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"Noise Control Using UPVC Windows & Acoustic Foam"

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I. INTRODUCTION

1.1 WHAT IS NOISE POLLUTION?

The word noise is derived from the Latin word 'Nausea' which means sickness in which one feels the need to vomit.
Noise pollution is considered to be any unwanted or disturbing sound that affects the health and well-being of humans and other organisms
The faintest sound which can be heard by the Human ear is 1 Db.
Due to increasing noise around the civilizations, noise pollution has become a matter of concern.
Some of its major causes are vehicles, aircraft, industrial machines, loudspeakers, crackers, etc. Some other appliances also contribute to noise pollution like television, transistor, radio, etc. when used at high volumes.
The intensity of sound is measured in **decibels (dB).**

1.2 SOURCES OF NOISE POLLUTION

Following are the three types of noise pollution:
1. Neighbourhood Noise- The noise from gadgets, household utensils etc. Some of the main sources are musical instruments, transistors, loudspeakers, etc.

2. Industrial Noise- It is the high-intensity sound that is caused by heavy industrial machines. According to many types of research, industrial noise pollution damages the hearing ability by around 20%

3. Transport Noise- It mainly consists of traffic noise which has increased in recent years with the increase in the number of vehicles. The increase in noise pollution leads to deafening in older people, headaches, hypertension, etc.

1.3 ALLOWABLE NOISE LEVELS:

RESIDENTIAL:

- Bedroom- 25dB
- Living room- 40dB

COMMERCIAL:

- Office- 35-45dB
- Restaurant- 40-60dB

INDUSTRY:

- Workshop- 40-60dB
- Lab- 40-50dB

EFFECTS OF NOISE POLLUTION ON HUMAN HEALTH:

Noise pollution can be hazardous to human health in the following ways:
1. Hypertension: It is a direct result of noise pollution which is caused due to elevated blood levels for a longer duration.

2. **Hearing loss:** Constant exposure of human ears to loud noise that is beyond the range of sound that human ears can withstand damages the eardrums, resulting in loss of hearing.
3. **Sleeping disorders**: Lack of sleep might result in fatigue and low energy level throughout the day affecting everyday activities. Noise pollution hampers the sleep cycles leading to irritation and an uncomfortable state of mind.
4. **Cardiovascular issues:** Heart-related problems such as blood pressure level, stress, and cardiovascular diseases might come up in a normal person and a person suffering from any of these diseases might feel a sudden shoot up in the level.

1.4 NECESSITY:

- The goal is to maintain low noise exposures, such that human health and well-being are protected.
- To develop criteria for the maximum safe noise exposure levels, and to promote noise assessment and control as part of environmental health programs.

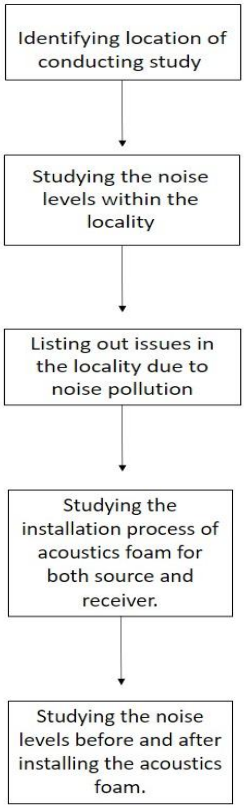
1.5 PROBLEM STATEMENT

- The acoustical design issues for buildings involve the principal issues like site noise considerations, including the control of noise transfer to a project's neighbors.
- Particularly if they are residential, establishing noise standards for each use space, including limitation of excessive ventilation noise, room acoustics considerations, sound isolation between various use spaces, vibration control for mechanical equipment, audio/visual system considerations.

1.6 OBJECTIVES OF PROJECT

- To use acoustic foam in commercial areas whereas to use UPVC windows in residential areas to attenuate noise.
- To enhance the sonic properties of a room by effectively managing unwanted reverberations.
- To reduce the energy in the reflected sound waves, so that they have less volume as an echo, and less effect on the primary waves as they reach your ears resulting in a cleaner listening experience.

1.7 METHODOLOGY



II. LITERATURE REVIEW

2.1 GENERAL

For studying the acoustic design of the room, technical papers, websites, and technical manuals have been referred. Few other literatures is also studied to understand the concept and importance of acoustic design and materials.

2.2 LITERATURE REVIEW

2.2.1 ACOUSTICS FOAM

Experimental Acoustic Evaluation of an Auditorium by **Marina Dana Topa**

The paper presents a case history: the acoustical analysis of a rectangular auditorium. The following acoustical parameters were evaluated: early decay time, reverberation time, clarity, definition, and center time. The excitation signal was linear sweep sine and additional analysis was carried out: peak-to-noise ratio, reverberation time for the empty and occupied room, the standard deviation of acoustical parameters, diffusion, and just noticeable differences analysis. Conclusions about the room's destination and modeling were drawn in the end. The paper presents the acoustical evaluation of an auditorium using an Omnidirectional loudspeaker for sound source and linear sweep sine signal for excitation. The hall was evaluated for 2 source positions. For the evaluation of the reverberation time, a photometer was also used for one source position. We did not detect important differences between the reverberation times determined in the 2 source positions with the unidirectional loudspeaker and with the photometer.

Assessment of classroom acoustics – A quantitative survey by Samir Gerges

Poor classroom acoustics is one of the main causes of unsuccessful learning and understanding of new and unfamiliar subjects, from kindergarten to high school. High background noise levels and excessive reverberation may frustrate and discourage students in the learning process and hinder teachers in the transfer of their knowledge and experience.

Legislation on building acoustics has been approved in several countries in order to face this problem. Acoustical requirements for buildings and special-purpose rooms such as

Classrooms are put forward to attain comfortable acoustical conditions for different uses. The acoustic comfort inside different purpose rooms stems from the combination of a variety of characteristics, the main ones being speech intelligibility, reverberation times, and background noise levels. This paper reports a quantitative survey carried out in a large number of classrooms. The results can point to different classrooms having a higher or a lower preference to attend classes. They could also explain a lower attendance in more theoretical classes in some of the rooms.

Design of room acoustics for open offices by **Jukka Keränen**

Noise control in open offices should aim at reducing disturbances caused by speech noise (I.e, improving speech privacy). Room acoustics can be controlled with high room absorption, high screens and bookcases, and sufficient masking sound. The interaction between these means is complicated, especially when speech privacy is studied at different distances from a speaking worker. The aim of this study was to develop a simple and fast model that predicts room acoustics in an open office in a way that has a high correlation with the experienced acoustic environment. Room acoustics were measured in 15 open offices. The model was developed using a multivariable regression analysis of the experimental data. The accuracy of the model was found to be sufficient for practical design work. The modeling tool is freely available on the Internet. It facilitates acoustical design significantly in all phases of building design. This study was a part of the national research program MAKSI (a perceived and modeled indoor environment),fund ed by TEKES (the national technology agency), the Finnish Institute of Occupational Health, and several participating companies.The companies who put their premises at our deposal are acknowledged. We thank all of the researchers, consultants, and the audience of seminars and companies for supporting comments that helped us in the creation of this approach.

2.2.2 UPVC WINDOWS

1) Recycling of UPVC by A.L. Kelly

On his paper described about recycling of UPVC window profile waste. The quality of untreated granular waste was compared to that of waste treated by a range of contaminant removal processes including melt filtration and dissolution. Product quality measurements such as mechanical properties and surface defects are made on extruded strip and the nature of stabilizers present were determined. The mechanical properties of recyclates were found to be comparable to better or than those of virgin material in all cases and conformed to industry standards for window profile.

2) Composite Stabilizers of UPVC by Peng Yonghong

Proposed about the contrast study of composite stabilizers of UPVC profiles for windows. The influence of lead package composite stabilizer, calcium-zinc package composite stabilizer on the heat stability and weathering performance of Unplasticised poly vinyl chloride were studied based on congo red test, gear oven ageing test and accelerated weathering test. The results indicated that the lead package composite stabilizer was the best composite stabilizer in the heat stability of UPVC, the calcium-zinc package composite stabilizer was the best in the weathering performance of UPVC. Vera Fernandes-Hachih[3], has described about influence of composition of UPVC on mechanical properties of window profiles exposed weathering. The durability of Unplasticised poly vinyl chloride components used in the building industry is a function of the interaction of several factors. Results of Charpy impact tests were used to assess the influence of three factors on the durability of the profiles and they are additivation levels of titanium dioxide, nature of the impact modifier and the nature of the thermal stabilizer. The influence of the composition of UPVC on mechanical properties of window profiles is demonstrated by means of the study of the modulus of elasticity. Results indicated the need for several additional experiments in order to check changes in molecular mass and color.

3) Durability of UPVC by Vera Fernandes-Hachih

Has determined the thermal, mechanical and acoustic properties of silica-aerogel/UPVC composites. The properties of silica-aerogel/UPVC composites have been investigated with an emphasis on sound and heat insulation. Hydrophobic silica aerogels were synthesized using silicate sodium precursors through a two-step sol-gel process. Then, the synthesized aerogels were mixed with UPVC compound at five different weight ratios in an internal mixer to find out the effects of silica aerogels on the thermal, mechanical, and acoustical characteristics. The results revealed that adding silica aerogel into the matrix of UPVC increases its hardness and softening temperature while decreasing impact strength. The sound absorption property of UPVC was increased up to three times by using silica aerogels due to its high porosity.

4) Determining the properties of UPVC by Navid Eskandari

Has made the comparison of windows with different types of materials. UPVC windows are good in aesthetics, durability, noise proof, and best air and water tightness. UPVC windows come with a very high-quality surface finish and soft contoured profiles. Due to their ability to conserve energy throughout their lifetime, UPVC windows are recognized as green windows thereby scoring over traditional timber and metal windows. They are the best fit for all weather conditions prevalent across India.

III. PROJECT PLANNING

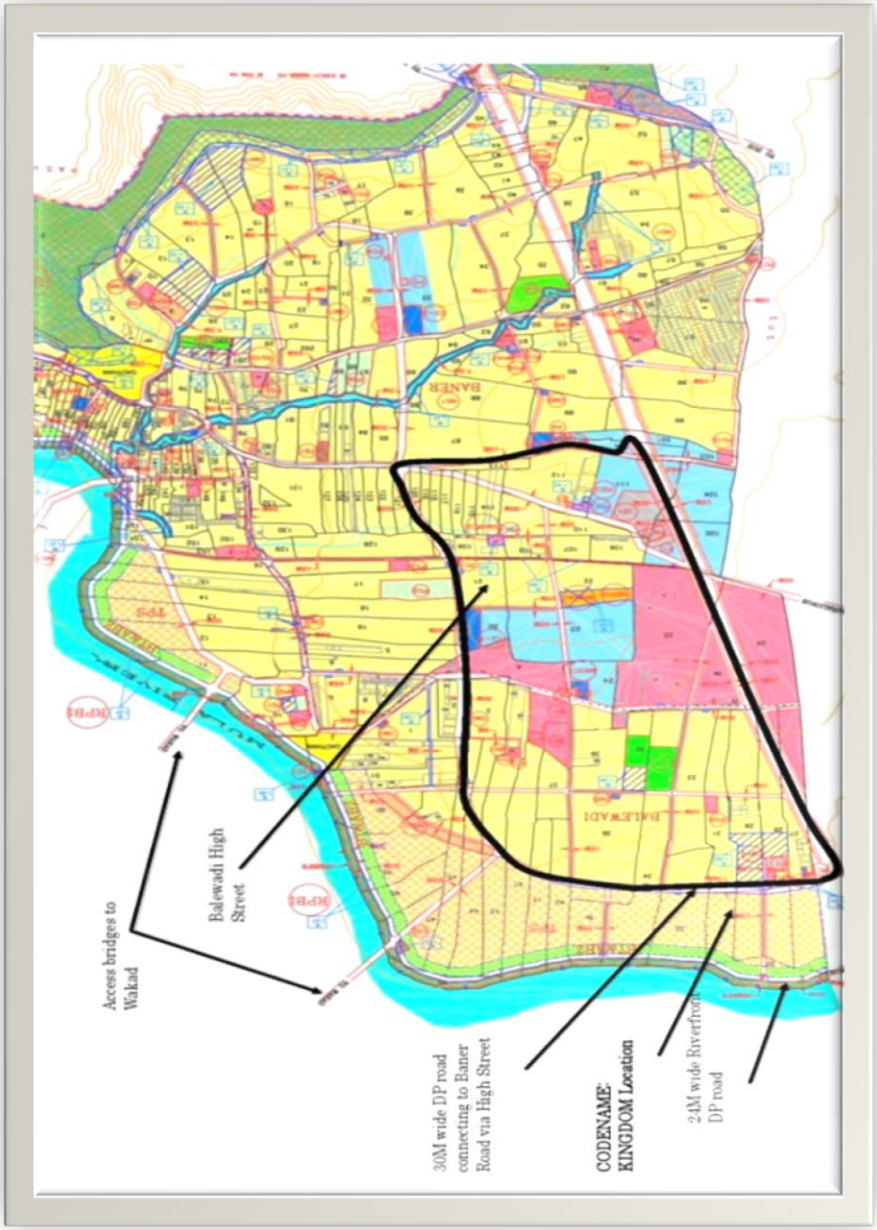
TABLE NO-3.1 SCHEDULE FOR PROJECT WORK

COLLECTION OF DATA									
LITEATURE REVIEW									
INTRODUCTION									
STUDY OF PROJECT									
SITE VISIT									
OTHER WORK									
CONCLUSION									

IV. DESIGN & CONSTRUCTION

4.1 CASE STUDY

The residential area of Baner starts just next to the Balewadi High Street. The restaurant owners have decided to use acoustics foam to reduce the noise caused due to pubs and also to provide the UPVC windows for the residential area which can restrict the noise from the neighboring disturbances.



4.2 Noise Levels in Restaurants and Pubs

It is impossible to run any business without generating some noise, the music and chatter of a busy pub can be a bone of contention with your neighbors, even though we all live our lives with noise constantly in the background.

Most of the time the noise emanating from a pub's nothing to worry about, but noise complaints tend to peak during the spring and summer when pub customers start using outside areas, windows are opened in the pub and neighbors start to enjoy their gardens and leave their windows open.

The level of "noise tolerance" is different for everyone, however, when the length of exposure to certain noise levels is exceeded or when one-off noises (peaks) are particularly loud – it can cause health and other problems to employees, customers, and neighbours.

In these circumstances, you are legally required to assess the risks of noise and take steps to control noise above fixed action levels.

Fig-4.2 Installation of Acoustic Foam on the roof.

4.3 Causes and Types of Noise

Noise pollution can be split into two categories: internal and external. Internal noise can present a health hazard in many business activities. Sources of workplace noise might include loud music in the bar, a disco in your function room or even a particularly noisy kitchen.

External or environmental noise, which emanates from your pub or is caused by your activities or those of your customers outside, your premises can impact on the public. Environmental noise may be regulated by the Environment Agency under the environmental permitting regime or by local authorities under statutory nuisance legislation. Under current legislation, members of the public may make a complaint against your business.

As a rule of thumb, you may have a noise problem if you have to shout to be heard by someone two meters away and/or people's ears ring after leaving your premises.

Continuous noises can present a hazard, for example, constant loud music in the bar, but noise can also be a hazard when it's sporadic for instance the noise of a boisterous set of football fans during a match you are screening.

The degree to which a noise presents a hazard depends on both its level and how long people are exposed to it. When assessing whether noise presents a health hazard consider its impact on:

1. You

2. Your employees
3. Your customers

You should also consider whether your business generates noise that could impact on members of the public living nearby.

4.4 Noise Pollution and Noise Complaints

The main legal duties apply where noise exposure in your business is likely to be at, or above, certain levels, known as "action values".

The main ones are 80 decibels and 85 decibels averaged over a working day or week – although there are also values relating to the maximum, or 'peak', noise to which employees are exposed.

Here are a few examples of decibel levels you might encounter in your pub:

1. Normal conversation 60-65 decibels
2. Noisy or crowded pub 70 – 80 decibels
3. Kitchen appliances 75 decibels
4. Amplified rock band – 120 decibels

Your focus should be on controlling noise through good practice rather than measurement. If anybody in your work has a daily personal noise exposure level at, or above, 80 decibels you must:

1.Carry out a noise risk assessment and check the actual level of noise exposure provide information and training about noise risk supply hearing protection to workers who ask for it

2. If the daily personal noise exposure level is 85 decibels or above you must: take steps to reduce exposure supply hearing protection to affected staff (and ensure that it is properly used and maintained)
3. Identify the area as a hearing protection zone
4. Where this is a risk to health, you must provide health checks and keep health records. This usually applies to workers frequently exposed to noise above 85 decibels.

You must also ensure that your employees are not exposed to noise levels above 87 decibels. This limit takes account of any reduction in exposure provided by hearing protection.

4.5 Noise Risk Assessment Process

The risks posed by noise generated by disco pub activities should be covered by your overall health and safety risks assessment for your business.

As with any risk assessment, your assessment of workplace noise should be carried out by a competent person and should:

1. Identify the sources of possible noise hazards
2. Determine who is at risk
3. Work out the daily personal noise exposure levels of employees
4. Note other noise risks, such as exposure to occasional but very loud noises
5. Assess whether current protective measures taken are sufficient
6. Decide what more can be done to provide hearing protection or control noise levels
7. Determine your priorities for action

4.6 Hearing Protection

The best way to reduce noise exposure in your business is to eliminate or reduce it at source. Hearing protection is a last resort and should only be used when all other reasonable steps have been taken to control risks or as a stop-gap measure.

You must provide hearing protection if a worker's noise exposure levels are:

1. Above 85 decibels
2. Between 80 and 85 decibels and they request hearing protection

4.7 Types of hearing protection include:

1. Earmuffs, which cover the ears – for instance might be used in your beer cellar
2. If the fans produce so much noise to make it a hazard earplugs, which go in the ears
3. Semi-inserts, which cover the entrance to the ear canal

4.8 Hearing protection should always:

1. Reduce noise exposure to below 85 decibels
2. Be compatible with other protective equipment worn
3. Fit properly
4. Be maintained in good condition
5. Be used correctly

4.9 Working of Acoustic Foam

Using foam panels, you can easily increase the noise absorption in any room of your house. However, many people expect more from this foam than it can deliver. If you are considering using Acoustic foam to Acoustic a room, you should understand how this foam works to ensure that it meets your needs.

Acoustic foam can help reduce background noises and echoes by absorbing some of the sounds. Depending on the type of foam, it may not necessarily keep sound from traveling into or out of the room.

There are two main groups of Acoustic foam. You can try Soundproofing foam, which can help block sounds. The other option is typically referred to as acoustic foam, but may still be marketed as Acoustic foam. The acoustic foam provides sound absorption, instead of real Soundproofing.

Soundproofing and sound absorption are two terms that are often used when referring to noise reduction products. However, they produce different results.

With Soundproofing, the material blocks sound, by preventing sound waves from traveling through the material. A Soundproofing material needs to be thick and dense, to help prevent the noise from penetrating the room. This is used when you need to block exterior noises from reaching the inside of a room.

With sound absorption, the sounds are absorbed by the material, reducing background sounds and reverberation. These materials tend to be light and porous, which is necessary for absorbing sounds.

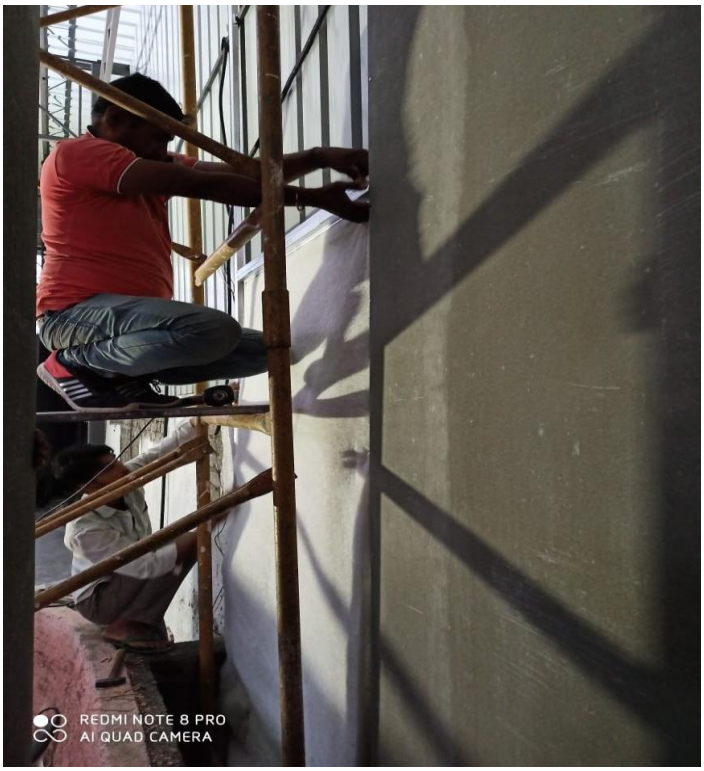


Fig-4.2 Installation of Acoustic Foam on the walls.

4.10 Soundproofing Foam Helps to Absorb Sounds

Most Soundproofing foam absorbs the sounds instead of fully blocking the sounds. The foam is typically sold in panels of varying sizes. When ordering the foam, you may even have it cut to size based on your specific needs.

The Acoustic foam panels are installed on walls to provide sound absorption. In some environments, the panels are installed in the corners of the room or hung from the ceiling. For the foam to be most effective, it should cover as much surface area as possible.

As mentioned, lightweight, porous materials are typically used to improve sound absorption and reduce reverberations in a room. Using polyurethane foam with extruded melamine foam, the material provides the perfect texture for sound absorption.

When sound hits the wall, instead of bouncing back or traveling through the wall, some of the sounds get absorbed by the foam material. This reduces echoes and helps create a quieter environment, which is why foam is often used in music recording studios.

For additional sound absorption, the foam panels typically have a pyramid or wedge shape molded into the side, allowing the sound to hit the foam from various angles, instead of providing a flat surface for the sounds to bounce off.

4.11 Soundproofing Foam to Help Block Sounds.

Along with the Acoustic foam that has a light, porous texture, there are denser foams designed to block sounds. These foams are closer to true Soundproofing, as the thicker material helps prevent sound from escaping or entering a room.

The thicker Acoustic foam may not feature the distinct pyramid or wedge shape found on the lighter materials. They are often flat panels that work best when installed inside the wall.

When choosing Acoustic foam, you should determine your reason for needing to Acoustic the room. If you want to block loud sounds or keep sounds from escaping the room, you should ensure that the foam is dense and thick, instead of light and porous. If you are content with moderate noise reduction and sound absorption, the lightweight foam should suit your needs.

4.12 Installation of UPVC Windows

UPVC window frames provide intense thermal and noise insulation. In such windows, a plastic powder called UPVC (unplasticized polyvinyl chloride) is used to make the frames for windows.

The first step is to heat the UPVC to a certain temperature and then, mould it as per the required shape. After it has been injected into a mould, several cooling methods are applied to it.

Then, the material is cut and prepared, along with other components to be assembled in the window. As UPVC does not have any chemicals or plasticizers, it is stronger than any other material available in the market.

UPVC windows are cost effective compared to other wooden windows. Apart from this, UPVC windows are highly durable and possess multipurpose functionalities.

Fig-4.2 Installation of UPVC Windows.

Fig-4.2 After installing UPVC Windows.

4.13 UPVC AS ACOUSTIC VIEW

To reduce the extent of neighborhood traffic, and building noise entering your home, consider windows and doors that are specifically designed for improved acoustic performance.

We are hardwired to crave and luxuriate in sunlight; it's in our DNA. Windows make this possible and intrinsically are vital to a properly laid out home. Numerous studies are done that show the link between emotions and sunlight.

Denied the warming rays of the sun for too long we humans become far less emotionally healthy and stable. This is why things like Seasonal major affective disorder exist – because sunlight plays an important and key role in our physical (think of all that Vitamin D) and emotional health.

Windows serve a massively important role therein they permit for us to dwell in structures (which is significant as we'd like to be shielded from the weather and have a secure place to live) and still still receive and absorb those nourishing rays.

Thinking back to our imaginary home without windows, you'll immediately get a way for a way bleak and confined that home would feel. Regardless of the quantity of artificial lighting you applied the house would still feel closed off, secluded, and stifling – windows are a key and essential a part of any home and that's why you'll likely never see a home without them!

Fig 4.4 Acoustic View of a residential building after installing UPVC Windows.

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