RQF LEVEL 5

TRADE:MASONRY

MODULE CODE: MASSP501

TEACHER'S GUIDE

Module name: PRINCIPLES OF SOUND PROOFING/ INSULATION

Table of content

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Acronyms

L.O: Learning Outcome

L.U: Learning Unity

G: Group

RTB: Rwanda TVET board

TSS: Technical secondary school

C: content

Introduction

This module describes the basic principle of sound insulation with simplified assumption. the method for measuring airborne and impact insulation are briefly described and the methods of objectives evaluation of the measurement result are presented. And also quality and requirements of good sound insulators /proofing are described.

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

This is a core module which describes the performance outcomes, skills, knowledge and attitude required to apply principles of sound proofing.

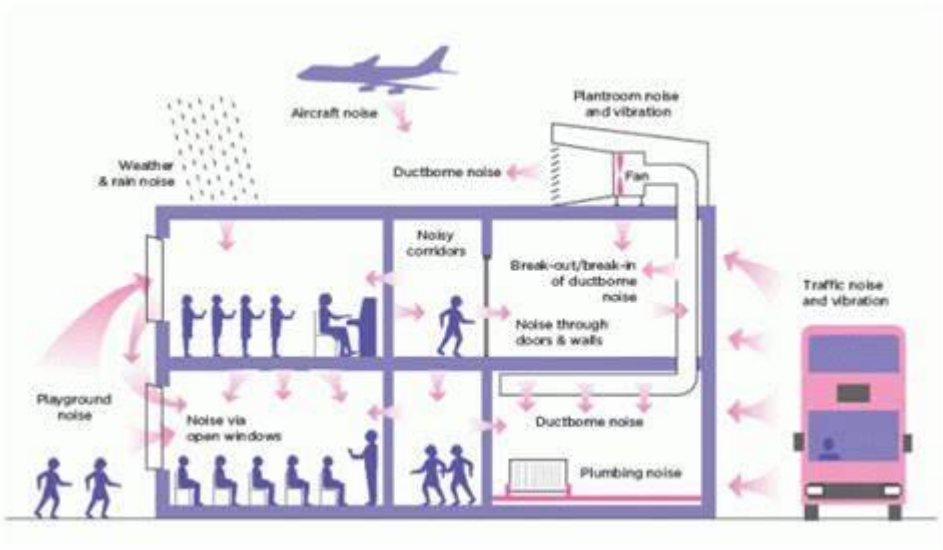
Module Code and Title: MASSP501 - PRINCIPLES OF SOUND PROOFING/ INSULATION

Learning Units:

1. Identify sound insulation
2. Prepare tools, materials and equipment
3. Apply sound insulators

Learning Unit 1: Identify sound insulation

Picture/s reflecting the Learning unit 1



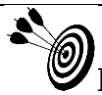
STRUCTURE OF LEARNING UNIT

Learning outcomes:

1.1: Identify sounds
1.2: Identify purpose of sound insulation
1.3: Identify insulation types

Learning outcome 1.1. Identify sounds

 **Duration:** 10 Hours

 **Learning outcome 1 objectives:**

By the end of the learning outcome, the trainees will be able to:

1.to define sound

2.identify characteristic of sound

3.determine effect of sound

 **Resources**

Equipment	Tools	Materials
Amplifier speaker Streophonic soud	radio receivers, AV receivers, CD players, tape recorders	Soundproofing foam A vinyl acoustic barrier drywall on steel studs partion wall heavy draps plywood

Theoretical learning activity

Groups and individual discussion about:

1. Definition of sound
2. Identification of sound characteristics
3. Determination of sound effects

Advance preparation:

- teacher’s handouts
- tutorials about sound proof
- sound insulators photos

Definition of key terminologies in sound

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.

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

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

Sound insulation/insulator: are material or combination of materials that make 9a room or building) resistant to the passage of sound.

iv) Insulator:

a substance which does not readily allow the passage of heat or sound or

a substance or device which does not readily conduct electricity.

Content 1.1.1 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.

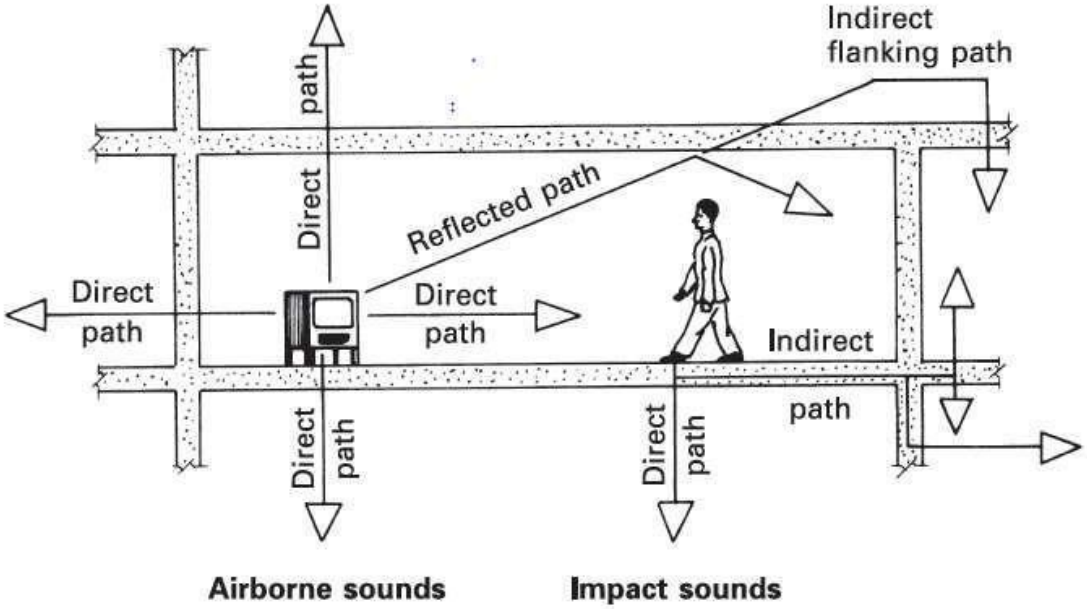
Content1.1.2 Identify sound transmission

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



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Content 1.1.3 sound effects

Sound effects are commonly defined as non-musical, non-speech sounds used in some artificial context, such as theatre, TV, film, video game or virtual reality. The purpose of a sound effect is typically to provide a diegetic context of some event or action, that is a sound that exists within the narrative of the story line. A 1931 BBC White Paper proposed that there were 6 types of sound effects (BBC, 1931)

- ✓ **Realistic, confirmatory** effect The convincing sound of an object that can be seen, to directly tie into the story, eg. the sound of a gunshot when we see a gun being fired
- ✓ **Realistic, evocative effect** A convincing sound within the landscape, that cannot be directly seen eg. in a forest, a bird tweeting off screen
- ✓ **Symbolic, evocative effect** Sounds that don't actually exist within the narrative, designed to create an emotion within the listener, eg. a swelling sound to build suspense
- ✓ **Conventionalised effect** A sound that though not entirely realistic, is perceived as realistic, due to overuse and hyper-realism eg. the ricochet after a gun shot in a western film
- ✓ **Impressionistic effect** creating a general feeling or indication of an occurrence without an exact realistic example eg. a cartoon punch sound
- ✓ **Music as an effect** producing a sound effect through some musical means, eg. chimes to represent a transformation

From this, sound effects can often be the linchpin of a sound scene, and different sounds and styles will vary drastically dependent on the style and design of the medium, among other factors.

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 leads to fatigue
- ✓ It causes heart disease

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.

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. (hand book of noise control)

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.

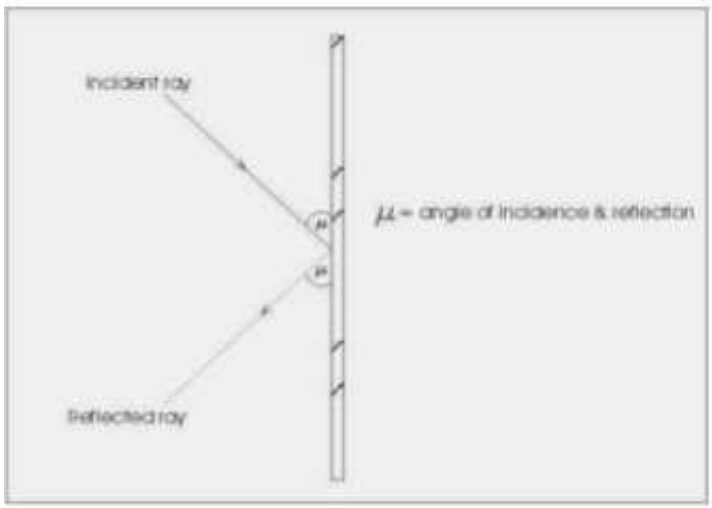
Materials can absorb sound, reducing the effect of indirect sound.

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

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

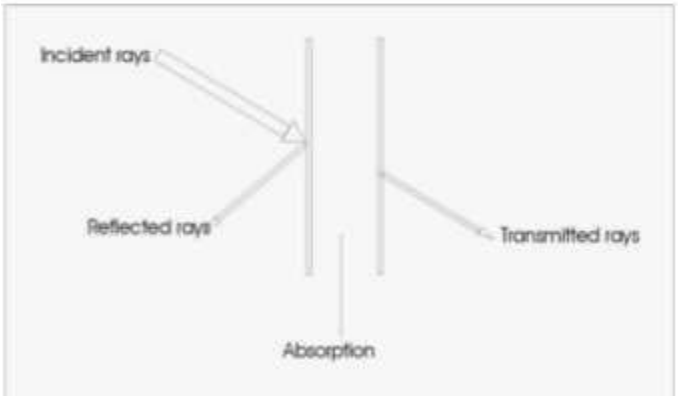
i. Reflection

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.



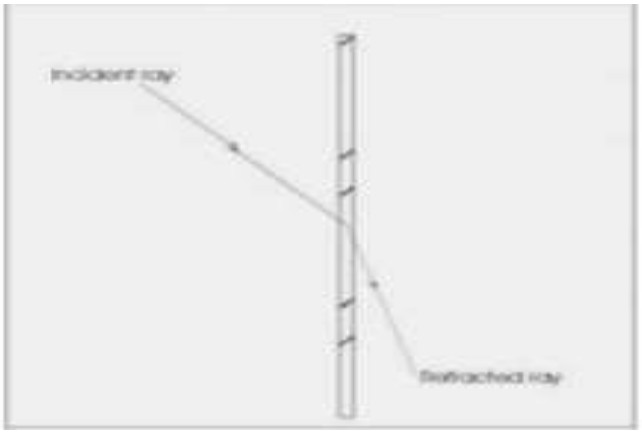
ii. **Absorption**

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.



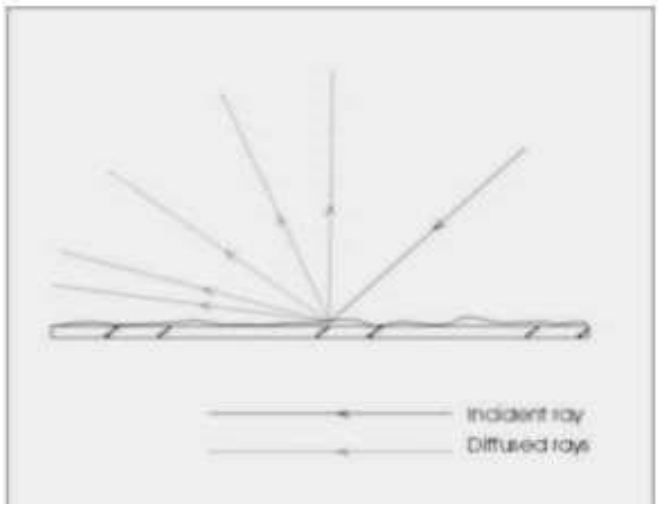
iii. Refraction

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.



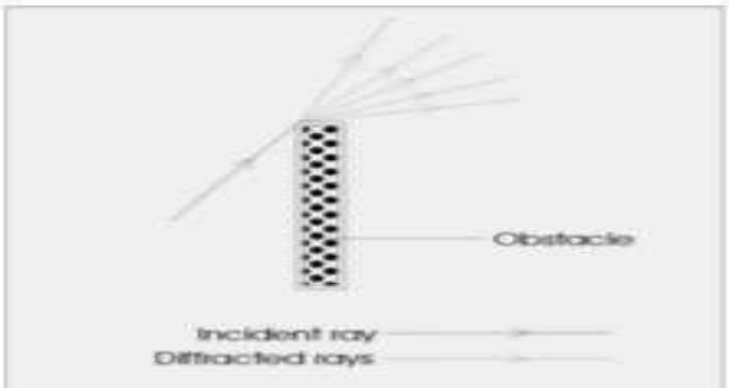
iv. Diffusion

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.



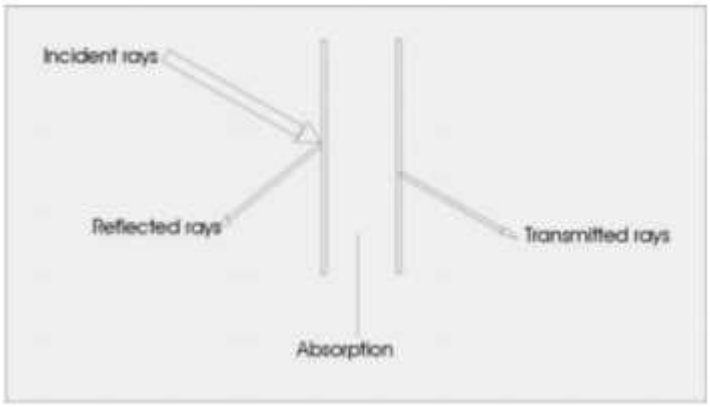
v. Diffraction

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

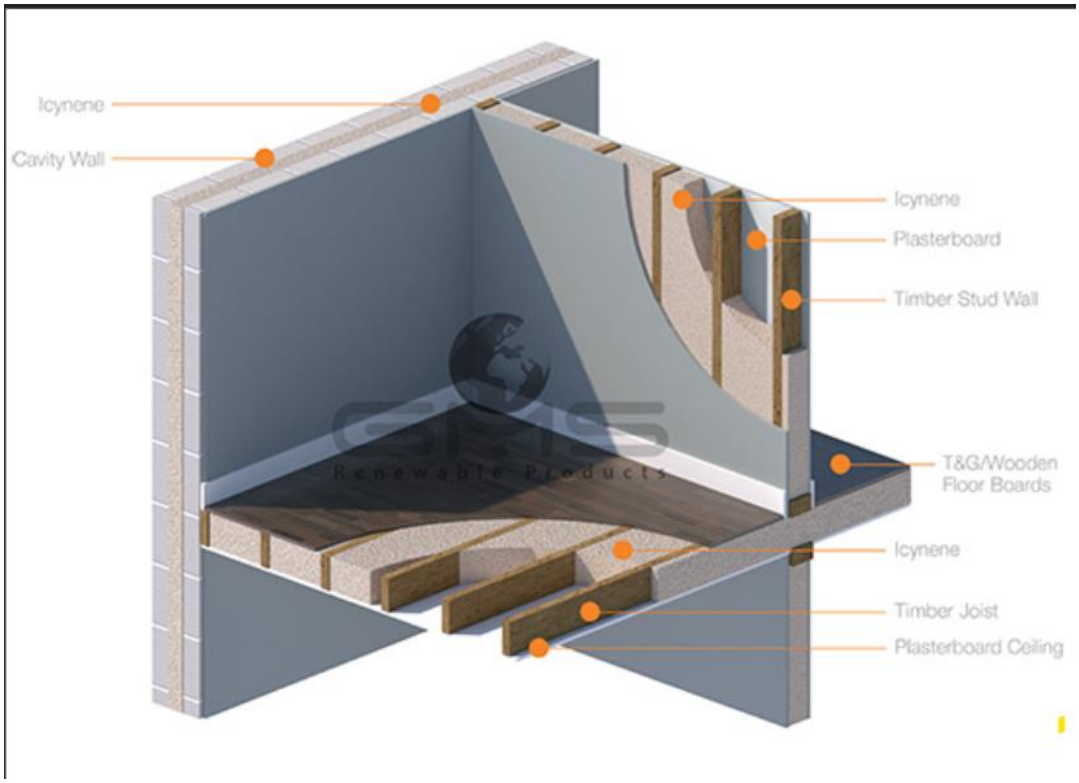
In this phenomenon, sound wave is carried by molecules of the obstacle through vibration and reemitted at the other side irrespective of the medium. It can be structure borne, air borne or impact sound.



Points to Remember (Take home message)

- ✓ To differentiate different types of sound transmission
- ✓ To identify sound effects
- ✓ Differentiate sound from noise

Learning Outcome 1.2: Identify purpose of sound insulation



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Duration: 10 Hours

Learning outcome 1.2 objectives:

By the end of the learning outcome, the trainees will be able to:

1.Identify sound reduction effect method

2.Select policies and regulation of sound

Resources

Equipment	Tools	Materials

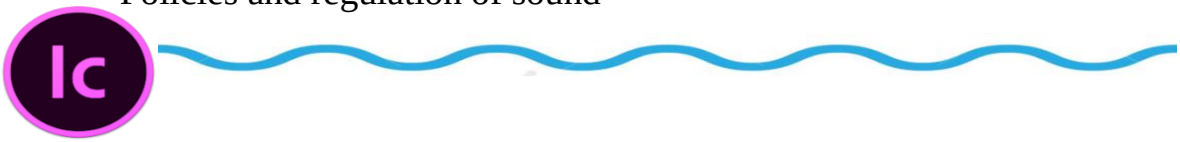
Amplifier speaker Streophonic soud	radio receivers, AV receivers, CD players, tape recorders	Soundproofing foam A vinyl acoustic barrier drywall on steel studs partion wall heavy draps plywood

Advance preparation:

- teacher's handouts
- tutorials about sound proof
- sound insulators photos

Theoretical learning activity

- Methods of Sound Reduction effect.
- Policies and regulation of sound



Content 1.2.1 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.

Content 1.2.2 policies and regulation of sound

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.

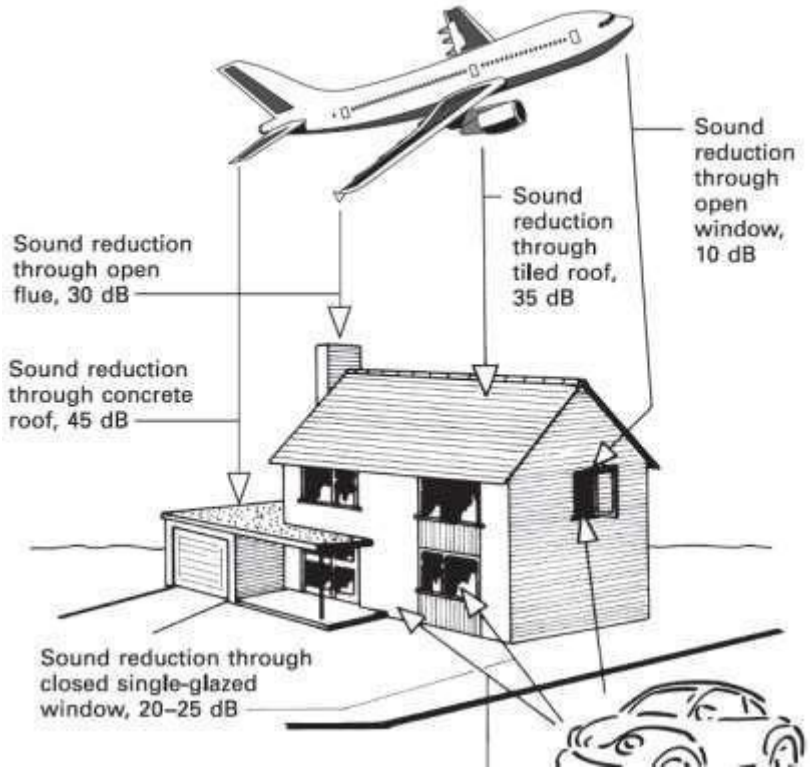
Providing highly absorbent materials on critical areas (curved spaces).

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.



(R.GREENO BA(HONS)FCIOB)

Formative assessment

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:

Number of absorbing units and time of reverberation

No audiences

One third audiences

Two third audiences

Full audiences

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

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

V

Sabine formulary equation
T=0.16*$\frac{}{}$ 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 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.

Points to Remember (Take home message)

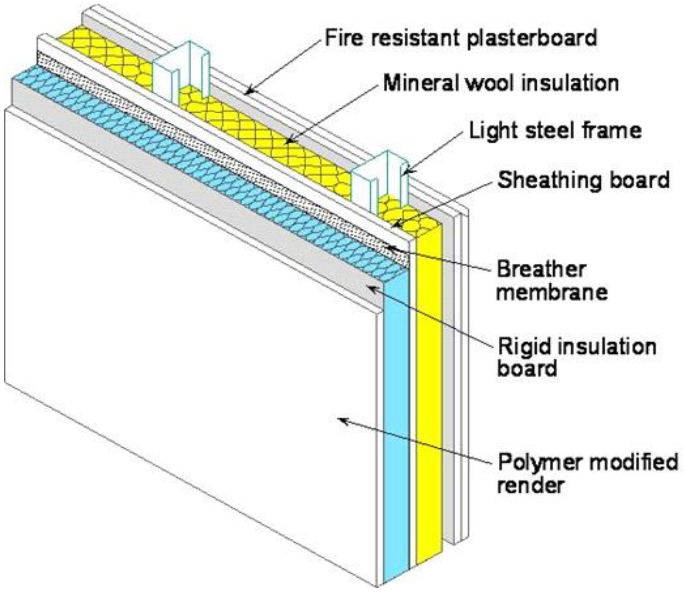
Description of sound reduction effects and to illustrate policies and regulations regarding sound control.

Formative assessment

Q1. Answer true or false?

i) 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.

Learning outcome 1.3 Identify insulation types



Duration: 10 Hours

Learning outcome1.3 objectives :

By the end of the learning outcome, the trainees will be able to:

1.differentiante types of sound insulations

Resources

Equipment	Tools	Materials
Amplifier speaker Streophonic soud	radio receivers, AV receivers, CD players, tape recorders	Soundproofing foam A vinyl acoustic barrier drywall on steel studs partion wall heavy draps plywood

Advance preparation:

- teacher's handouts
- tutorials about sound proof
- sound insulators photos

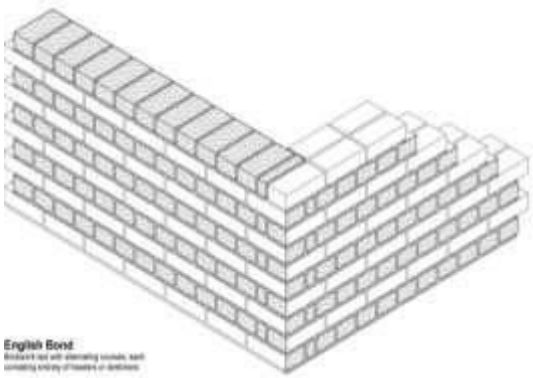
Theoretical learning activity

- Types of insulation
  Wall and floor insulation

Content 1.3.1 Types of insulation

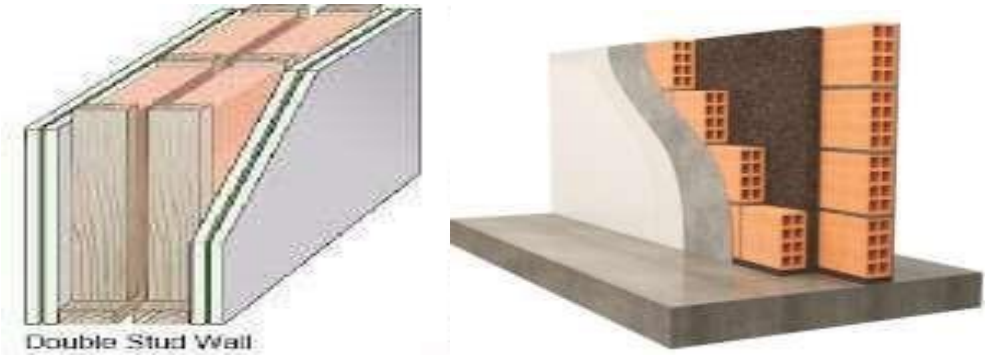
I. Wall Insulation

- ✓ **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.

Points to Remember (Take home message)

The leaner should remember:
The full meaning of insulations and differentiate two types of insulations, either wall, floor or ceiling insulations.

Formative assessment

Q1. What is a sound

Q2. Discuss effect of sound

Q3. List down any 3 equipment used in sound identification

Q4. List down any 2 tools used in sound identification

Q5. True or false? Sound foci is due to concentration of reflected sound in a particulararea whereas dead spots are the consequences of sound foci. And reflected soundis of low intensity that is insufficient to hearing.

LEARNING UNIT 2. PREPARE TOOLS, MATERIALS AND EQUIPMENT

Learning Outcomes :

1. Select sound proofing materials
2. Select sound proofing tools
3. Select sound proofing equipment’s

leaning outcome 2.1.select sound proofing materials

Duration: 4 Hours

Learning outcome 1 objectives :

By the end of the learning outcome, the trainees will be able to:

1. select appropriate sound proofing material properties
2. Specify sound proof applications area
3. enumerate all sound proofing materials types

Resources

Equipment	Tools	Materials
Amplifier speaker Stereophonic sound	radio receivers, AV receivers, CD players, tape recorders	Soundproofing foam A vinyl acoustic barrier drywall on steel studs partion wall heavy draps

		plywood

Advance preparation:

- teacher's handouts
- tutorials about sound proof
- sound insulators photos

Theoretical learning activity

- Physical Properties of sound insulating
- Identify area of application of sound proof
- Types of sound proofing materials

Content 2.1.1 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).

Content 2.1.2 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.

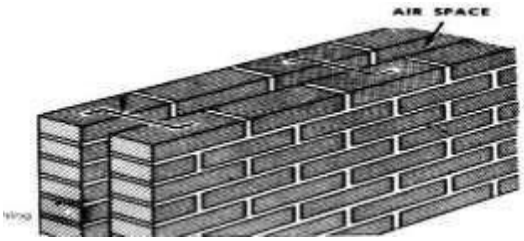
b. Partition wall of porous materials: As indicated early, porous materials may be rigid or non-rigid. Rigid porous material such as porous concrete masonry under concrete etc. The insulation increases 10% higher than non-porous rigid materials.

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 consists 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 nonrigid 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. g

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 aluminium 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

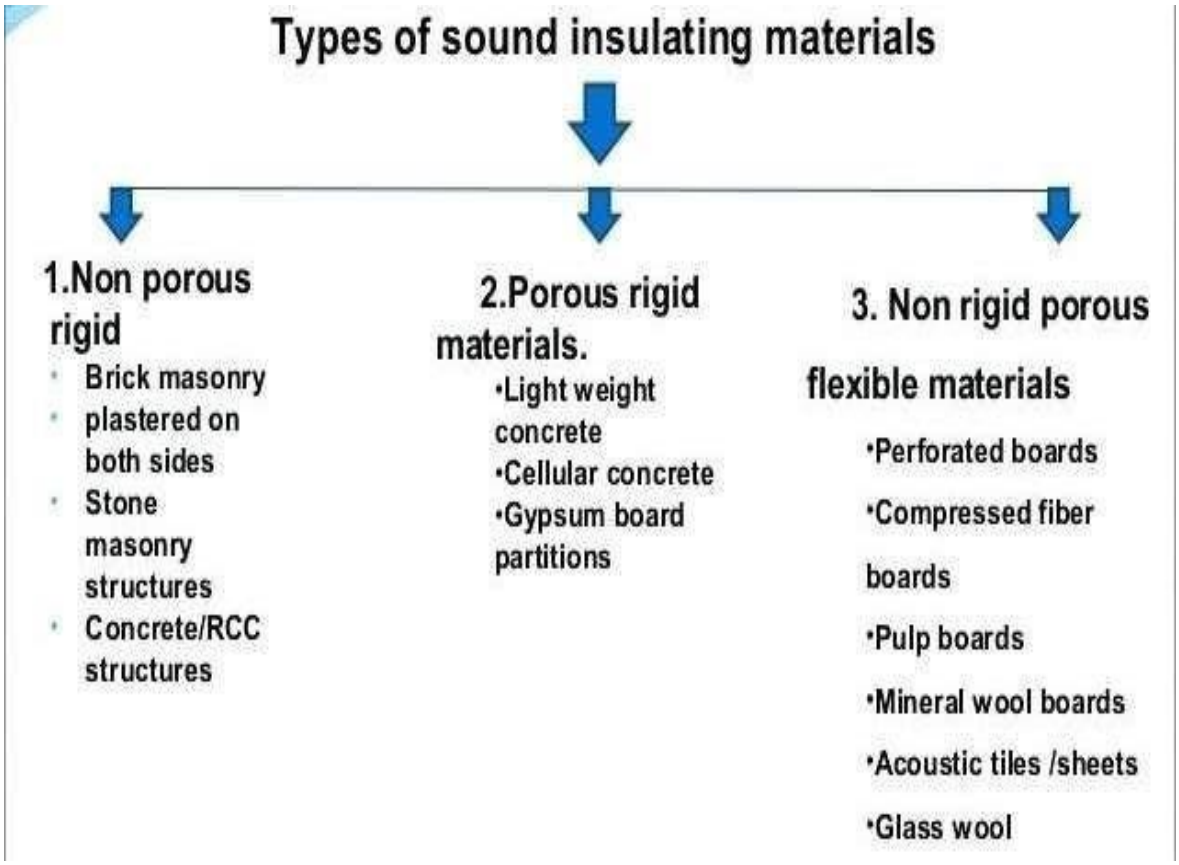
soundproofing material to a hollow core door will increase its sound dampening ability somewhat. (onsolidated, 30 noveber 1964)

Content 2.1.3 Types 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)

Points to Remember (Take home message)

- ✓ Selection of materials for sound proofing according to its properties and area of applications
- ✓ Types of sound proofing materials

Learning Outcome 2.2: Select sound proofing Tools.

Duration: 3 Hours

Learning outcome 2.2 objectives :

By the end of the learning outcome, the trainees will be able to:

1. to select tools according to their types
2. to choose the appropriate method of tools maintanance

Resources

Equipment	Tools	Materials
Amplifier speaker Stereophonic sound	radio receivers, AV receivers, CD players, tape recorders	Soundproofing foam A vinyl acoustic barrier drywall on steel studs partition wall heavy drapes

		plywood

Theoretical learning activity

- Types of tools for sound proofing
- Maintenance of Tools for Sound proof

Content 2.2.1 Types of Tools for Sound proofing

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.

1. 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.

2. 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. (punmia)

Content 2.2.2 maintenance of tools for sound proof

- lean your tools
- protect electrical cords
- lubricate tools inspect and repair tools regularly
- store tools with care


Points to Remember (Take home message)

Identification of sound proofing tools, their usage and maintenances

Learning Outcome 2.3 Select Sound proofing equipment.

Marking and tracing Equipment

Duration: 3 Hours

Learning outcome 1 objectives :

By the end of the learning outcome, the trainees will be able to:

1. Select type of Equipment according to their fonctions in Sound proofing installation
2. to choose the appropriate method of Tools maintenance

Resources

Equipment	Tools	Materials
Amplifier speaker Streophonic soud	radio receivers, AV receivers, CD players, tape recorders	Soundproofing foam A vinyl acoustic barrier drywall on steel studs partion wall heavy draps plywood

Advance preparation:

- teacher's handouts
- tutorials about sound proof
- sound insulators photos

Theoretical learning activity

- Types of equipment for Sound proofing
- maintenance of sound proofing equipment

Content 2.3.1 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 aluminium, 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**

Content 2.3.2 maintenance of Sound proofing equipment

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

Points to Remember (Take home message)

Identification of sound proofing equipment, their usage and maintenances

FORMATIVE ASSESSMENT

Q1. Answer by true or false?

The following are tools to tie mineral wool:

a. crown hammer

b. screws

c. nails

d. string

Q2. Give at least 5examples of wall sound proof materials?

Q3. Give at least 2examples of CEILLING sound proof materials?

Q4. Discuss at least 3examples of FLOOR sound proof materials?

Practical assessment

Task to be performed.

As mason supervisor of a building room of (3*5 m) to be sound insulated:

a) select the appropriate tools, materials and equipment needed to perform the work of insulating your room.

Solution

Checklist	**Score**	
	yes	**No**
Indicator:materials		

Non porous rigid materials		
Porous rigid materials		
Non rigid or flexible ferrous material		

Checklist	**Score**	
	yes	**No**
Indicator: tools to be used		
scissors and shears		
sound level meter		
Trowel		
Pliers		
Screw driver		
Tape measure		
Hack saw		
Spade		
Weel barrow		
Spirit level		
Try square		
Steel float		
Pan/bucket		

Checklist	**Score**	
	yes	**No**
Indicator: equipment		
Roll bending machine		
Pvc jacket cutter		
metal jacket cutter		
Climbing		

Bending machine		
Roll bending machine		

Learning Unit 3: Apply sound insulators

Learning period: 40 hours

Learning Outcomes

1. Apply insulation techniques
2. Test sound insulation
3. Maintain sound insulators

Learning out Comes 3.1 Apply sound insulators

Duration: 20 Hours

Learning outcome 3.1 objectives :

By the end of the learning outcome, the trainees will be able to:

- Differentiate wall insulation from floor and ceiling **insulation**

Resources

Equipment	Tools	Materials
Roll bending machine Pvc jacket cutter Climbing Bending machine Roll bending machine	scissors and shears sound level meter Trowel Screw driver Tape measure Hack saw Spirit level Try square Steel float	Soundproofing foam A vinyl acoustic barrier drywall on steel studs partion wall heavy draps plywood

Advance preparation:

- teacher's handouts
- tutorials about sound proof
- sound insulators photos

Theoretical learning activity

- Wall Insulation
- Floor and ceiling Insulation

Content 3.1.1 Wall Insulation

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

Content 3.1.2 Floor and ceiling Insulation

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

Practical assessment

Task: to install sound insulators to the administrative building of busasamana TSS By helping of wall insulation installation procedures.

SOLUTION

- ✓ Measure the total area of the walls to be insulated.
- ✓ Get other tools necessary to complete the job.
- ✓ Cut batts to the appropriate height.
- ✓ Push each batt into the gap between each stud.
- ✓ Secure the lip of the batting to each stud.
- ✓ Apply vapor-retardant poly film over batting for exterior wall

Points to Remember (Take home message)

To install sound proofing material by using different technics either wall or floor ceiling insulation Installation of sound proofing material procedures

Learning Outcome 3.2 Test Sound insulation

Noise meter

Duration: 10 Hours

Learning outcome3.2 objectives:

By the end of the learning outcome, the trainees will be able to:

- Measure sound intensity required
- Identify sound effect reflection

Resources

Equipment	Tools	Materials
Noise meter Drilling machine **Noise tester**	Pliers Scissors Step ladder	radio receivers, AV receivers, CD players, tape recorders

Advance preparation:

- teacher's handouts
- tutorials about sound proof
- sound insulators photos

Theoretical learning activity

- Sound Intensity Measurement
- reflected sound defect

Content 3.2.1 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 neighbors or if bars and restaurants are in residential areas and produce noise levels after 10pm in excess of what local laws permit.

Content 3.2.2 reflected sound defect

Echoes: an echo must reach after 1/10th 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.

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 result in confusion with the sound created next.

Points to Remember (Take home message)

Rate of sound intensity by using testing equipment to control the level of noise Reflected sound defect

Learning Outcome 3.3 Maintain sound insulators

Duration: 10 Hours

Learning outcome3.2 objectives :

By the end of the learning outcome, the trainees will be able to:

- To maintain sound proofing systems periodically
- Illustrate different method used in periodic maintenance

Theoretical learning activity

- Periodic Maintenance of sound proofing system**.**
- Methods used in Periodic Maintenance.

Content 3.3.1 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.

Content 3.3.2 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.

Points to Remember (Take home message)

The way of maintaining sound proofing system periodically Method of maintaining sound proofing system

Summative assessment

- Assessment tools
  - ✓ **Assay**

    Busasamans tss has a contract with Nyanza district to insulate its Meeting room located In south Province, Nyanza district in a single house according to the newly implementation of soundproof policies and regulations to avoid the noise caused by the round speakers in the meeting.

    Task to be performed.

    As mason supervisor from fore said Company, you are requested to:
    a) Identify the source of sound.
    b) Give an advice on type of insulation techniques.
    c) Give an advice on type equipment required.
    d) Apply those techniques in 8 hours The Meeting room is a new building shall be inaugurated after the insulation of this meeting room.
    NB: all material and equipment shall be curved by Nyanza district.

Observation checklist

Assessment Criterion 1: Quality of Process

Checklist	**Score**	
	Yes	**No**
Indicator: Identification of sounds are done		
Intensity level in club range between 10-120dB		
Sound is transmitted in wave form		
Intensity level in club range between 10-120dB		

Sound is transmitted in wave form		
Intensity level in club range between 10-120dB		
Sound is transmitted in wave form		
Indicator: Identification of sound insulation types is done.		
Alignment		
Verticality		
Horizontality		
Measurements		
Setting out		
Indicator: Identification of sound insulation materials is done.		
Mineral Wool		
Timber floor Floating Construction		
Resilient Materials		
glass fibers		
Skirting		
Indicator: Test of sound insulation is done		
ntensity of sound is 0 db		
Observation		

Assessment Criterion 3: Quality of product

Checklist	**Score**	
	yes	**No**
Indicator: Sound s well proof insulation i done		
✓ Intensity of sound is 0 db		
Observation		

Assessment Criterion 3: Relevance

Checklist	Score	
	yes	No
ndicator: Instructions are respected		
✓ Time respected :8 Hours		
✓ Advice on type of sound insulation technique is given		
Observation		

Assessment Criterion 4: Safety

Checklist	Score	
	yes	No
Indicator: PPE are used		
✓ Helmet		
✓ Clothes		
✓ Shoes		
✓ Goggles		
Observation		

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