PRINCIPLES OF SOUND PROOFING/ INSULATION

MASSP501 Apply principles of sound proofing/ insulation

Competence

REQF Level: 5

Credits: 8

Learning hours

80

Sector: Construction

Sub-sector: Masonry

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Purpose statement

Elements of competence	Performance criteria
1. Identify sound insulation	1.1. Proper identification of sounds. 1.2. Right purpose of sound insulation 1.3. Proper identification of sound insulation types
2. Prepare tools , materials and equipment	2.1. Appropriate selection of sound proofing materials. 2.2. Appropriate selection of sound proofing tools. 2.3. Appropriate selection of sound proofing equipment.
3. Apply sound insulators	3.1. Proper application of insulation techniques. 3.2. Adequate testing of sound insulation. 3.3. Relevant maintenance of sound insulators.

LEARNING UNIT 1. IDENTIFY SOUND INSULATION

Learning Outcome: 1.1: Identify sounds.

Definition of key terms terminology of sound)

i) a) Sound: Anything that can be heard is a sound whether it is made by conversation, machinery or walking on hard surface. All sound are produced by a vibrating that moves rapidly to and from, causing movement of the thing particles of air surrounding the vibrating surfaces.

b) Sound: vibrations that travel through the air or another medium and can be heard when they reach a person's or animal's ear.

ii) Noise: a sound, especially one that is loud or unpleasant or that causes disturbance.

iii) Sound insulation/insulator: are material or combination of materials that make (a room or building) resistant to the passage of sound

iv) Insulator: a) a substance which does not readily allow the passage of heat or sound

b) a substance or device which does not readily conduct electricity.

Types of sound.

1. Impact sound (noise): Are sound caused by direct contact with the structure. Common occurrences such as people running, dropping objects (utensils), and even walking (footsteps) cause impact sound

2. Airborne sound: Airborne sound (or airborne noise) is sound that is transmitted through the air. Typical examples of airborne sound include talking, sounds from radio and television, sounds from pets like a dog barking and the sound of cars starting, or travelling down a road.

Rating intensity of sound

Sound intensity level also known as acoustic intensity is defined as the power carried by sound waves per unit area in a direction perpendicular to that area. The rate at which sound energy passes through a unit area held perpendicular to the direction of propagation of sound waves is called intensity of sound.

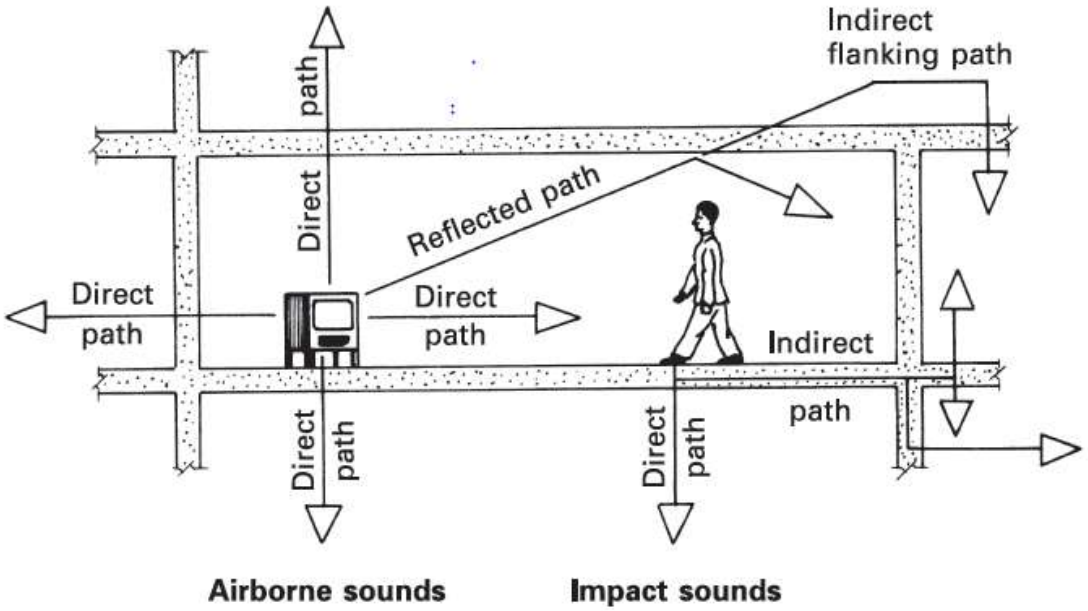
Identify sound transmission:

Sound transmission in building design refers to a number of processes by which sound can be transferred from one part of a building to another. Typically these are:

- Airborne transmission is those which are generated in air and which are transmitted in air directly to human ear. Such sound travels from one part of the building to the other, from the outside of the building to the inside.

- Impact transmission are those which originate and progress on the Building structure. These are caused by structural vibration originated due to impact. The Common sources of this sound are: movement of furniture, dropping of utensils on floor, etc. Noise is transmitted through air, by vibrations of structural members or through structural members.

- Flanking transmission: Flanking sound (or flanking noise) is sound that transmits between spaces indirectly, going over or around, rather than directly through the main separating element. This can allow sound to transmit between spaces even though the main separating element itself provides good acoustic insulation



Different between sound and noise

Sound is something that you can hear or that can be heard. Ex: speech, music. Whereas

Noise is sound, especially when it is unwanted, unpleasant or loud. Ex: footsteps, crying of babies

Identify noise effects to human.

- Damage to hearing.
- It creates discomfort
- It has adverse effect on blood pressure, muscular strain and sleep
- It leads to fatigue, and decrease the efficiency of persons
- It takes away essence of music and speech
- It disturbs concentration
- Reduction in noise increases output of labor
- It lead to fatigue
- It cause heart disease

Characteristics of sound

A sound can be characterized by the following three quantities:

There are three characteristics of sound:
a) Intensity and Loudness of sound
Intensity of sound is defined as the amount or flow of wave energy crossing per unit time

Through a unit area taken perpendicular to the direction of propagation

b) Frequency and pitch of sound
Frequency or pitch is defined as the number of cycles which a sounding body makes in each unit of time. It is a measure of quantity of sound.

c) Quality or timbre
The quality of sound is that a characteristic which enables us to distinguish between two notes of The same pitch and loudness played on two different instruments or produced by two different Voices.

BEHAVIOUR OF SOUND IN AN ENCLOSURE

An enclosed space is a room or area bounded on every of its sides. The materials for enclosure may be classified into two:

- Some of the sound is reflected back in the room.
- Some of the sound energy is absorbed by the surfaces and listeners.
- Some of the sound waves set on the walls, floors and ceiling vibrating and are thus transmitted outside the room.

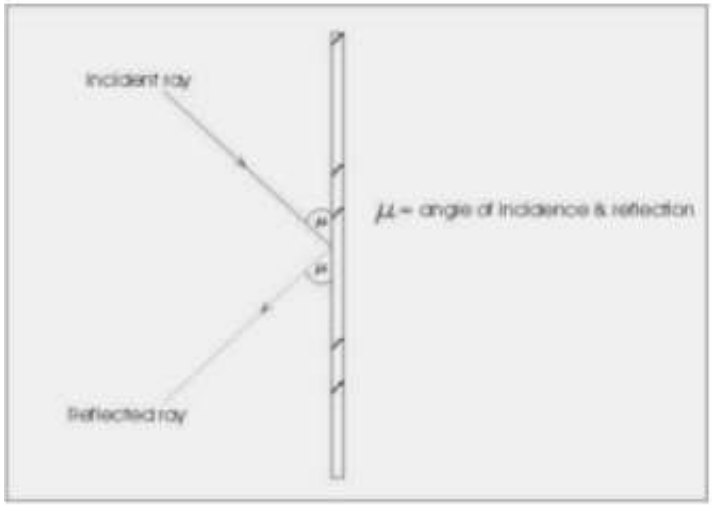
Materials can absorb sound, reducing the effect of indirect sound.

On encountering barriers posed by the enclosure, sound waves are likely to behave in the following ways:

- Reflection
- Absorption
- Refraction
- Diffusion
- Diffraction
- Transmission

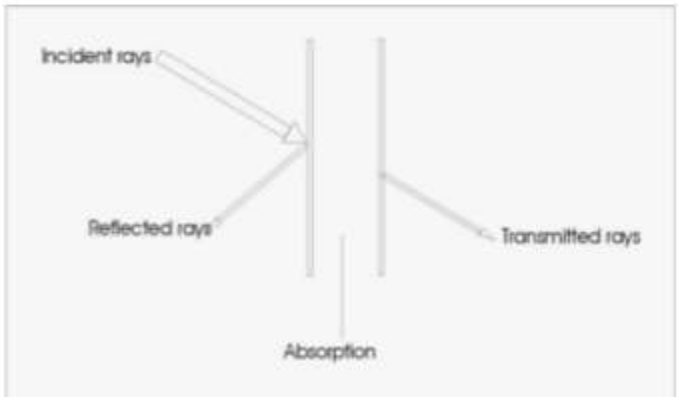
i. Reflection

This occurs when the wavelength of a sound wave is smaller than the surface of an obstacle. In the case of an enclosed space, the sound waves hit every side of the enclosure continuously until the sound energy reduces to zero. The amount of waves reflected depends on the smoothness, size, and softness of the materials of enclosure. The angle of incidence of sound rays is equal to that of the reflected rays only if the surface of the reflector is flat. But when it is curved, the angles are different.



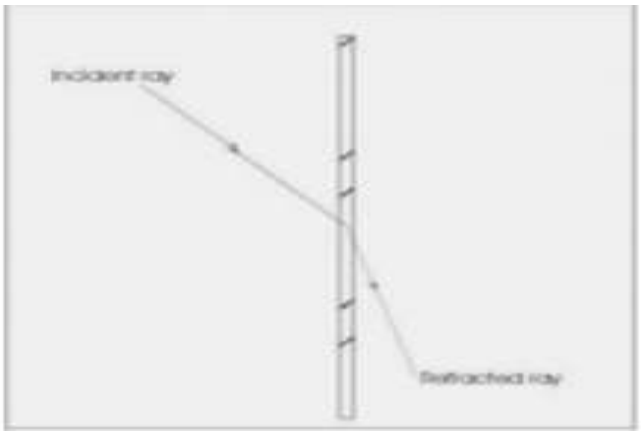
ii. Absorption

When sound waves hit the surface of an obstacle, some of its energy is reflected while some are lost through its transfer to the molecules of the barrier. The lost sound energy is said to have been absorbed by the barrier. The thickness and nature of the material as regards its softness and hardness influences the amount of sound energy absorbed.



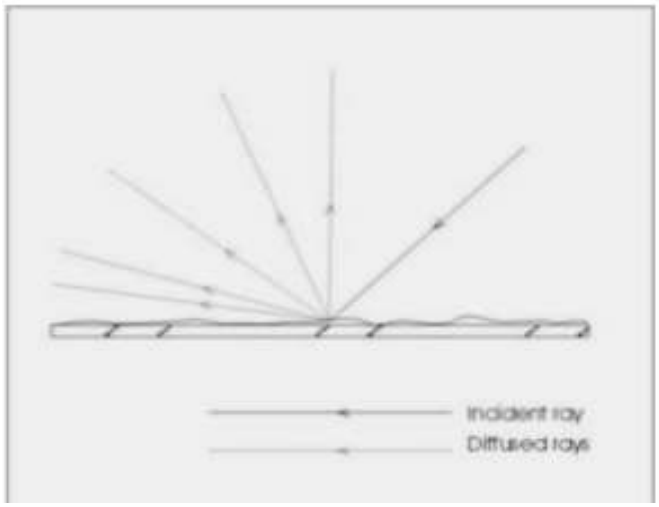
iii. Refraction

This is the bending of sound when it travels from one medium into another medium. The difference in the composition of the two different media bends the sound i.e. the angle of incidence changes into an angle of refraction as it travels into the new medium.



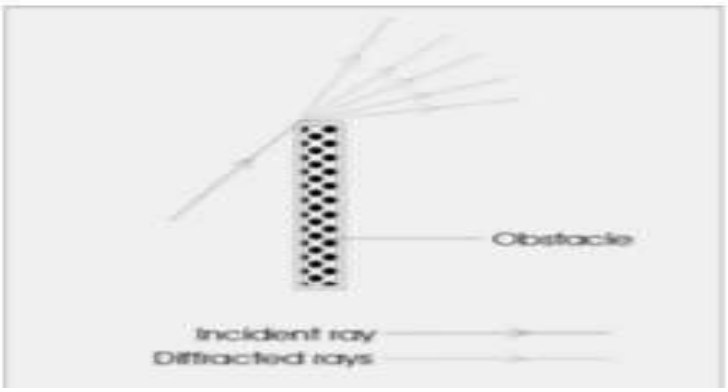
iv. Diffusion

This is the scattering of waves from a surface. It occurs as a result of the texture and hardness of the obstacle is comparable to the wavelength of the sound. The direction of the incident ray changes when it strikes the surface of the obstacle. Satisfaction is achieved when sound is heard in all direction at equal level.



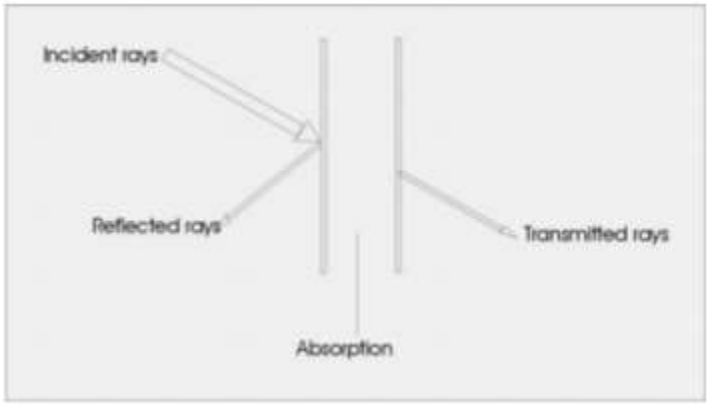
v. Diffraction

When the wave length of a sound wave is smaller or equal to the size of the obstacle, the sound rays tend to bend round the edge of the obstacle thereby turning the edge to a sound source.



vi. Transmission

In this phenomenon, sound wave is carried by molecules of the obstacle through vibration and reemitted at the other side irrespective of the medium. It can be structure borne, air borne or impact sound.



Learning Outcome: 1.2: Identify purpose of sound insulation

Methods of Sound Reduction effect.

Increase the mass and stiffness of the wall. In general, the denser the wall material, the more it will reduce noise. Thus, concrete walls are better insulators than wood walls of equal thickness. Increasing the thickness of a wall is another way to increase mass and improve sound insulation.

Sound insulation is the process of soundproofing an enclosed space, such as a room. This type of insulating activity is usually employed when there is a need to keep sound from filtering into or out of the space.
The actual process of sound insulation involves inserting some type of insulating material into the walls, as well as above the ceiling and below the floor. In some cases, this involves the use of rolls of fiberglass insulation or introducing foam insulation into the open spaces.

Methods of Sound Reduction effect

- Cover floors with rugs
  Area rugs can be used to protect high-traffic areas of your home. If you have wood flooring in areas like hallways, entries, and living rooms, you should consider adding an area rug. They reduce the wear and tear while still letting you show off your stylish floors.

- Cover thin windows with heavy drapes
  Heavy draperies (drapes) are used in the windows even the doors in order to reduce the intensity of sound to make the users of the room comfortable.

- Move devices away into sound proof area.

Any devices should be removed near the area of sound proofing materials installed. This is to increase their resistance to those materials.

Requirements a good acoustic material

- It should have high coefficient of absorption
- It should be efficient over a wide range of frequencies
- It should be relatively cheap and easily available
- It should give pleasing appearance after fixing
- It should be self-supporting and should afford easy fixing.
- It should be fire resistant

ACOUSTICAL DEFECTS

a) Reverberation

Reverberation is the persistence of sound in an enclosed space as a result of continuous reflection or scattering of sound after the source has stopped. Reverberant sound is the reflected sound, as a result of improper absorption; reverberation may results in confusion with the sound created next. However some reverberation is essential for improving quality sound.

The time during which the sound persists is called the reverberation time of sound in the hall.

As per Prof. W .C. Sabin's reverberation time "t" is given by formula:

$t = 0.16V / A$ where

V= Volume of room in cubic meters

A= Total absorbing power of all the surfaces of room/ hall.

Reverberation time should remain within limits as per Indian Standard Code: 2526-1963.

Sno.	Recommended time in seconds	Acoustics
1	0.50 to 1.50	Excellent
2	1.5 to 2.0	Good
3	2.0 to 3.0	Fairly good
4	3.0 to 5.0	Bad
5	Above 5.0	Very bad

b) Formation of echoes.

Not all sound that hits matter is absorbed. Some of it is reflected. That means sound bounces off the solid matter the way a tennis ball bounces off a wall. Sound reflected back to its source is an echo. The sensation of sound persists for $1/10^{th}$ of a second after the source has ceased. Thus an echo must reach after $1/10^{th}$ second of the direct sound. This occurs when the reverberation time is long enough to cause a distinct repetition of the direct sound. This condition is an advanced form of reverberation where the sound is heard clearly and repeatedly after some time until it fades. Multiple echoes may be heard when a sound is reflected from a number of reflecting surfaces placed suitably. This defect can be removed by selecting proper shape of the hall and by providing rough and porous interior surfaces to disperse the energy of echoes.

c) Sound foci

Sometimes shape of the hall makes sound waves to concentrate in some particular areas of hall Creating a sound of large quality. These spots are called sound foci.

This defect can be removed by

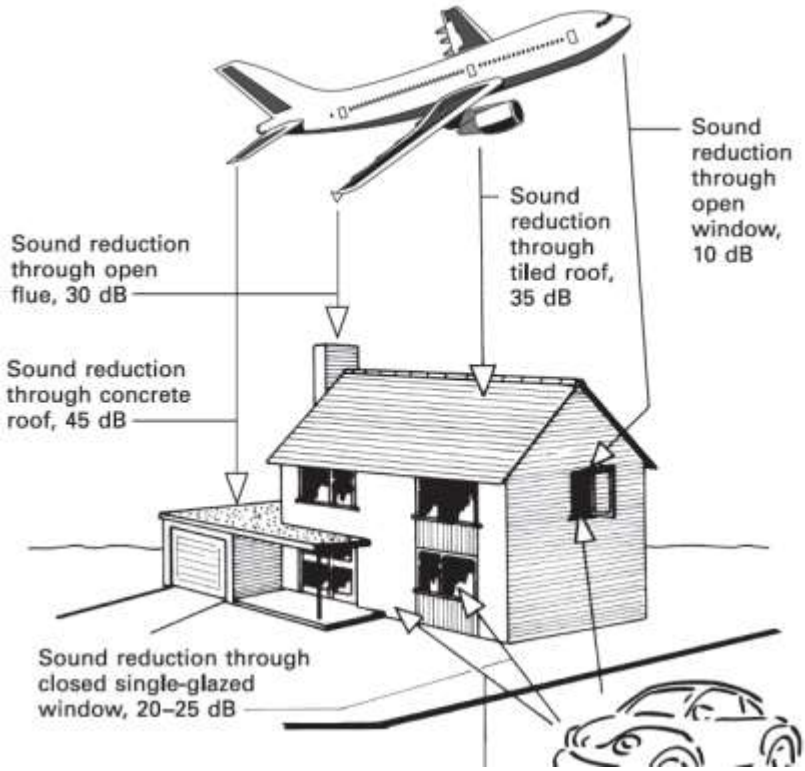
- ✓ Geometrical design shapes of the interior faces.
- ✓ Providing highly absorbent materials on critical areas (curved spaces).

d) Dead spots

This defect is the outcome of formation of sound foci. Because of high concentration of reflected Sound at sound foci, there is deficiency of related sound at some other points. These spots are known as dead spots where sound intensity is so low that it is insufficient for hearing. This defect can be removed by suitably placing diffusers and reflectors. Right proportions of internal spaces.

e) External noise

External noises from vehicles, traffic engines, factories, machines etc. may enter the hall either Through the openings or even through walls and other structural elements having improper sound insulation. This defect can be removed by proper planning of the hall with respect to its surroundings and by proper sound insulation of external walls.


Sound reduction through open flue, 30 dB
Sound reduction through concrete roof, 45 dB
Sound reduction through tiled roof, 35 dB
Sound reduction through open window, 10 dB
Sound reduction through closed single-glazed window, 20–25 dB

Exercise on reverberation time

Auditorium rectangular is shape has the following dimension
-length=35m
-breadth=25m
-height=9m
Internal area of different surfaces is as follows
-cement plaster =800m^2
-concrete floor=700m^2
-timber floor=200m^2
The capacity of auditorium is 1050 seats determine the following:

a) Number of absorbing units and time of reverberation
   - No audiences
   - One third audiences
   - Two third audiences
   - Full audiences
b) Number of extra absorbing units required so as to get an optimum reverberation time of 1.2 second when the strength of audience in two third of its capacity

c) Coefficient of absorbing materials if the area available for fixing absorbing materials is 1200m^2

Solution

Existing absorbing materials if area available

The existing absorption units exclusive of audience is computed in the following tab

Surfaces	Area (m^2or number)	absorption coefficient	absorbing unit
Cement plaster	800	0.02	16
Concrete floor	700	0.03	21
Timber floor	200	0.09	18
Ceiling	600	0.05	30
Seat	1050	0.16	168
Total			253m^2-sabine

Thus is exclusive of the audience the absorption the absorption power per person is 0.46 obtained by deducting the absorption power of seat from of the person

Hence net absorption power per person is obtained by deducting the absorption power of seat from that of the person

Net absorption power per person is 0.46-0.16= 0.3

The final absorption power inclusive that due to the audience at various audience factor is tabulated below:

Audience	absorption unit s of audience	absorption units of materials surface	totals absorption unit in
a) Null	0	253	253
b) $\frac{1}{3}$*1050	105	253	358
c) $\frac{2}{3}$*1050	210	253	463
d) 1050	315	253	568

Total volume of auditorium= 35*25*9= 7875m^3

The reverberation time for different strength of audience can be worked out from the following Sabine formulary equation T=0.16*$\frac{V}{A}$

The values are tabulated below:

Audience	total absorption units (A) in m^2 Sabine	t in second unit
Null	353	4.98
½ capacity	358	3.52
2/3 capacity	463	2.72
Full capacity	568	2.22

b) It is to be noted that each of the above reverberation time is high than the optimum of 1.2 second

T =1.2second

T=0.16V/A

1.2=$\frac{0.16*7875}{A}$

A=1050m^2- Sabine

For 2/3 audience capacity (absolute power of hall) =463m^2 Sabine

Extra absorbing unit required

=1050-463=587m^2 - Sabine's

c) Coefficient of absorbing materials

When A =1200m^2

Coefficient=587/1200 =0.49

Policies and Regulations on Sound Control

ACOUSTICAL DESIGN OF A HALL

The following conditions should be considered for halls possessing good acoustical properties:

- The initial sound from the source should be of adequate intensity so that it can be heard throughout the hall.
- For halls of big sizes suitable sound amplification system should be installed.
- The sound produced should be evenly distributed so that there is no dead spots and sound foci.
- The boundary surface should be so designed that there are no echoes or near echoes.
- Desired reverberation time should be achieved by proper placement of absorbents on wall.
- The outside noise should be eliminated.
- Ratio of shape (Plan and section) , Length :1.2 to 1.7; Width :1; Height : 0.4 to 0.7

ACOUSTICAL DESIGN FOR STUDIO

Definition: a studio is a big room where a sound is picked up with a microphone and it is either recorded or broadcasted.

REQUIREMENT OF A GOOD STUDIO

- The studio walls should be of rigid construction so as to completely insulate and exclude the external noise.
- The studio should be rectangular in plan with ratio of height, breadth and length as 2:3:5. The ceiling should be flat.
- The outer surfaces of wall should be of reflective type, while the interior surfaces of Walls, ceiling, floors etc. should be of absorbent materials.
- The noise level in the studio should be brought down to 20 to30 dB.
- Provision of windows should be minimum, to prevent transfer of noise from outside.
- Air conditioning machinery etc. should be completely isolated, and their noise should be completely insulated.
- If there is more than one studio in a building; they should preferably be on the same floor. In no case should two studios be located one above the other; there should be a gap of at least one floor.

❖ General principle factors in acoustical design

Following is the planning principles and factors which are important for good acoustical conditions in a hall:

1. Site selection and planning: noise is an important factor for site selection for an auditorium, a noise survey of the area should be made, and site selection should be in quietest surrounding as otherwise elaborate and expensive construction may be required to provide requisite sound insulation. Depending on the ambient noise level of site, orientation, layout and structural design should be arranged to provide necessary noise reduction.

2. Dimensions: size should be fixed in a relation to the number of audience required to be seated and also in proportion to the intensity of sounds to be generated. For music halls, the volume should be large so that enough space is available for the music to spread in the hall. On other Hand, for lecture halls, small volumes is useful for weak sounds.

3. Shape: the shape of a hall is extremely important in the acoustical design since it is a governing factor like echoes, sound foci, dead spots etc. The shape of a hall is to be geometrically arranged in view of better audibility.

4. Seats and seating arrangement: seats maybe arranged in concentric arcs of circles drawn with the centre located as much behind the centre of the curtain line as its distance from the auditorium rear wall.

For a good visibility, as also for good listening conditions, the successive rows of seats have to be raised over the preceding ones with the result that the floor level raises towards the rear.

5. Treatment of interior surfaces: the treatment of interior surfaces i.e. ceiling side walls, rear walls play an important role in the acoustical design. The ceilings and walls should provide favorable reflections to reinforce the sound that reaches the rear parts of a big auditorium.

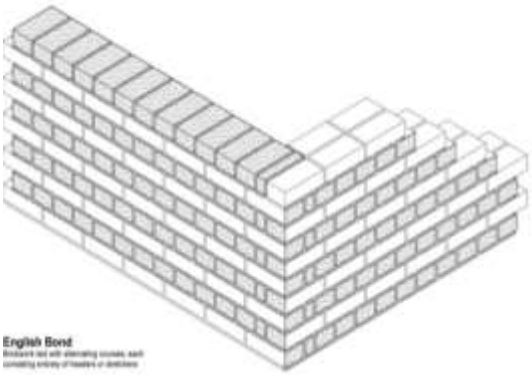
6. Reverberation and absorption: a certain amount of reverberation is desirable, especially for giving richness to music, but too much reverberation is undesirable. The optimum time of reverberation for a hall depends upon the purpose for which it is to be used, also it depends upon

Learning Outcome: 1.3 Identify insulation types

Types of insulation

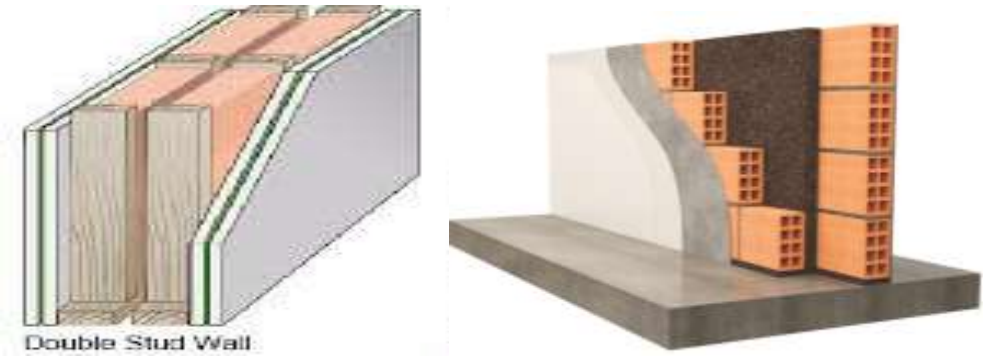
i. Wall Insulation

- Rigid and massive homogeneous walls: A rigid wall consists of stone, brick or concrete masonry construction, well plastered on one or both sides. Sound insulation depends upon their per unit area. Sound insulation increases with the increase in the thickness of the wall.

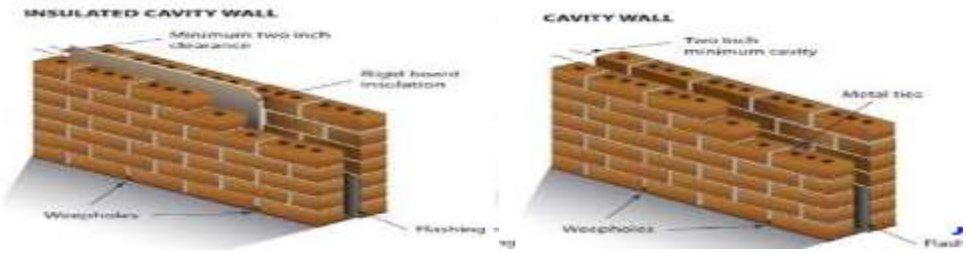


- Partitions of porous materials: The porous materials may be rigid or non-rigid. Rigid porous materials increase insulation 10% than the non-porous materials. However, non-porous material offer very low sound insulations.

- Double wall partitions: Consists of plaster board or fiber boards or plaster on laths on both the faces with sound absorbing blanket in between.



- Cavity wall Construction: The two faces of the wall may be fixed with insulating board. The width of cavity should be at least 5 cm and the two wall leaves should be tied by use of only light butterfly wall ties.



ii. Floor and ceiling Insulation

- Use of Resilient surface Material on Floor: By covering floor with resilient material such as insulation board, linoleum, cork, asphalt etc. This provision helps to damp the impact noises. An insulation of 5 to 10 dB over the base concrete floor may be obtained with such a material.

- Concrete floor floating Construction
- Timber floor Floating Construction
- Skirting: The larger the contact area it provides between the floor area the walls, the lower would be the insulation. ″An air gap or resilient material between the skirting and the floor is provided.

LEARNING UNIT 2. PREPARE TOOLS, MATERIALS AND EQUIPMENT

Learning Outcome: 2.1 Select sound proofing materials

Physical Properties of sound insulating Materials

- Humidity or moisture proof
- Degree of absorption
- Fireproof.
- Insect proof
- Resistant to any physical change that would reduce its effectiveness against heat flow (Resistance to Heat).

Identify area of application of sound proof.

- Walls
- Floors
- Ceilings
- Doors and Windows

i. Wall insulation

Wall and partition are the vertical barrier to noise, their proper design and construction may insulate the sound to the desired layer. Wall construction used for sound insulation or layer wall construction used for sound insulation may be of three types:

a. Rigid homogenous walls: Consists of stone, brick or concrete masonry construction, well plastered on one or both sides. Sound insulation increases with the increase in the thickness of the wall.

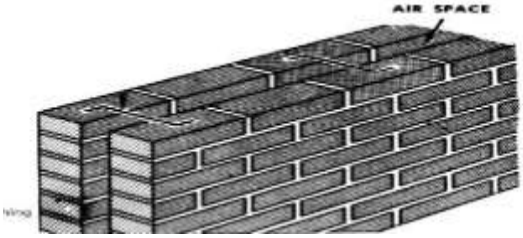
b. Partition wall of porous materials: As indicated early, porous materials may be rigid or non-rigid. Rigid porous material such as porous concrete masonry under concrete etc. The insulation increases 10% higher than non-porous rigid materials.

However partition wall of non-rigid porous materials such as felt, mineral wool etc. Offer very low sound insulation through they can be used in construction which rigid materials with added advantage.

c. Double wall partition: A double wall partition consist of plaster board of fiber board or plaster on both face with sound absorbing blanket in between a double wall construction is thus a partition wall of rigid and non-rigid porous materials.

d. Cavity wall construction: this is an indeed construction from the point of view of sound proofing. The gap between the two leaves of the wall may be left air-filled or else filled with some reliant material like quilt etc. well suspended in the gap.

The two faces of the wall may be fixed with insulating board. The width of cavity should be at least 5cm and two wall leaves should be tied by use of only light wall ties.



ii. Floor and ceiling insulation.

Insulation of floors and ceilings act as horizontal barriers to both air born sound as well as impact sound. Normally the rigid construction materials like R.C.C, stones etc. used for against air born noise but they do not act well for impact sound. Objectives of sound proofed floor and ceiling is aimed at offering good insulation against impact sound and this can be achieved by the following construction feature.

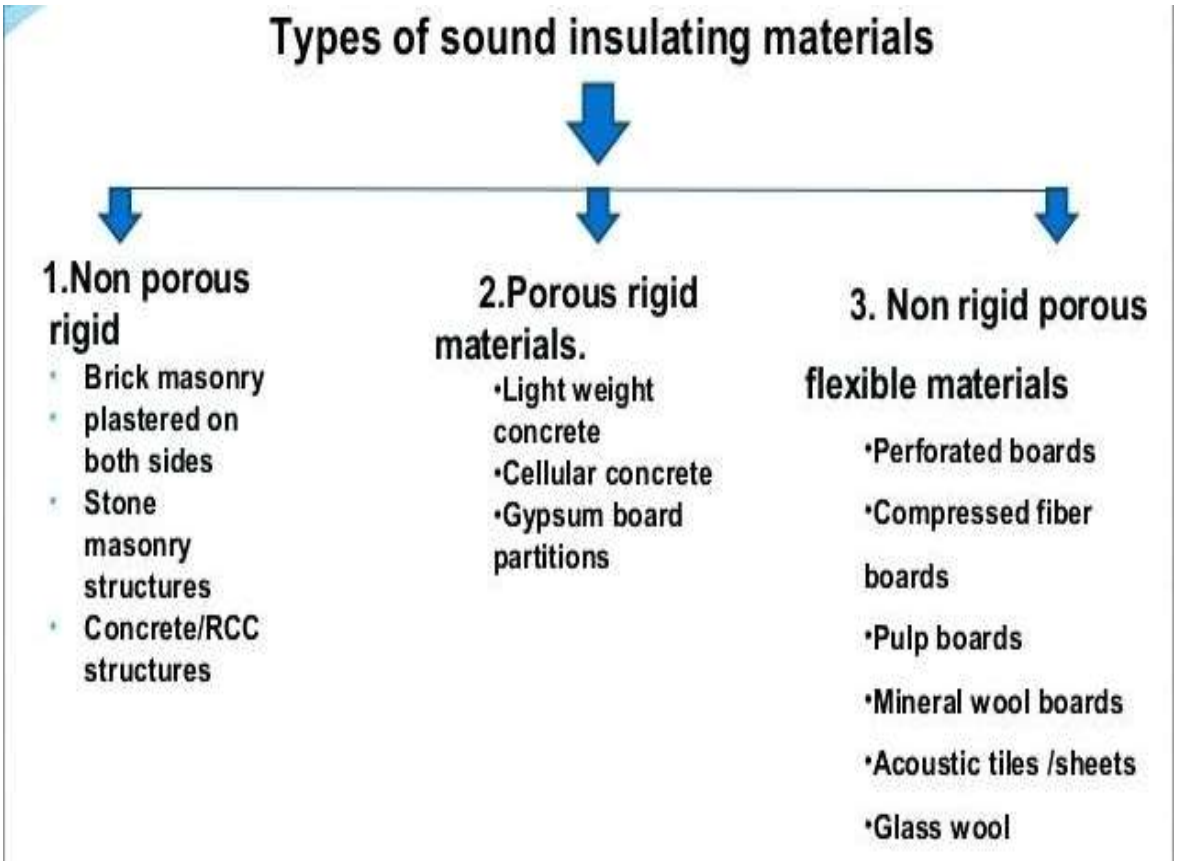
iii. Doors and Windows insulation.

Soundproof windows or standard triple-paned windows add layers of glass to help deflect sound. They also have a sound dispersing air layer sandwiched between the glass panes. If you currently have aluminum frame windows, even just making the change to vinyl will help cut the noise.

Like windows, doors are notorious for letting sound leak in and out even when they're closed. To create a better sound barrier around doors, swap hollow core doors for MDF (medium density fiber) or solid wood doors, and add closed cell foam tape or weather stripping around doorframes. If you're on a tight budget, adding vinyl peel-and-stick soundproofing material to a hollow core door will increase its sound dampening ability somewhat.

Type of sound proofing materials

- Non Porous rigid
- Porous rigid material
- Non rigid or Flexible porous materials



Sound Absorbing Materials

1. Acoustic Foam

2. Sound Absorbing Foam (Pro Studio Acoustics Tiles)

3. Acoustic Panels (ATS Acoustics)

4. Acoustic Curtains (Utopia Thermal Blackout Curtains)

5. Moving Blankets (Sure Max Heavy Duty)

6. Door Sealing Gasket & Sweep Kit

Learning Outcome: 2.2Select sound proofing tools.

Types of tools for sound proofing

1. Duct Tape

Duct tape can be used to seal the edges of the foam that you are attaching to the walls. This will also be useful to help you attach rags into any gaps around the garage door to muffle (silence) any sound. It will enable you to fix the soundproofing material without causing damage to the glass.

2. Room Dividers

Fixing soundproof material to the garage door may not be sufficient to prevent all noise from drifting (travelling) to the outside world, so a room divider should also be used. This can also be achieved with the use of any items that are being stored in the garage. Line up boxes of stored items against the walls and doors to prevent sound from escaping.

3. Utility Knife

A utility knife will be needed to cut the foam and cardboard.
The scissors must be sturdy enough to cut tough material. Also, a utility knife will enable you to be more precise and cut straight lines. After the correct dimensions are marked out, a straightedge can be laid into position so that you can carefully run the blade along the edge.

4. Tape Measure

In order to ensure that the sound proofing method fits properly, a tape measure should be used to measure. This will ensure that you are not left with gaps around the edges of the soundproof material. Gaps, holes and missing material allow sound to escape.

Other tools used in application of sound proof.

Scissors & Shears, Sound level meter, Trowel, Plier, Screw driver, Tape Measure, Hack saw, Step ladder, Spade, Wheel barrow, Sprit level, Try square, Steel float, Pan/bucket, Cleaning tools.

Learning Outcome 2.3 Select sound proofing equipment.

Types of equipment for sound proofing

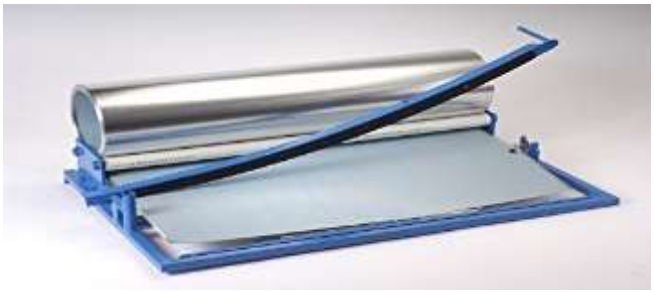
- Roll Bending Machine: Roll bending may be done to both sheet metal and bars of metal. If a bar is used, it is assumed to have a uniform cross-section, but not necessarily rectangular, as long as there are no overhanging contours, i.e. positive draft. The material to be shaped is suspended between the rollers.

Roll bending Machine.

- Mini Brake: Make big or small fabrications on the job with this lightweight and portable tool! The versatile Mini-Brake produces bends up to 135 degrees in sheet metals, including aluminum, copper and gauge galvanized steel. The brake's compact size can accommodate sheet metal stock up to 4-feet wide, in any length, because there is no fixed throat depth to contend with.

- PVC Jacket cutter:

- Metal Jacket Cutter



- Crimping Machines

Learning Unit 3: Apply sound insulators

Learning Outcome 3.1: Apply insulation techniques

✓ Walls Insulation

- Construction of rigid and massive homogeneous walls
- Construction with partitions of porous materials
- Double wall partitions construction

- Cavity wall Construction

✓ Floor and ceiling Insulation

- Use of Resilient surface Material on Floor
- Concrete floor floating Construction
- Timber floor Floating Construction
- Skirting
- Use of resonant panels

Learning Outcome 3.2 Test sound insulation

Sound Intensity Measurement

Noise meter: The Noise Meter / Sound Meter is a simple sound measuring device. The noise meter /sound meter is used to quickly determine the ambient noise level. In addition to the volume measurement, the noise meter / sound meter also has the option of determining the ambient temperature.

Noise tester: Here you will find industrial standard noise testers. With these portable noise testers you can carry out measurements quickly to gain control of a situation or to set the devices to take timed measurements. The noise testers is important for all industries, especially by using it as a mobile device which is able to assess office stress levels or street noise levels. Often problems arise from noisy neighbours or if bars and restaurants are in residential areas and produce noise levels after 10pm in excess of what local laws permit.

Learning Outcome 3.3.Maintain sound insulators

Periodic Maintenance of sound proofing system.

- ✓ Cleaning: Cleaning acoustic panels that are PVC, is easy, but it ...and may be cleaned with all conventional cleaning systems. This and any other routine maintenance is determined by end use conditions.

  How to clean soundproofing materials.
  - Use of Machine
  - Clean those materials with Manual means.
- ✓ Replacement of defected elements: While insulating materials are old and the maintenance is not possible replacement of those materials is useful.

Methods used in Periodic Maintenance.

- ✓ Cleaned insulators
- ✓ Regular cavity
- ✓ Alignment
- ✓ Verticality
- ✓ Horizontality
- ✓ Measurements

Three types of maintenance.

The basic types of maintenance falling under the following:

- Preventive maintenance: is "a routine for periodically inspecting" with the goal of "noticing small problems and fixing them before major ones develop. Ideally, "nothing breaks down.
- Corrective maintenance where equipment is repaired or replaced after wear, malfunction or break down.

- Predictive maintenance is the replacement of an item that is still functioning properly. Usually it's a tax-benefit based replacement policy whereby expensive equipment or batches of individually inexpensive supply items are removed and donated on a predicted/fixed schedule.

How do you reduce noise in wall?

- Choose a Noise Reducing Drywall. Traditionally to reduce noise transfer between rooms you'd use a resilient channel.
- Insulate Interior Walls.
- Float the Floors.
- Seal it up.

EXERCISES ON SOUND INSULATION

I. OPEN QUESTIONS

1. Define the following terms as related to sound proofing/insulation and give one example for each

a) Sound
b) Noise
c) Sound insulation
d) Impact noise
e) Airborne sound (noise)

2. List any five defects of noise to human

i.
ii.
iii.
iv.
v.

3. Highlight any four requirement of a good acoustical material

a)
b)
c)
d)

4. Highlight at least any 3 the methods of sound reduction effect (3marks)

a)
b)
c)

5. 2. Name at least any 4 requirement of a good acoustic material (4marks)

a)
b)
c)

d)

6. True or false? Reverberation is not the persistence of sound once the source has ceased whereas reverberation time is the time that the sound is heard in enclosed area once the source has stopped. (1mark)
7. True or false? Sound foci is due to concentration of reflected sound in a particular area whereas dead spots is the consequences of sound foci. And reflected sound is of low intensity that is insufficient to hearing. (1mark)
8. Name any four acoustical design of a hall from your choice. (4marks)
   a)
   b)
   c)
   d)
9. After defining a term 'studio', mention any five requirement of a good one.
   a)
   b)
   c)
   d)

II. CLOSE QUESTIONS

Answer by true or false

10. The reverberation is the persistence of sound in an enclosed space as a result of continuous reflection of sound after the source has stopped.
11. The time during which the sound persists in a hall is called the reverberation time
12. The formula for calculating reverberation time, $R_T = \frac{0.16V}{A}$