

the ceiling decreases as it travels downwards. Hence it should be adequate to provide ceiling at a height of about 1 to 1.3 m above the occupant.

Thermal insulation of roofs

Thermal Insulation of exposed walls

Ventilation

Ventilation may be defined as supply of fresh air into an enclosed space or the removal of inside air from the enclosed space.

Ventilation is necessary for the following reasons:

1. Creation of air movement.
2. Prevention of undue accumulation of carbon dioxide.
3. Prevention of flammable concentration of gas vapour.
4. Prevention of accumulation of dust and bacteria carrying particles.
5. Prevention of odour caused by decomposition of building material.
6. Removal of smoke, odour and foul smell generated/liberated by the occupants.
7. Removal of body heat generated/liberated by the occupants.
8. Prevention of condensation or deposition of moisture on wall surfaces.
9. Prevention of suffocation conditions in conference rooms, committee halls, cinema hall, big rooms, etc.

System of ventilation

The system of ventilation are basically developed in two following categories
(a) Natural Ventilation(Aeration): In this system of ventilation the outside air is supplied into a building through windows, door, ventilations or other operating due to wind outside and convection effect arising form temperature of vapor pressure difference or both between the inside and the outside of the building. The rate of ventilation by natural means through doors, windows and other opening depends upon the following effect:
Wind effect or wind action Stack effect

(b) Mechanical ventilation or artificial ventilation: In this system of ventilation the outside air is supplied into a building either by positive ventilation or by infiltration by reduction of pressure inside due to exhaust of air or by a combination. The supply of outside air by means of mechanical device such as a Fan is termed as "Positive Ventilation" where the removal of air and its disposal outside by such a device is termed as "Exhaust of air"
The following method of mechanical or artificial ventilation are in common use:

i. Extraction system(exhaust system): This system is based in creation of vacuum in the room by exhausting the vitiated inside air by means of propeller type fans (exhaust fans). The extraction of air from the room permits the fresh air to flow from outside to inside either through Tobin tubes or even through a window. This system is more useful in removing smoke, dust, odours, etc., from kitchen, latrines, industrial plants etc.

ii. Plenum system (or supply system): In this system, fresh air is forced into the room and the vitiated air is allowed to leave through ventilators. The air inlet is selected on that side of the building where purest air is available. The incoming air which is mechanically forced into the room is passed through a fine gauge screen or filter. A constant stream of water is kept flowing down the screen giving a fine mist of water through which the air is drawn by means of blower fan. Thus, all the mechanical impurities are removed from the air. In summer, this also results in cooling of air. At this point air may be further disinfected by the introduction of ozone from an ozonizing apparatus. In winter, the air may be forces through a battery of hot water tubes and be heated before being forced into the room. In the case of big hall or factories etc. This ventilation system is costly, but is used for factories, conference halls, theatres, big offices, etc. The ventilation by plenum process may be either downward or upward

iii. Extraction-Plenum system: This is an extension of plenum system in which extraction fans are used for the exit of the vitiated air from the room. This system is adopted where the delivery of fresh air is either sluggish or where it is desired to discharge vitiated air containing obnoxious fumes as from kitchens, latrines, or various manufacturing processes, in specially isolated areas.

iv. Air conditioning: This is the best system of artificial ventilation in which provision is made for filtration, heating of cooling, humidifying or dehumidifying etc., thus creating most comfortable working conditions.

Principles of air conditioning

The basic principle of air conditioning is to remove heat from the air inside a room, thereby lowering the internal temperature to levels set on the thermostat. The air is passed over coils carrying refrigerated gasses that reduce temperature levels. ... Fresh **air** is not brought inside the room.

Different type of air conditioning system

i. Central system : All equipments pertaining to air conditioning are installed in a central place and then conditioned air is distributed to rooms by duct. In this system maintenance is easy, requires less space and economical.

ii. Unitary central system: In this system every room is provided with an air conditioning unit and room obtains supply from central system. Heating or cooling may take place in the room itself.

iii. Unitary system : In this system self contained room units are installed near ceiling or window. The conditioned air is formed inside the unit itself and directly thrown in room without the help of ducts.

FIRE FIGHTING SERVICES

CAUSES OF FIRE IN BUILDING

Most fires are caused by carelessness. Common instances of carelessness are:
(i) Careless discarding of lighted ends of cigarettes, cigars, matches and tobacco
(ii) Smoking in unauthorised places.
(iii) Indifferent maintenance of machinery including overloading and under or over lubrication of bearings.
(iv) General indifference to cleanliness.
(v) Incorrect storage of materials
(vi) Faulty workmanship and inattention to electrical installations
(vii) un-approved equipment and layout
(vii) inattention of persons concerned with inspection and patrol of the premises under their jurisdiction.
(ix) inattention of fire safety regulations, etc.
In case of an outbreak of fire, the danger is from fire, smoke and panic. The provision of suitable means of escape should be in relation to these dangers and the number of persons affected. The chances of damage due to panic can be reduced; the escapes should be located in such a way that they remain unobstructed by smoke or fumes. The means of escape from fire should be easily accessible, unobstructed and clearly defined.
Characteristics of fire resisting materials

1. The materials should not disintegrate under the effect of great heat.
2. The expansion of the materials due to heat should not be such that it leads to instability of the structure of which it forms a part.
3. The contraction of the material due to sudden cooling with water after it has been heated to a high temperature should not be repaid.

Building materials can be divided into two types:
(i) Non combustible materials: Combustible materials are those that readily ignite and burn. Many common construction materials are combustible, including wood and wood-plastic composite and plastic products.
(ii) Combustible materials: A **non-combustible material** is a substance that does not ignite, burn, support combustion, or release **flammable** vapors when subjected to fire or heat, in the form in which it is used and under conditions anticipated.

FIRE-RESISTING PROPERTIES OF COMMON BUILDING MATERIALS

1.Stone: It is a non-combustible building material and also a bad conductor of heat and does not contribute to the spread of fire However, it is a bad fire-resisting material since it is liable to disintegrate into small pieces when heated and suddenly cooled, giving rise to failure of structure.
2.Bricks: It is a poor conductor of heat. First class bricks moulded from a good clay can withstand exposure to fire for a considerable length of time, up to temperatures of about 1200 C. Brick masonry construction, with good mortar and better workmanship, is the most suitable for safeguarding the structure against fire hazards.

3.Concrete: The behaviour of concrete during exposure to heat varies with the nature of coarse aggregate and its density, and the quality of cement. It also depends upon the position of steel in concrete. Aggregates expand on heating while ordinary cement shrinks on heating. These two opposite actions may lead to spalling of the concrete surface. Aggregates obtained from rocks containing higher calcareous content, tend to crack more while the aggregates like foamed slag, cinder and bricks are better. The cracks formed in concrete generally extend to a depth of about 25 mm. Hence reinforced concrete fire-resistant construction should have greater cover.

4. Steel: It is non-combustible, it is very low fire resistance, it is a good conductor of heat. During fire, it gets heated very soon, its modulus of elasticity reduces and it loses its tensile strength rapidly. It is found that yield stress of mild steel at 600C is about ½ of its value at normal temperatures. Such construction is widely und in making fire-resisting doors and windows.

5. Glass: It is a poor conductor of heat, and its thermal expansion is also less. When it is heated snacks are formed then suddenly cooled, cracks are formed. These cracks can be minimised if glass is reinforced with steel wire netting. Thus, reinforced glass is more fire resistant, and can resist variations in temperature without serious cracks Reinforced glass has a higher melting point. Even if cracks are formed, the embedded wires hold the cracked portion. Reinforced glass is therefore commonly used for fire-resisting doors, windows, dome sky-lights etc.

6. Timber: It is a combustible material. It ignites and rapidly destroyed during fire,if the section is small. however ,if the timber is used in thick sections,it possesses the properties of self insulation and slow burning. If the temperatures are higher than 500 degreeC timber gets dehydrated under continued exposure. Painting these with oil paints or varnish should sot be done since these pants catch fire.

7. Cast-iron and wrought iron: Cast iron behaves very badly in the event of fire. On sudden cooling, it gets contracted and breaks down into pieces,giving rise to sudden failure. Hence it is rarely used in fire-resistant building unless suitably covered by bricks, concrete etc.

Wrought iron behaves practically in the same way as mild steel.

8. Asbestos cement: It is formed by combining fibrous asbestos with Portland cement. It has a low coefficient of expansion and has property of incombustibility. It has, therefore, great fire resistance. Asbestos cement products are largely used for construction of fire resistant partition walls roofs, etc. It is also used as a protective covering to other structural members

9. Aluminium: It is a very good conductor of heat. It has very poor fire-resistant properties. Its use should be restricted to only those structures which have very low fire risks

10. Plaster or mortar: It is non-combustible. Hence it should be used to protect walls and ceilings against fire risks. Cement plaster is better than lime plaster. The fire-resistance of plaster can be increased by using it in thick layers or reinforcing it with metal laths. Gypsum plaster, when used over structural steel members, make them better fire resistant.

FIRE ALARM SYSTEM

Fire alarms are installed to give an alarm and to call for assistance in the event of fire. The fire alarms gives enough time for the occupants to reach to a safe place. Fire alarms can be either manual or automatic.

1. Manual alarms: These are of a hand-bell type or similar other sounding device, which can emit distinctive sound when struck. These are sounded by watchmen and the occupants are thereby warned to safe exit in the shortest possible time. Manually operated alarms shall be provided main exits and in the natural path of escape from fire, at readily accessible points which are not likely to be obstructed.
2. Automatic alarms: These alarms start sounding automatically in the event of fire. It is used in large industrial buildings which may remain unoccupied during night. The automatic fire alarm sends to the nearest control point. The system can also perform the function of sending a message to the nearest fire brigade station.

PRECAUTIONS AND CONTROLLING DEVICES

1. Fire hydrants: It is a horizontal pipe running around the periphery of the building property at the ground floor level for external fire fighting system which is connected to the U.G. Tank. These are provided on ring main of 150mm dia.in the ground the building periphery.
2. SPRINKLER SYSTEMS:It is a network/ branching of pipes filled with water covering every square inch of the building premises except fire fighting staircases, electrical rooms, UPS rooms, sub stations and other areas where water would aid in the spread of fire. It terminates into a sprinkler which sprinkles water in the area affected by fire. This arrangement is adopted for important structures like textile mills, paper mills etc.the system consists of a net net pipes 20mm dia. Fixed to the ceiling of the room. these pipes are spaced at 3m centre to centre.the fire is thus brought under control in a short period.
3. Fire panels: Fire alarm panel is the controlling component of a fire alarm system. The panel receives information from devices designed to detect and report fires, monitors their operational integrity and provides for automatic control of equipment, and transmission of information necessary to prepare the facility for fire based on a predetermined sequence.

GENERAL FIRE SAFETY REQUIREMENTS FOR BUILDINGS

1. All buildings and particularly buildings having more than one storey shall be provided with liberally designed and safe fire-proof exits or escapes.
2. The exits shall be so placed that they are always immediately accessible and each is capable of taking all the persons on that floor as alternative escape routes may be rendered unusable and/or unsafe due to fire.
3. Escape routes shall be well-ventilated as persons using the escapes are likely to be overcome by smoke and/or fumes which may enter from the fire.
4. Fire-proof doors shall conform rigidly to the fire safety requirements.

5. Where fire-resisting doors are employed as cut offs or fire breaks, they shall be maintained in good working order so that they may be readily opened to allow quick escape of persons trapped in that section of the building, and also, when necessary, prompt rescue work can be expeditiously carried out.
6. Electrical and/or mechanical lifts, while reliable under normal conditions may pot always be relied on for escape purposes in the event of a fire, as the electrical supply to the building itself may be cut-off or otherwise interrupted, or those relying on mechanical drive may not have the driving powder available.
7. Lift shafts and stairways invariably serve as flues or tunnels thus increasing the fire by increased drought and their design shall be such as to reduce or avoid this possibility and consequent spread of fire.
8. False ceiling, either for sound effects or air-conditioning or other similar purpose shall be so constructed as to prevent either total or early collapse in the event of the fire so that persons underneath are not fatally trapped before they have the time to reach the exits, this hall apply to cinemas, and other public or private buildings where many people congregate.
9. Floors: They are required to withstand the effects of fire for the full period stated or the particular grading. The design and construction of floors shall be of such a standard hat shall obviate any replacement, partial or otherwise, because experience shows that certain types of construction stand up satisfactorily against collapse and suffer when may first be considered as negligible damage, but in practice later involves complete stripping down and either total or major replacement. This consideration shall also be applied to other elements of structure where necessary.
10. Roofs: Roof for the various fire-grades of the buildings shall be designed and constructed to withstand the effects of fire for the maximum period for the particular grading,and this requires concrete or equivalent construction.
11. Basements. Where basements are necessary for a building and where such basements are used for storage, provision shall be made for the escape of any heat arising due to fire and for liberating and smoke which may be caused. It is essential that fire resistance of the basement shall conform the highest order and all columns for supporting the upper structures.
12. Smoke extraction from basements

    (a) Unobstructed smoke extracts having direct communication with the open air shall be provided in or adjoining the external walls and in positions easily accessible for firemen in an emergency.

    (b) The area of smoke extracts shall be distributed, as far as possible, around the perimeter to encourage flow of smoke and gases where it is impracticable to provide a few large extracts.

(c) Covers to the smoke extracts shall, where practicable, be provided in the stall board and/or pavement lights at pavement level, and be constructed of light cast iron frame or other construction which may be readily broken by fire-men in emergency. The covers shall be suitably marked.

(d) Where they pass through fire resisting separations, smoke extracts shall in all cases be completely separated from other compartments in the building by enclosures of the appropriate grade of fire resistance. In other cases, steel metal ducts may be provided.

(e) Where these are sub-basements, the position of the smoke extracts from sub- basements and basements shall be suitably indicated and distinguished on the external faces of the building.

LIFT [Elevators]

Lift is a moving platform which moves up and down .This moving platform is called as car. The moving platform moves in a duct which is known as left well.

Classification of lifts:

1. The lift car moving on guide rail.
2. Buffer for the car in the lift pit floor.
3. Machine room with winding machine, electric motor and other memory mechanisms.
4. Suspension ropes [steel wire ropes with factor of safety 12 to 20].
5. Specially operating landing for entry and exit.
6. The passenger capacity of a lift is usually rated assuming the weight of person as 68 kg.

   ### TYPES OF LIFTS:

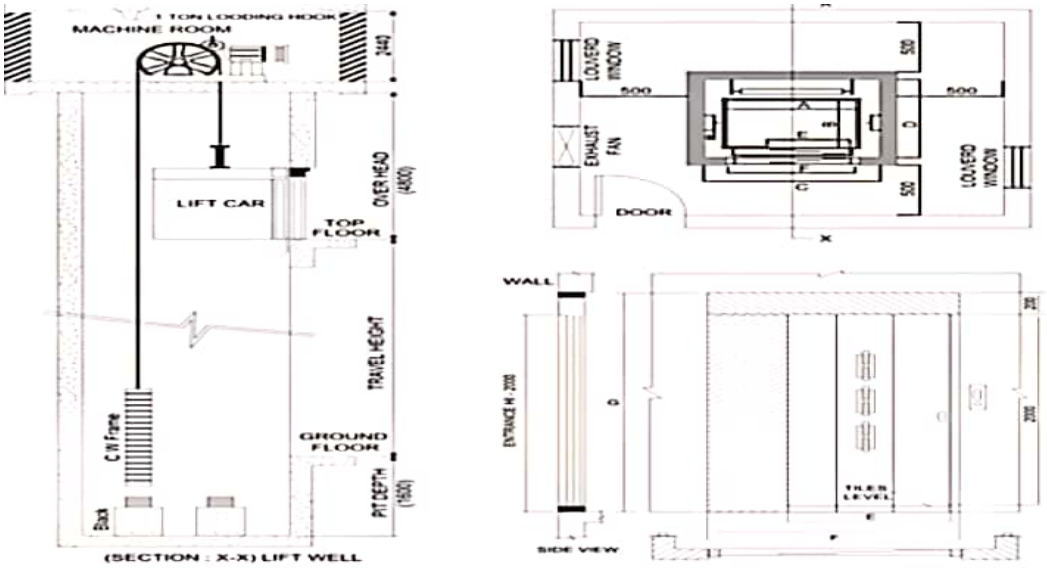
   Lifts are usually classified as follow:

   1. Passenger lifts
   2. Goods lifts
   3. Hospital lifts
   4. Service lifts
   5. Fireman `s lifts.

      #### 1. Passengers lift:

      A **passenger lift** has a completely enclosed **lift** car that travels vertically within a specially prepared **lift** shaft. **Passengers** are transported between floors at reasonably quick speeds and the control systems are often designed to give the most economical

distribution of **passengers** throughout the building.



2. Goods lifts: This kind of lifts enables goods to be transported from one floor to another. These goods lifts are highly customizable, enabling the client to fit the product exactly to his needs and requirements.

3. Hospital lifts: This is an assistive device that allows patients in **hospitals** and nursing homes and people receiving home health care to be transferred between a bed and a chair or other similar resting places, by the use of electrical or hydraulic power.

4. Services lifts: This type of lift is used by servants and trades people and for carrying goods, baggage, etc . From one floor to another floor in a building .

5. Fireman`s lifts: This technique is allowing one person to carry another person without assistance, by placing the carried person across the shoulders of the carrier.[1]

The technique was commonly used by firefighters to carry injured or unconscious people away from danger.

Sizes of lifts:

According to persons:

a. 6 persons = 450 kg [1 person = 75kg]
b. 8 persons = 630kg
c. 10 persons = 800kg
d. 13 persons =1000kg
e. 17 persons = 1275 kg
f. 33 persons = 2500kg

Standard size is 40" to 48"

44" to 54"

44" to 60"

INSTALLATION OF LIFTS :

The elevator installation team usually has 3 or 4 members. Technical works participating in the installation must have taken the training of safe practice for special operations,

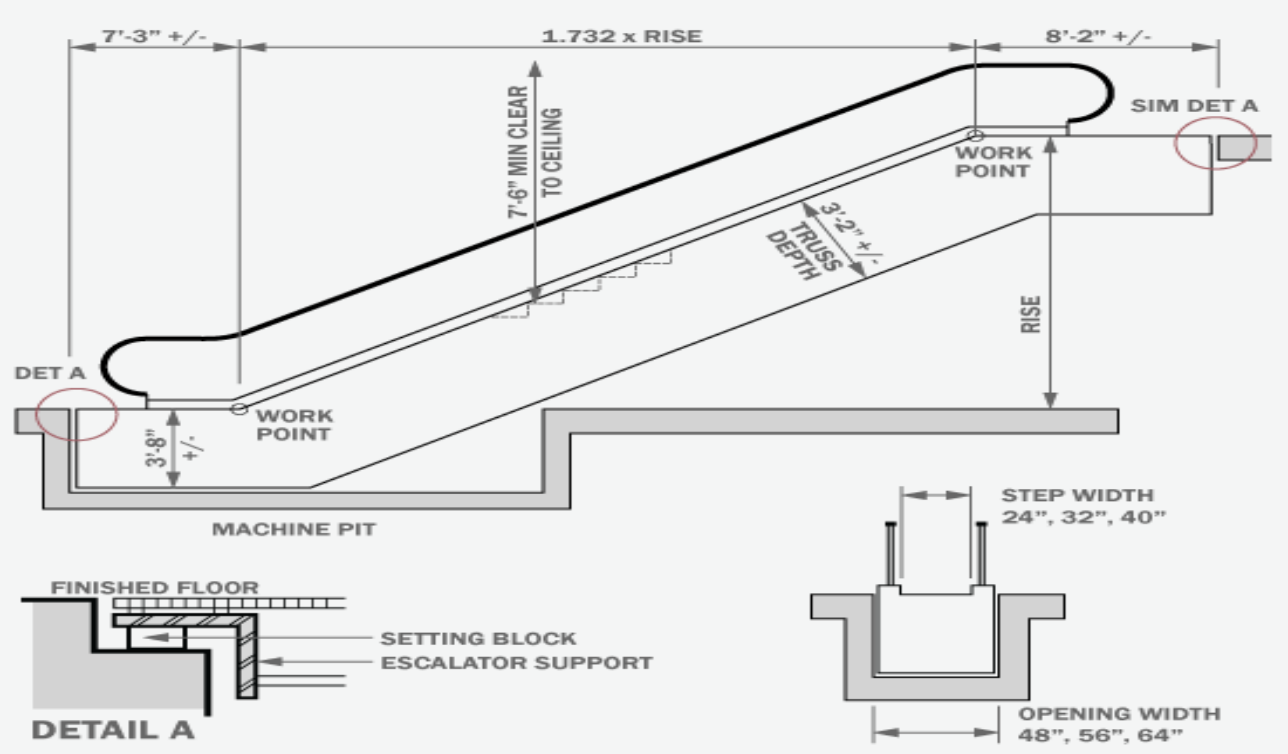
The team must include one installation mechanic and one electrician who are familiar with elevator products and responsible for installation and adjustment of the elevator.

1. Use the construction layout drawing of the elevator to check the plane layout of the machine room, the clearance dimensions (width, depth, and height) of the machine room, the positions and sizes of preformed holes in the floor, and the height and position of lifting hooks.
2. The power supply for the machine room must be controlled through a an emergency. The fuse shall be a former one and shall not be replaced with a copper wire.
3. The power supply for the electric welding machine shall be controlled through an independent switch.
4. Before the landing doors are installed, be sure to set up protective doors or guard rails at the landing door openings and entrances to the hoistway. The height of any protective door (or guard rail) shall be not less than 1m. The bottom of the guard rail shall be fixed with about 150mm skirt boards. And easily visible warning signs shall be hung lest personnel enter the hoistway by accident or extraneous objects fall into the hoistway and cause injurie.

ESCALATOR

An **escalator** is a moving staircase which carries people between floors of a building. Principal areas of usage include department stores, shopping malls, airports, transit systems (railway/railroad stations), convention centers, hotels, arenas, stadiums and public buildings.

Speed = 38 m per min



Capacity = 3200 to 6400 person in per hour

Types of escalator

1. Moving walkways[horizontal]
2. Paired continuous escalator
3. Paired discontinuous escalator
4. Single continuous escalator
5. Single crossing escalator
6. Single discontinuous escalator

Safety norms to a escalator :

- Check the direction of the escalator before you board.
- Always pick up your feet and step carefully on or off the escalator.
- Stand in the center part of the step. Never drag or slide your feet

along the edge.

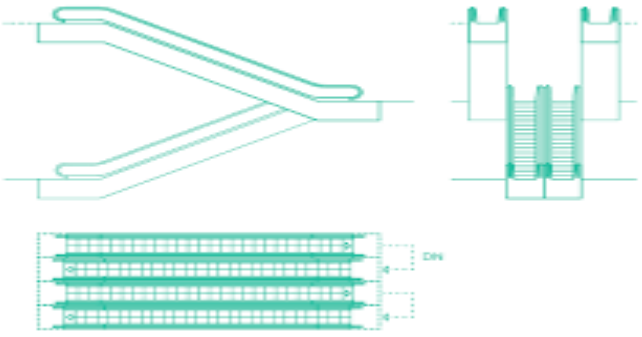
- Always face forward and hold the handrail.
- Do not sit on the handrail.
- Do not lean against or reach over the sides of the escalator.
- Exit promptly from the escalator.
- Never stop, stand or play at an escalator landing; this can cause a dangerous pileup.

Do not board an escalator with a baby stroller, walker or packages.

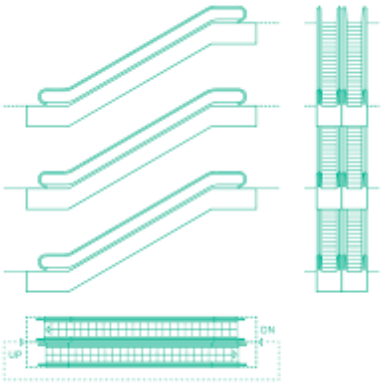
Types of escalator

1. Moving walkways[horizontal.
2. Paired continuous escalator
3. Paired discontinuous escalator
4. Single continuous escalator
5. Single crossing escalator
6. Single discontinuous escalator .

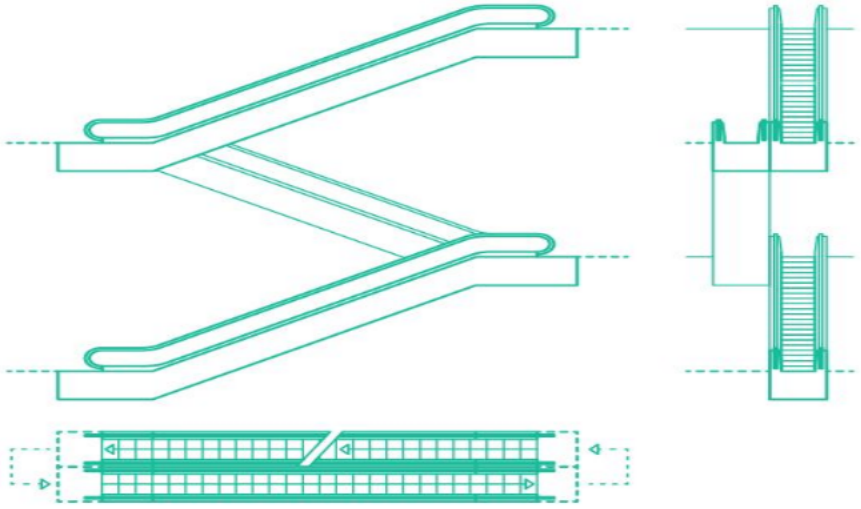
.paired continuous escalator :



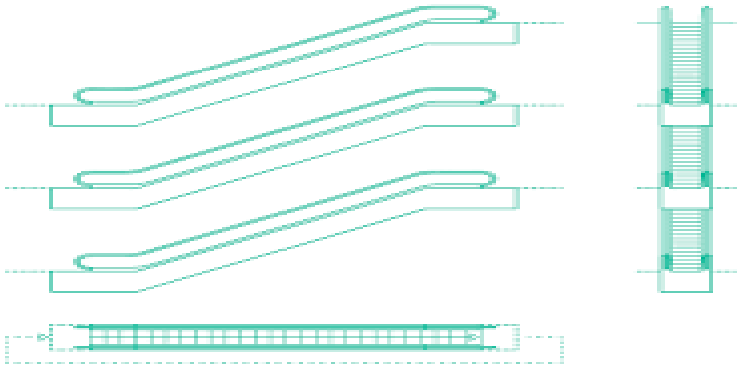
. paired discontinuous escalator :



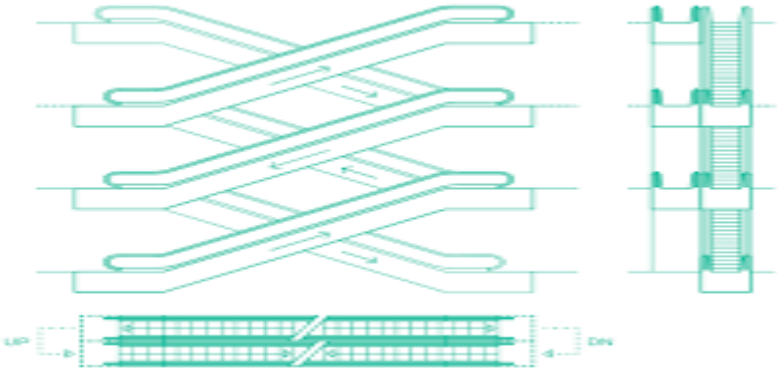
.Single continuous escalator :



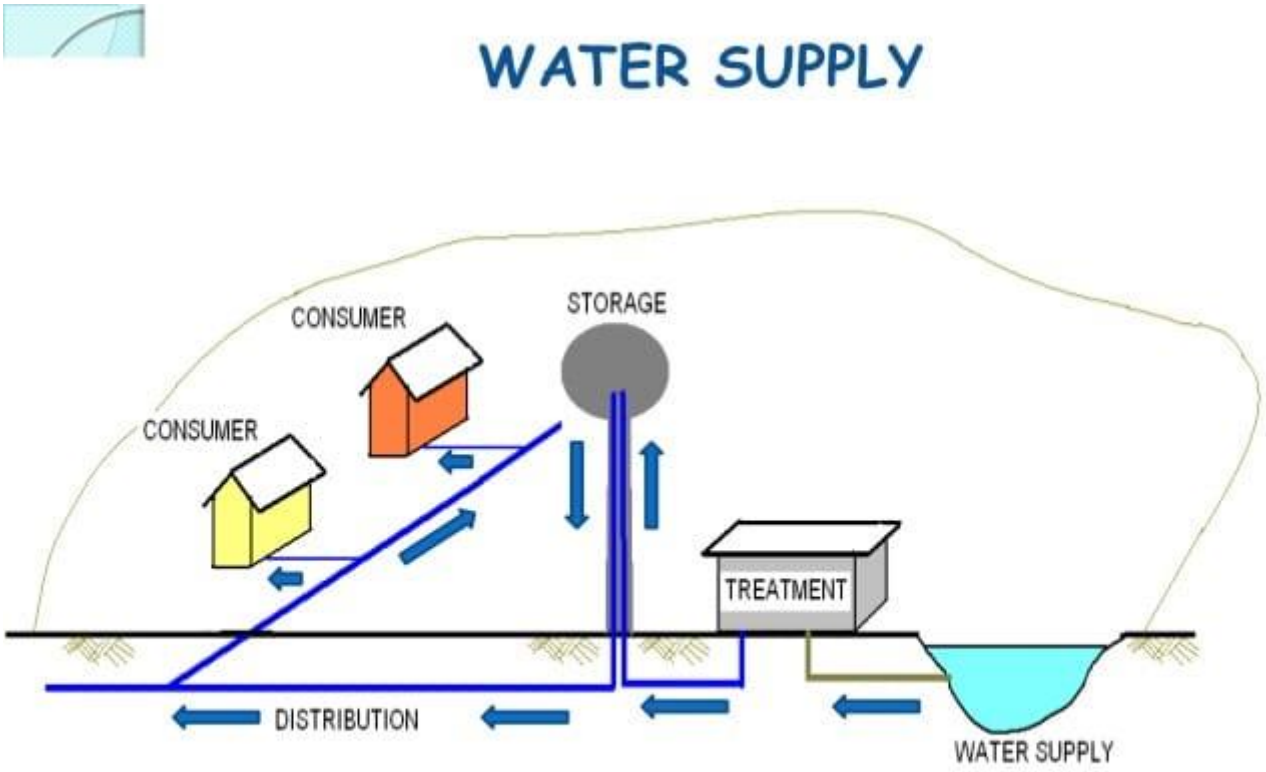
.single discontinuous escalator:



.single crossing escalator :



1. **Water Supply:** Is the provision of water by public utilities, commercial organizations, community endeavors or by individuals, usually via a system of pumps and pipes.



1.1

(A) Water as a natural resource: The water sources on the surface of the earth get their supplies from precipitation which may falls on the earth's surface in various forms such as rain, snow ,hail ,dew ,etc.The major part of all the supplies being rain.

Water resources are natural resources of water that are potentially useful. Uses of water include agricultural, industrial, household, recreational and environmental activities. All living things require water to grow and reproduce. 97% of the water on the Earth is salt water and only three percent is fresh water.

(B) Public health significance of water quality: Water has a profound influence on human health. At a very basic level, a minimum amount of water is required for consumption on a daily basis for survival and therefore access to some form of water is essential for life. However, water has much broader influences on health and well-being and issues such as the quantity and

quality of the water supplied are important in determining the health of individuals and whole communities.

The quality of water does, however, have a great influence on public health; in particular the microbiological quality of water is important in preventing ill-health. Poor microbiological quality is likely to lead to outbreaks of infectious water-related diseases and may causes serious epidemics to occur.

Microbiological drinking-water quality and human health: The microbiological quality of drinking-water has been implicated in the spread of important infectious and parasitic diseases such as cholera, typhoid.

(C) Demand of water for domestic use: It includes that water required for drinking ,cooking, bathing, washing ,sanitary purposes and other household purposes .In India , it is recommended as 135 liters per capita per day as per IS 1172-1971.

(D)Industrial and commercial purposes: It includes that water required for factories, hotels, offices, stores, mills, etc. In this case, the percentage of water required varies from 20 to25 liters of the total water requirements.

(E)Public use: In this case water is needed for hostels, schools, colleges, cinemas , restaurants , cities , halls , etc. The percentage of water requirements for public use amounts to about 10% of total water requirements.

(E) Per capita demand: Generally, it means the average amount of water each person in a particular area uses on a daily basis, expressed as “gallons per capita per day.” Water is used for various purposes in a community .If P is population , and Q is total quantity of water used in a year , then per capita demand is expressed as ,

Per Capita Demand (q) = Q/PX365 (Gallons or Liters per day)

q = per capita demand

Q = total water used in a year in liters

P = population

It indicates the average value but does not indicate the actual value.

(F) Leakage and wastage of water: Leaks can waste water, damage your home, and encourage unwanted organic growth. Unfortunately, because you cannot see most of the pipe work in your home, you may not always know that **a leak has formed. One of the best ways to protect your home from** future

leaks is to understand and look for common situations that cause leaks to develop.

Preventive measures of leakage and wastage of water:

1. **Joint leakages**
2. **Pressure in the supply system**
3. **Method of supplying water**
4. **Method of changing water supplies**
5. **Illegal connections**

1.) **Joint leakages**: The best time to fix a plumbing leak is before it happens, by properly connecting water supply and waste line fittings

2.) **Pressure in the supply system:** Pressure management is one of the most influential and cost-effective activities of reducing leakage. It can be defined as the practice of managing water distribution system pressures to the optimum levels of service ensuring sufficient and efficient supply to consumers.

3.) **Method of supplying water: ?**

4.) **Method of changing water supplies:** When the water supplies are changed losses are reduced, because people use water economically.

5.) **Illegal connections:** Illegal connections must be detected & the defaulter must be punished in order to reduced such losses .

1.2) <u>System of water supply:</u>

A) <u>Continuous system:</u> When water is supllied to the consumers for all the 24 hours , the system is known as continuous system.This system is possible where adequate quantity of water is available for supply.This is the best system and should be adopted where practicable.This produces a sense of confidence among consumers.

Water is available for fire fighting . Due to continuous circulation water always remain fresh . There is less wastage if all building connections are metered & actual quantity of water consumed is charged for .

***Advantages :**

-In this system water is not stagnant in pipe at any instant and hence fresh water is always available .

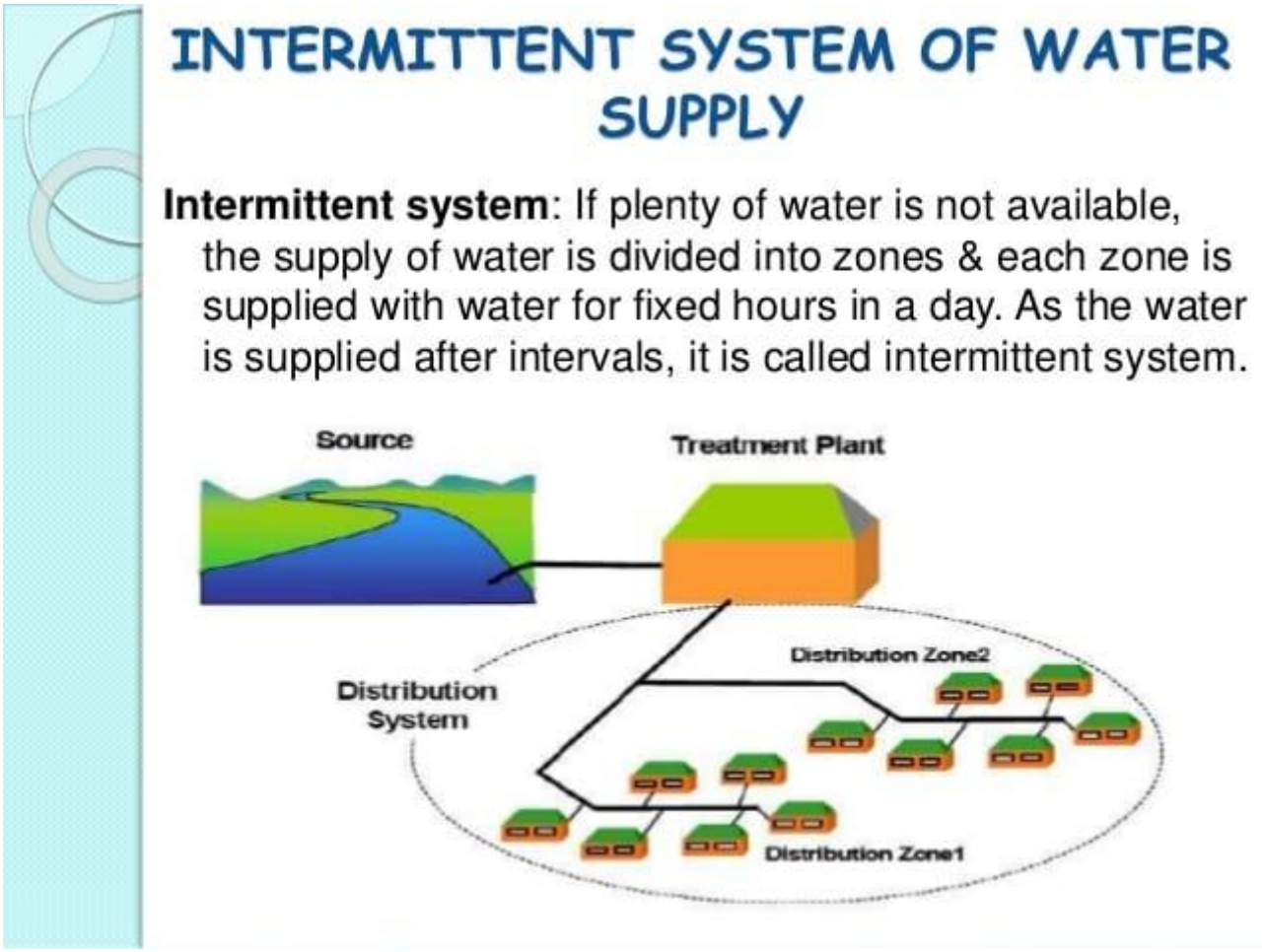
-Lesser pipe sizes are required .

-Fire hazards can be met within time .

*__Disadvantages:__

-If there are some minor leakages etc. in the system , great volume of water is wasted because of long duration of flow .

-More water is required at the source which is difficult in tropical countries like India , which get rains only during a particular season .
-More wastage of water due to lack of civic sense .
B) Intermittent system : If plenty of water is not available the supply of water is divided into zones and each zone is supplied with water for the fixed hours in a day maintaining good working pressure . As the supply is not continuous , it is called intermittent system . Repair to pipes can be carried out during non supply hours .



***Advantages :**
-Reduced pressure also helps lowering leakage .
-Time is available for repair and maintenance out of supply hours .
-For older distribution systems having weaker joints and more leakage , restrained supply hours can limit leakage .

***Disadvantages:**
-Consumers need to store water between supplies and tend to throw away remnant store. This causes water wastage and storage costs.
-Frequent wear and tear on valves, water meters malfunction.
-More manpower and infrastructures needs.

1.6 Concept of Rain Water Harvesting:

Rain water harvesting is a technique of collection and storage of rain water in to natural reservoirs or tanks.

One method of rain water harvesting is rooftop rain water harvesting, which water is quite clean and free from impurities like cow-dung, leaves, pebbles, etc. can be used for the household purposes for the years. This is a high quality of drinking water and year round storage can be done.

*__Uses:__

-Drinking and cooking.

-Bathing and laundry.

-Flushing toilets.

-Watering lawns, gardens and house plants.

-Water for wild life, pets or livestock.

-Compositing.

-Outdoor ponds and water features.

-Rinsing vegetables.

*__Advantages:__

-Rain water harvesting will improve water supply and food production,

-Rain water is free from chemicals and bacterias, hence no need of treatment.

-It is the only state source where canals or river water is not available like in some areas of Rajasthan.

-People use water economically.

-No heavy plumbing work is required.

*__Disadvantages:__

-Sufficient arrangement is required for storing water.

-Rain is not assured.

-Storage are cleaned only when they are empty.

-Sometimes this water may cause breeding mosquitoes.