INVESTIGATION ON EFFECTIVENESS OF DIFFERENT TYPES OF NOISE BARRIERS

A Project report was submitted to

VELAGAPUDI RAMAKRISHNA

SIDDHARTHA ENGINEERING COLLEGE

In partial fulfillment of the requirements for the award of the Degree of

BACHELOR OF TECHNOLOGY

in

CIVIL ENGINEERING

by

PITTU YAMINI SINDHU	**(198W1A0143)**
KOLUSU LAKSHMI MANASA	**(198W1A0119)**
SHAIK SHARMILA BEGAM	**(198W1A0147)**
BHASKAR SAI CHAKRAVARTULA	**(198W1A0105)**

Under the esteemed guidance of

Dr. Chava Srinivas

PROFESSOR & HOD

DEPARTMENT OF CIVIL ENGINEERING

V.R. SIDDHARTHA ENGINEERING COLLEGE

(Autonomous)

(**AFFILIATED TO JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA)**

APPROVED BY AICTE – ACCREDITED BY NBA

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CERTIFICATE

This is to certify that the project report entitled **“INVESTIGATION ON EFFECTIVENESS OF DIFFERENT TYPES OF NOISE BARRIERS”** submitted by **“PITTU YAMINI SINDH (198W1A0143), KOLUSU LAKSHMI MANASA (198W1A0119), SHAIK SHARMILA BEGAM (198W1A0147),BHASKARA SAI CHAKRAVARTHULA (198W1A0105)”** in partial fulfillment for the award of the Degree of Bachelor of Technology in Civil Engineering to the VR Siddhartha Engineering College affiliated to JNTUK, Kakinada is a record of the bonafide work carried out under my guidance and supervision. The results presented in this project report have not been submitted to any other university or Institute for the award of any degree.

SIGNATURE OF THE GUIDE

NAME : **Dr. Chava Srinivas**

DATE :

HEAD OF THE DEPARTMENT

NAME : **Dr. Chava Srinivas**

DATE :

DECLARATION

I hereby declared that the **"INVESTIGATION ON EFFECTIVENESS OF DIFFERENT TYPES OF NOISE BARRIERS"** is a Bonafide work duly completed by us. It doesn't contain any part of the project or thesis submitted by any other candidate to this or any other institute or university.

All such materials that have been obtained from other sources have been duly acknowledged.

PITTU YAMINI SINDHU (198W1A0143)

KOLUSU LAKSHMI MANASA (198W1A0119)

SHAIK SHARMILA BEGAM (198W1A0147)

BHASKAR SAI CHAKRAVARTULA (198W1A0105)

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PITTU YAMINI SINDHU (198W1A0143)

KOLUSU LAKSHMI MANASA (198W1A0119)

SHAIK SHARMILA BEGAM (198W1A0147)

BHASKAR SAI CHAKRAVARTULA (198W1A0105)

ABSTRACT

In recent years, with the rapid development of highways, traffic noise has become a risk source in the environment, and noise control has attracted wide attention. As an economical and effective method, highway noise barriers were the best way to reduce traffic noise and protect residents. At the same time, considering the various surroundings in selecting suitable materials (sound-reflective or sound-absorbing materials), types (such as concrete and metal noise barriers could greatly improve the sound reduction performance of barriers. This study investigates the effectiveness of existing noise barriers of different types. It is mainly focused on the natural sound barriers of low and high-dense plantations and noise barriers of polycarbonate sheets. The efficiency of the barrier was determined by its insertion loss of broadband noise and attenuation of low frequency in the range of 20 to 200 Hz. These are solid obstructions built between the highway and the homes along a highway and are generally seen as effective means by which noise propagation can be mitigated.

Keywords: *Noise barrier, Flyover, Noise Adsorption, Noise Reduction, Traffic Noise, Barrier effect*

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ABBREVIATIONS

CPCB	Central Pollution Control Board
STC	Sound Transmission Class
OITC	Outdoor Indoor Transmission Class
ODOT	Ohio Department of Transportation
LFN	Low Frequency Noise
WHO	World Health Organization
Leq	Equivalent continuous sound pressure level

CHAPTER - I

1. INTRODUCTION

1.1 Noise barriers:

Noise barriers can provide numerous benefits to communities, such as reducing noise pollution, improving the quality of life for residents, and increasing property values. They can also help to protect wildlife habitats and minimize the negative impact of noise on their health and behavior. Although it has gotten less attention than other environmental problems like air and water pollution, noise pollution is a phenomenon that must be addressed in many locations worldwide. Around 55% of the world's population has been exposed to the consequences of road traffic noise in particular and transportation-related noise in general during the past 40 years. As a result of more research being done in the field of noise science, noise barriers have slowly come to be accepted as a means of noise management. Although costly, noise barriers are often employed to prevent noise from spreading along roadways and railway lines. Traffic noise is linked to hearing loss, mental tiredness, mental stress, headaches, hypertension, heart damage, and several other physical and biological problems such as alterations in digestion, metabolism, and blood circulation. Your hearing may begin to be harmed if exposed to noise exceeding 70 dB for an extended length of time. Your ears might suffer instant damage from loud noise exceeding 120 dB. Highway noise barriers are used to reduce the effect of traffic noise along the route.

Figure 1.1. This noise abatement wall in the Netherlands has a transparent section at the driver's eye level to reduce the visual impact forroad users.

In general, noise barriers prevent sound from travelling directly from the traffic source to the exposed receiver. Trees can serve as a natural noise barrier by limiting the amount of noise that reaches a particular location, such as a residential neighbourhood or a park, from a noise source, such as a highway or railway. Trees have the ability to absorb, reflect, and deflect sound waves, which lowers noise levels and enhances the acoustics of the surrounding area via their leaves, branches, and stems, trees absorb sound waves. High-frequency sound waves may be absorbed by a tree's leaves and branches, while low-frequency sound waves can be absorbed by the tree's trunk and stem. Its absorption effect aids in lowering ambient noise levels. Moreover, trees reflect and deflect sound waves, which can lessen the volume of noise that reaches a particular region. Some sound waves are reflected back towards the noise source when they come into contact with a tree, while other waves are diffracted around the tree. As a result, the strength of the sound waves and the degree of background noise may be reduced. Many variables, including the kind and size of the trees, their placement, and the distance between the trees and the noise source, affect how efficient trees are at blocking noise. A row of tall, closely spaced trees may significantly reduce noise levels, especially when used in conjunction with other noise-cancelling techniques like walls or berms. In general, trees may help enhance acoustics and lower noise pollution in urban and suburban environments in a way that is both efficient and ecologically being.

1.2 Natural sound barrier:

Trees act as noise barriers and reduce pollution through a phenomenon called sound attenuation, which is the damping of sound. In general, noise attenuation happenswhen sound waves dissipate over longer distances until there’s no energy left to vibrate the air. Trees attenuate noise by absorption, deflection, refraction, and masking.

Figure 1.2. Single-row plantation

Noise absorption by plants: Tree parts suchas stems, leaves, branches, and wood absorb sound waves. Thick, rough bark and fleshy leaves are particularly effective at sound absorption due to their dynamic surface area.In the case of shrubs, their size matters.

Sound deflection by plants: When sound waves hit the massive tree trunks, the trunks do not vibrate because they are rigid. Sound waves are reflected off the trunks and back toward the source. Whereas when sound hitsa flexible surface like leaves, leaves will vibrate and sound waves are transformed intoother energy forms. It can also change the phase of a sound, which can cause interference in sound waves and noisereduction.

Sound refraction by plants: As we know sound waves can be refracted. For example, if sound hit on solid floors, the waves bounceall over and create echoes; and with carpeting, the echoes disappear. Ground-covering plants, vines on walls, and green walls help achieve the same effect.

Sound masking by plants: Trees mask annoying noise when branches sway, leaves rustle, or stems creak. Trees and shrubs also attract birds and squirrels, whose chirping and squeaking help with masking noise pollution.

Figure 1.3. Double-row plantation

Published results by Huddart show that noise can be reduced by 6dB over a distance of 30 m when the noise barrier is dense with vegetation. Another study concluded that a dense tree-shrub belt of 15-30 m wide could reduce noise levels by 6-10dB. The percentage of noise control a tree can provide depends on several factors they are i) intensity, frequency, and direction of the sound and ii) location, height, width, and density of the tree. However, as a rule of thumb, a tree barrier with an open distance of 100 feet can reduce sound by 21dB. Research shows that soft ground surfaces attenuate low-frequency noise, while trees and shrubs attenuate high frequencies. Sound attenuation studies on traffic noise screening indicate that foliage can reduce frequencies in the range of 250 Hz to 2000 Hz or above.

The same studies showed tree trunks scattered the mid frequencies. Since most traffic noise peaks at mid-frequencies (1000 – 2000Hz), a dense noise barrier is suggested to attain effective noise reduction. The research also concluded that a 30 m dense plantation can give a noise reduction of 6dB.

1.3 Acoustic performance of Noise barrier:

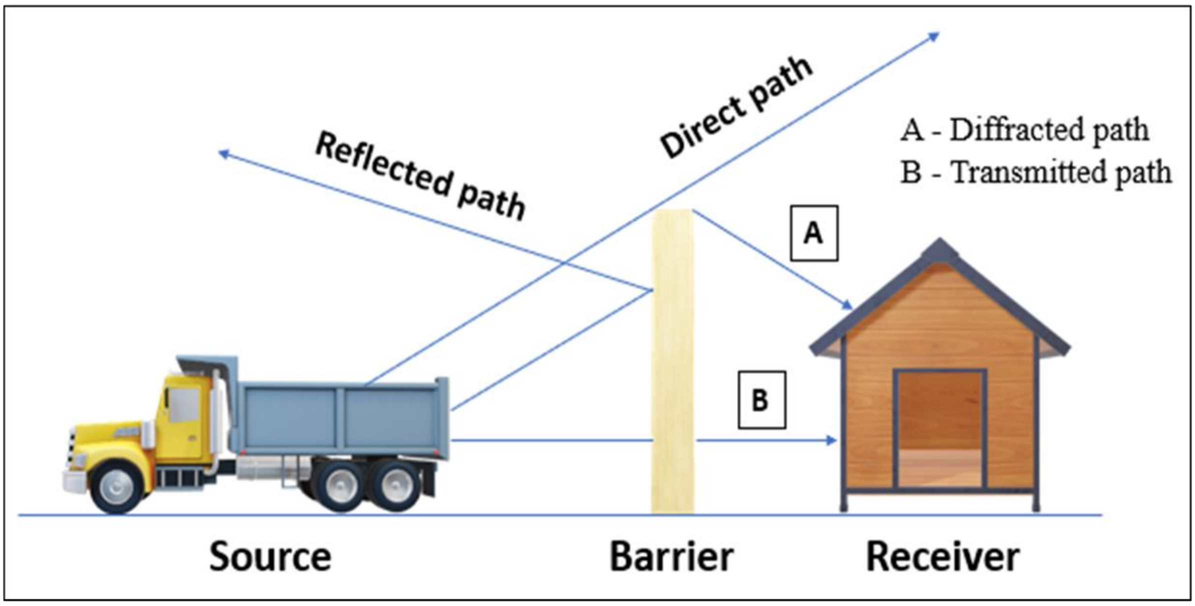


Figure 1.4. Acoustic performance of noise barrier

The acoustic performance of a noise barrier is a measure of how effective it is in reducing the amount of noise that travels from a noise source, such as a highway or railway, to a specific area, such as a residential neighbourhood or a park. The performance of a noise barrier is typically expressed in terms of its Sound Transmission Class (STC) or its Outdoor-Indoor Transmission Class (OITC). The STC is a rating that indicates the amount of sound that a barrier can block or absorb. It is measured in decibels (dB) and ranges from 0 (no sound reduction) to 100 (complete sound reduction). The higher the STC rating, the more effective the barrier is in reducing the amount of sound that passes through it. The OITC is a measure of the barrier's ability to reduce the amount of sound that travels from an outdoor noise source to an indoor space. It takes into account the sound frequencies that are most commonly associated with outdoor noise sources, such as traffic and aircraft, and is measured on a scale from 0 to 100.

A higher OITC rating indicates that the barrier is more effective in reducing the amount of outdoor noise that enters an indoor space. The acoustic performance of a noise barrier depends on various factors, such as its height, length, thickness, and the materials used to construct it. A taller and thicker barrier made from dense materials, such as concrete or masonry, can provide a higher STC and OITC rating than a shorter and thinner barrier made from lightweight materials, such as wood or plastic. In addition to the barrier itself, the acoustic performance also depends on the surrounding environment, including the distance between the barrier and the noise source, the type of noise source, and the terrain and topography of the area. Therefore, a comprehensive noise study is typically conducted to determine the appropriate height, length, and location of a noise barrier to achieve the desired level of acoustic performance.

Reflected path: A reflected path refers to the path that sound takes when it reflects off a surface and reaches the listener or receiver. Reflected sound can either add to or subtract from the direct sound, depending on the phase relationship between the two sounds. Direct path: The direct path is the most direct path that sound waves take from the source to the receiver, without being obstructed or reflected by any barriers or surfaces. The direct sound level is determined by the distance between the source and the receiver, as well as the acoustic characteristics of the surrounding environment.

Transmission path: The transmission path refers to the path that sound waves take when they pass through or around a noise barrier. When sound waves encounter a noise barrier, they can be absorbed, reflected, transmitted, or diffracted, depending on the acoustic properties of the barrier and the frequency of the sound waves. The sound level on the transmission path depends on the transmission loss of the barrier, which is the difference in sound levels between the source side and the receiver side of the barrier. Diffracted path:

The diffracted path: The diffracted path is the path that sound waves take when they diffract, or bend around, an obstacle, such as a noise barrier or building. When sound waves encounter an obstacle, they can bend around the edge of the obstacle and continue to propagate in the diffracted path. The sound level on the diffracted path depends on the diffraction loss, which is the difference in sound levels between the direct path and the diffracted path.

1.4 TYPES OF BARRIERS:

1. Wood Barriers:

Wood fences are an affordable and attractive option for any garden and are common in most households. However, most wood fences are ineffective as a noise barrier due to their lack of mass, air gaps, damage, and height.

Figure 1.5. Wood Noise Barrier

Wood barriers can be an effective solution for reducing noise in certain situations. For example, wooden acoustic barriers can be used along highways or other noisy areas to reduce the amount of sound that reaches nearby homes or businesses. The design and construction of the barrier are important factors in determining its effectiveness in reducing noise.

One of the primary ways in which wood barriers reduce noise is by blocking or absorbing sound waves. When sound waves encounter a solid surface like a wooden barrier, some of the energy is reflected back while some of it is absorbed by the material. The more solid and dense the material, the more effective it is at reflecting and absorbing sound waves. Wooden barriers are typically less dense than other materials like concrete, but they can still be effective at reducing noise levels.

Another way in which wooden barriers can reduce noise is by redirecting sound waves away from sensitive areas. For example, a wooden barrier placed along a highway can help redirect the sound waves upward and away from nearby homes, reducing the amount of noise that reaches the residents.

The effectiveness of wooden barriers in reducing noise depends on several factors, including the height and length of the barrier, the type of wood used, and the placement of the barrier relative to the source of the noise. In general, taller and longer barriers are more effective at reducing noise than shorter and smaller ones. The type of wood used can also make a difference, as denser woods like oak or maple are more effective at reducing noise than softer woods like pine or cedar

2. Metal Barriers:

Metal barriers are impressive structures due to their modular construction. They are cost-effective and quick to install. There are absorptive options to prevent sound reflecting, whereas a non-absorptive choice can cause the sound to reflect into unexpected areas in an unpredictable manner. The benefit of steel is that it can be molded in various ways to meet specific barrier requirements.

Figure 1.6. Metal Noise Barrier

Metal barriers are commonly used as noise barriers alongside highways, busy roads, and other sources of traffic noise. They are designed to reduce the amount of noise that reaches nearby homes, businesses, and other sensitive areas.

The effectiveness of metal barriers for reducing traffic noise depends on several factors, including the height and length of the barrier, the type of metal used, and the placement of the barrier relative to the source of the noise. In general, taller and longer barriers are more effective at reducing noise than shorter and smaller ones. The type of metal used can also make a difference, as denser metals like steel or aluminum are more effective at reducing noise than lighter metals like copper or zinc.

Metal barriers can reduce traffic noise in several ways. One of the primary ways is by reflecting sound waves away from sensitive areas. When sound waves encounter a solid surface like a metal barrier, some of the energy is reflected back while some of it is absorbed by the material. The more solid and dense the material, the more effective it is at reflecting and absorbing sound waves.

Metal barriers are typically denser than wood barriers, which makes them more effective at reducing noise levels. Another way in which metal barriers can reduce traffic noise is by creating a barrier between the source of the noise and the sensitive areas. For example, a metal barrier placed alongside a highway can help block the sound waves from reaching nearby homes or businesses. This is particularly effective when the barrier is placed close to the source of the noise.

Metal barriers can also help redirect sound waves away from sensitive areas. For example, a curved metal barrier can help redirect sound waves upward and away from nearby homes, reducing the amount of noise that reaches the residents.

3. Concrete Barriers:

This is a solid long-term investment because the material is long-lasting and extremely durable. This is why this solution exists along with the majority of highways throughout the world and many installations are decades old. However, being one of the most expensive options available this may not be an affordable option in most cases and may be an unnecessary expense based on your requirements.

Figure 1.7. Concrete Noise Barrier

Concrete barriers are often used as noise barriers in urban environments, particularly alongside busy roads and highways. They are designed to reduce the amount of noise that reaches nearby homes, businesses, and other sensitive areas.

The effectiveness of concrete barriers for reducing noise depends on several factors, including the height and thickness of the barrier, the type of concrete used, and the placement of the barrier relative to the source of the noise. In general, taller and thicker barriers are more effective at reducing noise than shorter and thinner ones. The type of concrete used can also make a difference, as denser concrete is more effective at reducing noise than lighter concrete.

Concrete barriers can reduce noise in several ways. One of the primary ways is by absorbing sound waves. When sound waves encounter a solid surface like a concrete barrier, the material absorbs some of the energy. The more solid and dense the material, the more effective it is at absorbing sound waves. Concrete barriers are typically denser than other types of barriers, which makes them more effective at reducing noise levels.

Another way in which concrete barriers can reduce noise is by creating a barrier between the source of the noise and the sensitive areas. For example, a concrete barrier placed alongside a highway can help block the sound waves from reaching nearby homes or businesses. This is particularly effective when the barrier is placed close to the source of the noise. Concrete barriers can also help redirect sound waves away from sensitive areas. For example, a curved concrete barrier can help redirect sound waves upward and away from nearby homes, reducing the amount of noise that reaches the residents.

Overall, concrete barriers can be an effective solution for reducing noise, particularly in situations where higher levels of noise reduction are required. When used in combination with other noise-reducing measures, such as soundproof windows or insulation, concrete barriers can help create a more peaceful and comfortable environment for nearby residents and businesses. However, it is important to ensure that the design and construction of the barrier is appropriate for the specific situation, as poorly designed or constructed barriers may not be effective at reducing noise levels.

4. Glass, Polycarbonate, or Acrylic Sheet Barrier:

Acrylic and toughened glass fences obstruct the line of sight to road traffic and are mainly used to reflect sound from roads. They provide a high aesthetic benefit of glass with a long lifespan and sound absorption qualities at affordable prices. Glass, polycarbonate, or acrylic sheet barriers can be effective at reducing noise in certain situations. These types of barriers are often used for interior applications, such as in office spaces or industrial facilities, as well as for outdoor applications, such as along highways or near airports.

Figure 1.8. Glass Noise Barrier

The effectiveness of glass, polycarbonate, or acrylic sheet barriers for reducing noise depends on several factors, including the thickness and material of the sheet, the size and placement of the barrier, and the specific sound frequency being targeted. In general, thicker sheets of glass or polycarbonate are more effective at reducing noise than thinner sheets, as they are better at absorbing and reflecting sound waves. Acrylic sheets are also effective at reducing noise, but they are typically not as durable as glass or polycarbonate.

Glass, polycarbonate, or acrylic sheet barriers can reduce noise in several ways. One way is by absorbing sound waves. When sound waves encounter a solid surface like a sheet of glass or polycarbonate, the material absorbs some of the energy. Thicker sheets are more effective at absorbing sound waves than thinner sheets. Another way in which these types of barriers can reduce noise is by reflecting sound waves away from sensitive areas. For example, a glass or polycarbonate barrier placed alongside a busy road can help reflect sound waves away from nearby homes or businesses.

However, it is important to note that glass, polycarbonate, or acrylic sheet barriers may not be as effective at reducing noise as other types of barriers, such as concrete or metal barriers. This is because glass, polycarbonate, and acrylic sheet barriers are typically not as dense or heavy as other types of barriers, which makes them less effective at absorbing sound waves. Overall, glass, polycarbonate, or acrylic sheet barriers can be an effective solution for reducing noise in certain situations, particularly for interior applications or for outdoor areas where aesthetics are important. However, it is important to consider the specific needs of the situation and to consult with a professional to ensure that the barrier is designed and constructed properly to achieve the desired level of noise reduction.

1.3.1. AIM:

- The investigation should provide a comprehensive evaluation of the different types of noise barriers and inform the selection of themost effective and acceptablesolution for reducing noise pollution in a specific area.
- The results should be used to develop and implement effective noise reduction strategies that consider the area's specific circumstances and local conditions and the availability of resources.

1.3.2.OBJECTIVES:

- The primary objective of implementing noise barriers is to reduce the level of noise pollution andimprove the quality of life for communities exposed to excessive noise.
- To improve the performance of the acoustical environment in schools, hospitals, and other facilities where noise reduction is important for learning, healing, and productivity.
- To identify best practices andrecommended guidelines for implementing effective noise barriersin different communities.

1.3.3.APPLICATIONS:

- Protect inhabitants of sensitive land use areas and also provides peace and safety to the patients in hospitals from noise pollution.
- Noise barriers force the pollution plumes coming from the road to move up and over the barrier creating the effect of an elevated source and enhancing the vertical dispersion of the plume.
- Frequently useful in cases where noise regulations are based on distance or property lines. In these instances, a facility is required to meet a certain decibel level at the property line itself or within a specified distance from the facility. When facilities are required to meet such property line-based regulations, even if no affected residences or sound-sensitive areas are nearby, the use of an acoustical wall can be extremely efficient and cost-effective in meeting the technicalities of the regulations.

CHAPTER – II

2. LITERATURE REVIEW:

Here are some case studies which we have gone through during our literature study.

2.1 Hocine Bougdah et.al,

Investigation of barrier performance is generally undertaken by a combination of modelling and full-scale testing. Full-scale on-site testing gives the true performance of a barrier however, the need to monitor manyvariables in an outdoor environment and the time required to undertake representative testing can make this method very expensive. Therefore, before undertaking any on-site testing, modelling techniques are generally employed, which provide well-controlled testenvironments. In this way, barrier profiles likely to perform better than others can be identified.

2.2 Satish K. Lokhande, Divyashree Sakhare et.al,

The evaluation based on the critical review ofthe response to road-induced noise impacts leads to the conclusion that the designing of eco-friendly noise barriers is a dire need as it provides the dual advantage of utilizing waste material and reducing noise levels. Theuse of waste materials and their possible effective utilization in the construction ofnoise barriers is a sustainable approach that needs to be practiced. If such concepts are given due attention, it will help in the economic designing of barrier structures and also somewhat lessen the burden of discardedwaste providing their proper management.

2.3 Herni Halim, Ramdzani Abdullahet.al,

Vegetation recorded the lowest insertion lossin this study. The concrete hollow blocks are fairly effective as noise barriers to protect receivers from traffic noise pollution. Moreover, the concrete panel has stable and sufficient insertion loss recorded during the measurement session. This was also due to the diffraction and refraction of noise waves by the flat and solid surface of concrete hollow blocks facing the highway. The cavities inside both concrete hollow block and concrete panel noise barriers help to absorb the noise from traffic on the highway.The precast concrete panels perform aconsistent insertion loss throughout all measurements.

2.4 Inan Ekici et.al,

During the past four decades, extensive research has been carried out on different noise barrier shapes using analytical and physical modeling as well as full-scale testing. This paper reviews traffic noise barrier research and its findings to date. It provides a catalog of noise barrier profiles identifying the relative acoustic benefits of each and the physical principles on which they operate. The likely effects of ground andatmospheric conditions on their absolute acoustic performance are described. The types of barriers that are commonly used in practice and those deserving further attention are highlighted. Based on the findings ofprevious work, recommendations are made on possible areas of further research.

2.5 Jennifer Louise Rose Joynt et.al,

One of the key aspects of noise barrier designand implementation is the lack of community involvement through public participation procedures. Through the experience of the development process of noise Barrier and consultation with The Highways Agency, it has been identified that the development of these structures is largely perceived as an engineering problem, of which only expert opinion can be beneficial. Consequently, the fundamental role of the public as objective evaluators is marginalized, and as a result solutions are imposed upon them withouttheir full integration or approval.

2.6 A. Mital, A S Ramakrishnan et.al,

The objective of this study was to determine the actual and perceived effectiveness of noise barriers along interstate highways. Using a 5-mile section of Interstate 71 in the greater Cincinnati area as the study area, traffic noise readings, and opinions of residents living along the sections of the highway were recorded. Noise readings weretaken before and after the noise barriers wereerected. A questionnaire was designed to elicit noise-related annoyance from the residents in the areas adjoining the highway. The results indicated that, in general, noise barriers were effective as indicated by a reduction in noise levels by as much as 11 dBA.

2.7 Mats E. Nilsson et.al,

Eighteen listeners scaled the annoyance of the experimental sounds with the method of magnitude estimation. The barrier sounds recorded 10-45 m from the road and non- barrier sounds recorded 50-200 m from the road were of similar L(A). Despite this, the barrier sounds were found to be moreannoying than the non-barrier sounds. The annoyance difference corresponded to approximately a 3 dB increase in L(A) and was mainly related to the barrier sounds higher relative level of low-frequency sound.This suggests that L(A) reduction may not bea valid indicator of the annoyance reduction caused by a noise barrier.

2.8 Andrew Carnegie, Tristan Thompson,et.al,

İstanbul is the most prominent Turkish city interms of the gradually worsening noise problems associated with the rapid increase in population. This study aims to investigate the noise exposure in the settlements around the link roads connecting the Bosporus Bridge to the European side of the city with the aid of simulations and noise mapping, in the frame of action planning studies performed in İstanbul. Noise maps were generated for L den and Ln noise indicators with the help of noise mapping software. Since a considerable part of the settlements isexposed to high noise levels, a noise barrier alongside the link road was proposed as a control measure with the aid of the acoustic simulation.

2.9 Aravind Shukla et.al,

The paper analyzed the existing noise levels in urban areas due to the movement of vehicles. Therefore, the entire city of Lucknow has been divided into different zones on the basis of different land use. The effect of other factors like the type of terrain,speed of traffic, the cross-section of roads, and traffic composition has also been considered during noise data analysis. In thispaper noise levels on the flyover in front of Engineering college (IET Lucknow UP India) has been taken for study and a noise barrier for this location has been designed forpredicted noise levels worked.

2.10 Lloyd A. Herman, Michael A. Finneyet.al,

In 1988, the Ohio Department of Transportation (ODOT) studied the I-71 corridor in Hamilton County, north of Cincinnati, to determine the environmental impacts of traffic lane additions. Residents were surveyed to determine the attitudes andperceptions of the effectiveness of the noise barriers in reducing traffic noise in the neighborhoods adjacent to I-71. Several survey options were considered: mail out/mail back, hand out/mail back, and telephone. The telephone survey was chosen for several reasons. The ratio of respondents reacting positively to the questions about thenoise barrier ranged from 1 in 5 to 1 in 7.

2.11 Inan Ekici, Hocine Bougdah et.al,

The polycarbonate/acrylic noise barriers are designed to be eco-friendly. It provides the required acoustic attenuation and is built to sustain in an outdoor environment. Outdoor properties: The noise barrier structure can withstand high-velocity wind and air pressure changes. The structure is firmly fixed and will not give way in adverse weather conditions. Safety: The noise barriers are safe in every aspect. The possibility of a mishap f rom the barrier structure is eliminated. The barriers are madefrom safe materials that are non-harmful to the atmosphere. Noise blockage: The barriersare designed in a manner to provide a substantial noise blockage. The height of thebarrier is calculated as per the sound attenuation requirement, which considers theheight of the source and the height of the area that needs noise protection.

2.12 Darus, N. Yahya, K. Jahya et.al

Physically, the investigated barrier has a height within the range of the typical height of a noise barrier (4m). The efficiency of the barrier was determined by its insertion loss of broadband noise and attenuation of low frequency in the range of 20 to 200 Hz. The insertion loss is the difference in the noise environment after the barrier is constructed and the free field. It was found despite the unsatisfactory field condition of the barrier, investigation at the receiver height of 1.5m shows that the barrier is still an effective method of abating transportation noise at a distance of more than 3.5m behind the wall. However, the disturbance-free from traffic noise still cannot be granted as the noise level behind the wall still exceeded the WHO permissible limit the for school playing area and the LFN exceeded the suggested limit.

2.13 Vijaya Laxmi, Chaitanya Thakre et.al,

The acoustical material can curtail the quality of sound or enhance the dispersion, depending on the application being considered. The efficient acoustic performance of noise barriers possessing different shapes and materials including waste materials is reviewed for field implementation to achieve the low-cost sustainable noise barrier application in the Indian context. The review analysis of research papers demonstrates that the acoustic performance of barriers is dependent on different shapes, materials, and textures as well as onsite geometry. Based on the review study, T-shaped barriers with a soft top surface are found to be efficient at noise attenuation. For transparent barriers, perceived loudness and noise annoyance are assessed lower than that for opaque barriers, and utilization of waste materials viz. plastic, rubber, bottom coal ash, etc. gives high noise attenuation along with low-cost efficiency.

2.14 K. Polcak, R.J. Peppin et.al,

A motorway noise barrier, also known as a highway noise barrier, is a panel that is placed between the noise source and the noise-affected area to provide sound insulation. These products, also called noise barriers, are often used to prevent the spread of traffic noise along lines such as roads. Noise-generating generators, compressors, etc. It is also used to prevent the spread of noise around machines such as. On the noise source side, some of the sounds that hit the screen are absorbed by the screen. This also improves the noise level on the noise source side in today’s world, the demand for vehicles such as cars and public transportation has increased considerably. This situation caused serious noise and noise pollution in the residential and commercial areas around the metropolitan and urban highways, railways, and bridges.

2.15 Shahiron Shahidan, Nurul izzati raihan ramzi hannan et.al,

Effective noise barriers are usually able to reduce noise levels by 5 to 10 dB(A) and heavily depend on their dimensions as well as the location of the noise sources and the noise receivers. The ability of environmental noise barriers to reduce A-weighted noise levels depends on its design, materials, the density of absorbent material, porosity, and thickness A reduction of as much as 5 dB(A) in noise level produced can be achieved if the noise barrier surface density exceeds 20kg/m2 and possesses a height tall enough to break the line of sight from the road to the receiver. An additional 1.5 dB (A) reduction can be achieved for each additional meter of height.

2.16 Timothy Van Renterghem, Dick Botteldooren et.al,

The effect of a row of trees (in leaf) behind a noise barrier in wind is investigated. An experiment was set up along a highway. Measurements at a location with and without a row of trees behind a noise barrier were compared. This continuous monitoring lasted from the middle of the summer till the middle of fall. It is shown that for downwind sound propagation for an orthogonal incident wind, the efficiency of the noise barrier with trees becomes increasingly better compared to the noise barrier without trees, with increasing wind speed. The improvement by the trees is only slightly affected if the wind direction is not perfectly orthogonal to the barrier. Upwind sound propagation is affected only to a small degree by placing trees. Diffraction on the canopy of trees does not result in an increased total a-weighted sound pressure level due to the typical low-frequency spectrum of traffic noise. The presence of a row of trees behind a noise barrier results in increased sound pressure levels at high frequencies due to scattering on the canopy of the trees.

2.17 D.DuhamelP. Sergent et.al,

The main purpose of this article is to present a numerical method for calculating the sound pressure around noise barriers of arbitrary geometry. Varying impedance boundary conditions on the barrier and constant impedance on the ground are assumed. Sound propagation over an infinite barrier with a constant cross-section for a harmonic point source is determined by solving 2D problems only, avoiding the computational complexity of the solution of a true 3D problem. This can be done by using the solutions of a set of 2D models for a coherent line source for real and imaginary wavenumbers.

2.18 Yasar Avsar, M.Talha Gonullu et.al,

This initial analysis evaluating present school establishment rules puts forward a total disregard in this matter; it also suggests having an appropriate outdoor noise level. Using noise data obtained from a realized test roadwork, noise data derived for different traffic load levels by calculations showed that even one lane in a direction gives a noise level higher than 55 dBA. For this restrictive reason, using noise abatement barriers or other noise-protective materials is very necessary. It is possible that concrete walls of appropriate height and length near the road length near the embankment with bushes between the traffic current and the school, and also a combination of noise barriers such as vegetation and concrete walls or porous road pavements may decrease the outdoor noise level to less than 55 dBA in schools.

2.19 Randhawa Rominder et.al,

Construction of a flyover is often coupled with major changes in the environment. Many people in Delhi are exposed to high levels of traffic noise above the planning standards given by the Central Pollution Control Board. No Traffic Engineering improvement of a highway project is without both gains and losses. There is excessive traffic in Delhi and there is also limited scope to adopt traffic management solutions. So, in urbanized areas, the most effective reduction of traffic noise disturbances was obtained by implementing noise barriers or enclosures.

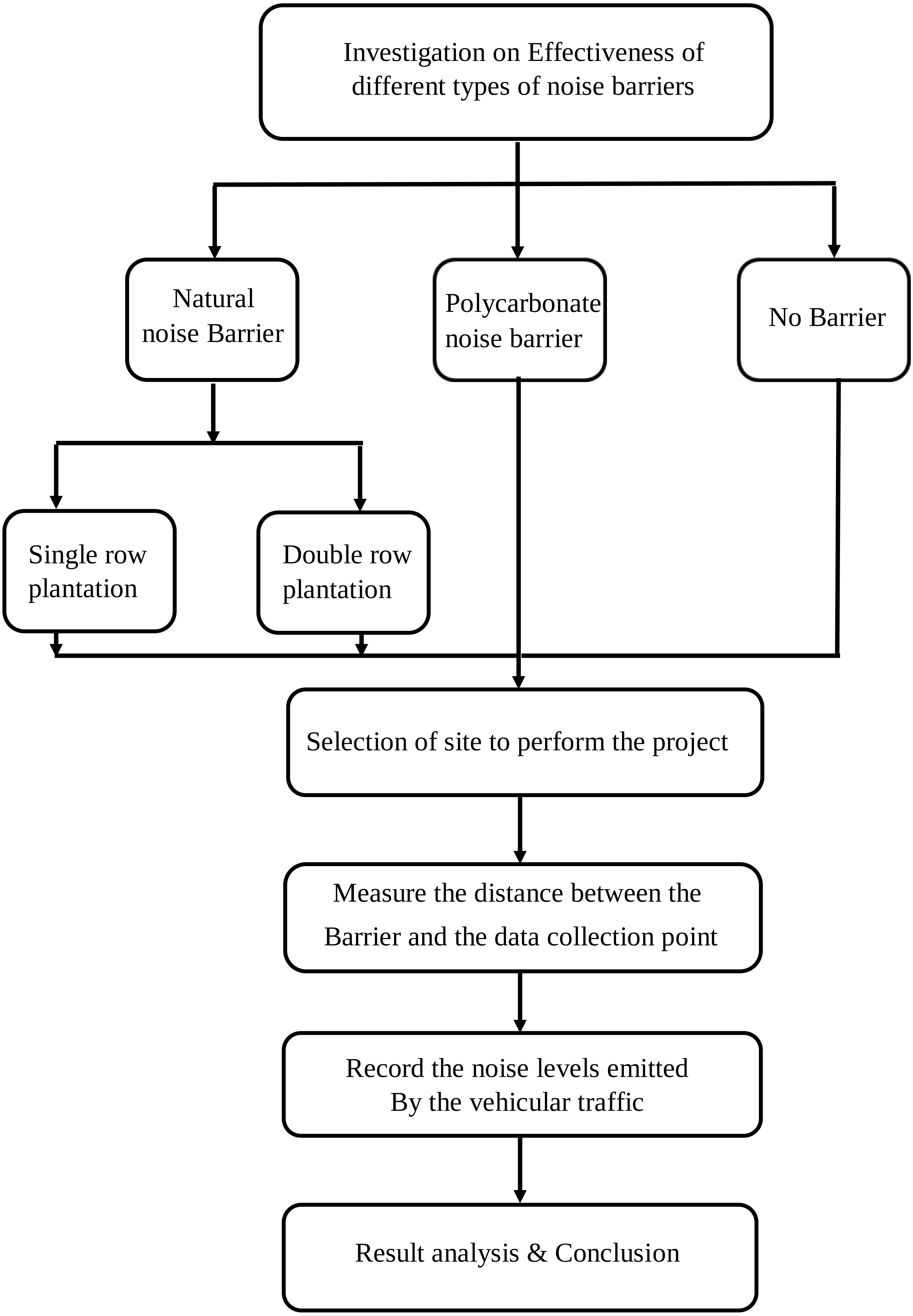
2.20 Z Haron et.al,

The study investigates the effectiveness of an existing noise wall barrier installed in a school for shielding noise from heavy traffic in Malaysia. In Malaysia studies in school, areas have been conducted since the 1980s covering west Malaysia even before the establishment of noise regulation. These include noise levels conducted in school at three schools in Klang Valley in 1985. All these selected schools exceeded the 55dB is the recommendation by the WHO for outdoor school areas that may affect teachers and Students performance. It was found that the barrier efficiently achieved an insertion loss of 5 decibles.

CHAPTER - III

7. METHODOLOGY:

7.1 Basic Flowchart:



- Identification of noise sources: The first step is to identify the sources of noise pollution in the selected area of interest, including traffic, industry, construction sites, and other sources of noise.
- Barrier Location: The location of natural noise barriers (single row plantation, double row plantation) and polycarbonate noise barrier are selected to observe the noise levels.
- Measurement of noise levels: The first step is to measure the current noise levels in the selected area of interest using equipment such as a sound level meter (UNI-T 353).
- Comparison of results: The results from the different types of noise barriers are compared to determine the most effective solution for reducing noise pollution in interest.

It is important to note that the methodology for investigating the effectiveness of different types of noise barriers may need to be adjusted based on specific circumstances and local conditions. The method used should ensure the accuracy and reliability of the results.

Permissible Noise Levels:

Table 1. (As recommended by CPCB)

Category ofArea	Noise levels in L_{eq}(dB)	
	Day time	Night time
Industrial	75	70
Commercial	65	55
Residential	55	45
Silence Zone	50	40

The locations of Case Study:

Figure 7.1. Double row plantation

Figure 7.2. Single row plantation

Figure 7.3. No plantation

Figure 7.4. Polycarbonate barrier

Figure 7.5. No barrier

Table 2. Noise reduction by different plantations in dB

Trails	Single row plantation		Double row plantation		No plantation	
	5m away from source	29m away from source	5m away from source	29m away from source	5m away from source	29m away from source
1	80.5	70.5	84.5	69.2	82.6	77.4
2	89.1	77.8	85.6	68.6	83.2	78.2
3	75.9	67.1	85.1	67.2	84.2	78.3
4	76.4	65.8	81.1	66.9	85.2	78.4
5	86.1	76.1	83.2	69.1	85.5	80.9
Average	81.6	71.86	83.9	68.2	84.14	78.64
Noise reduction	10.14		15.70		5.50	

Table 3. Noise reduction by polycarbonate noise barrier in dB:

Trails	Polycarbonate barrier		No barrier	
	5m away from source	29m away from source	5m away from source	29m away from source
1	85.0	78.1	88.6	81.8
2	84.2	75.3	89.2	80.3
3	85.9	70.8	87.4	80.0
4	85.1	76.4	87.5	80.2
5	86.1	72.0	86.2	79.5
Average	85.26	74.52	87.78	80.36
Noise reduction	10.74		7.42	

*** Height : 1.5m & Thickness : 1cm of Polycarbonate sheet ***

Case 1: Noise Reduction at Natural noise barriers:

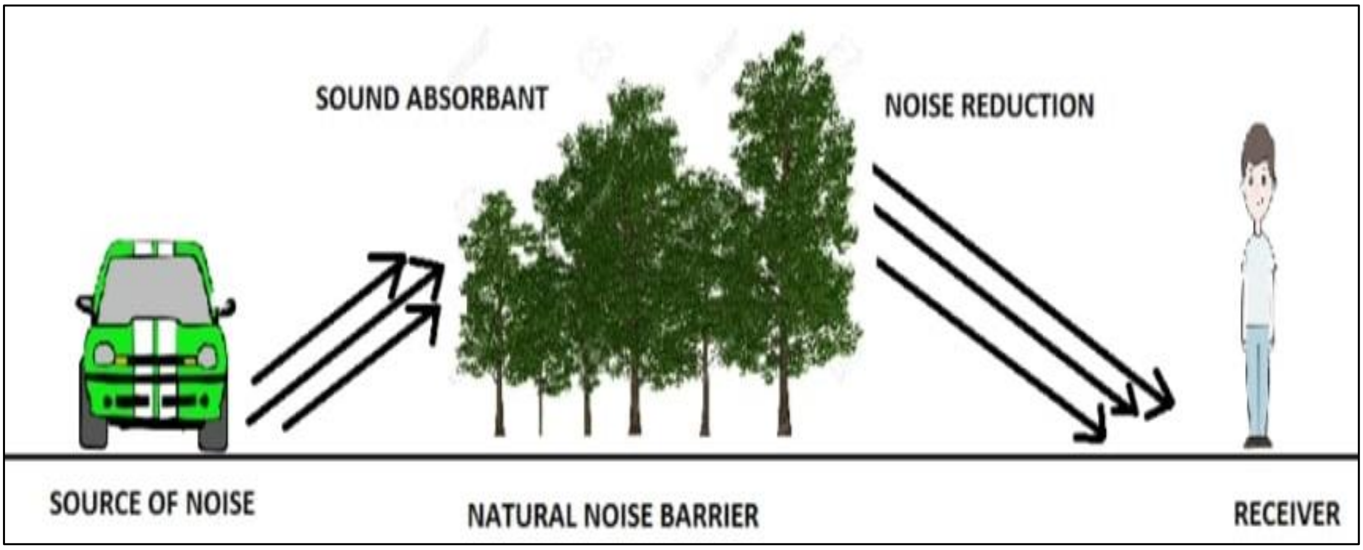


Figure 7.6. Natural noise barrier

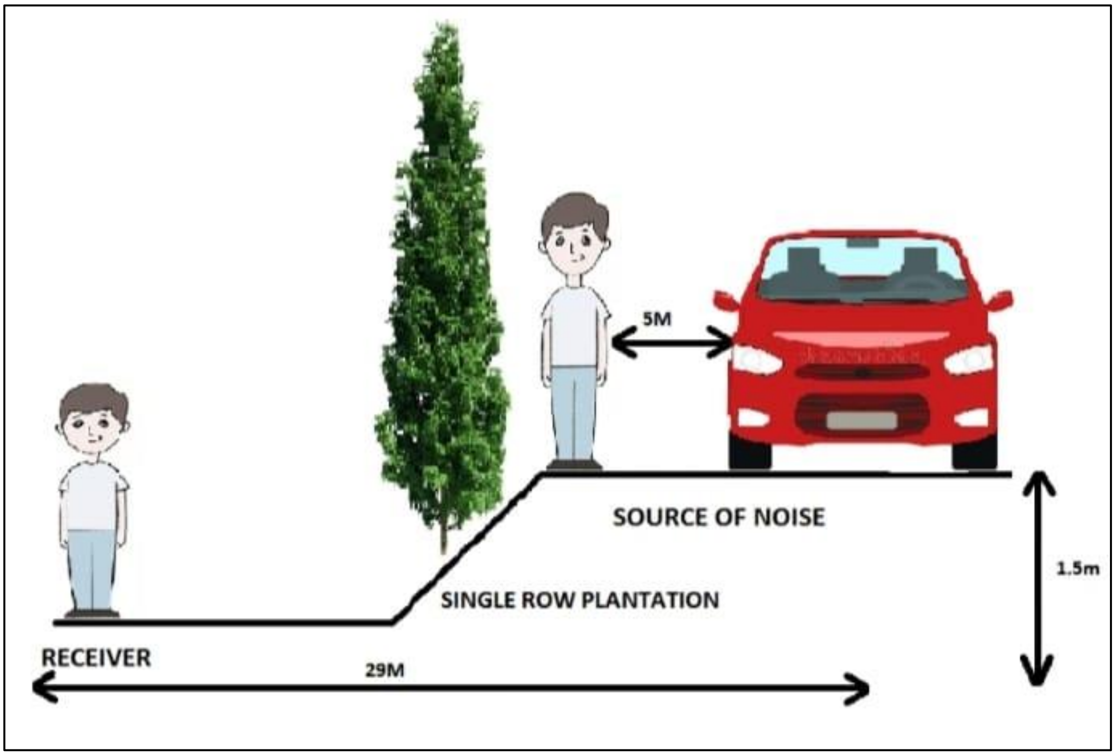


Figure 7.7. Single-row plantation

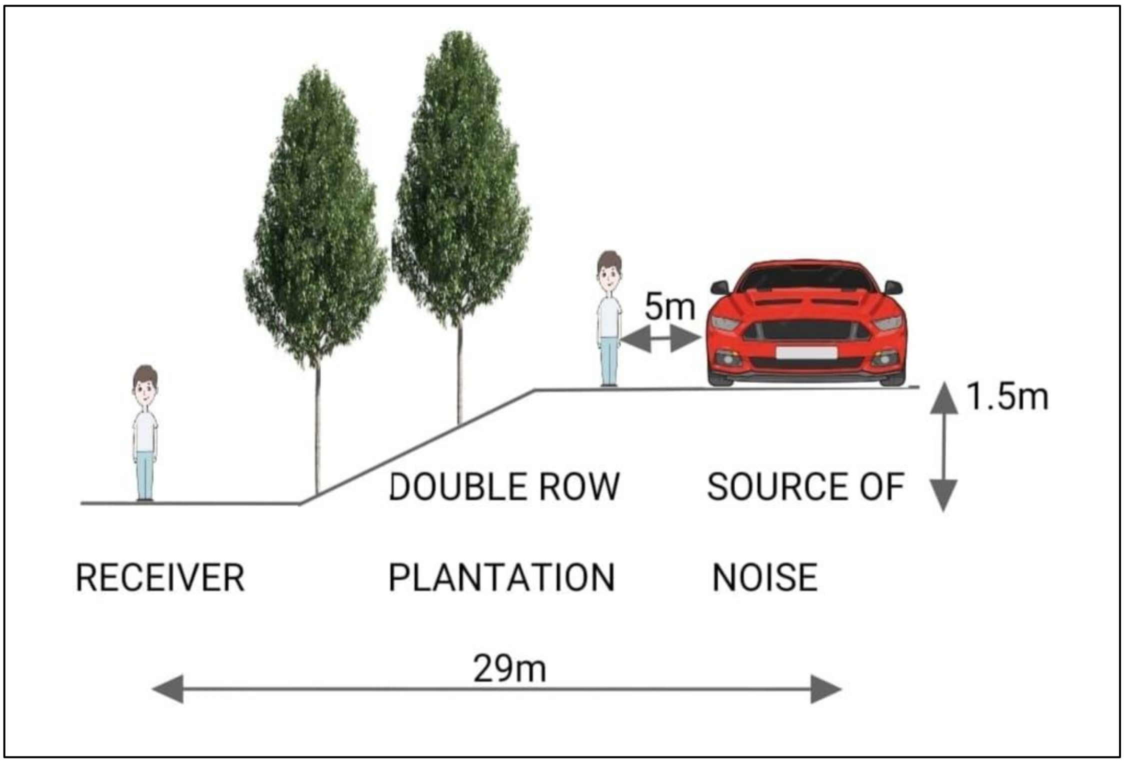


Figure 7.8. Double row plantation

Case 2: Noise Reduction at Polycarbonate noise barrier:

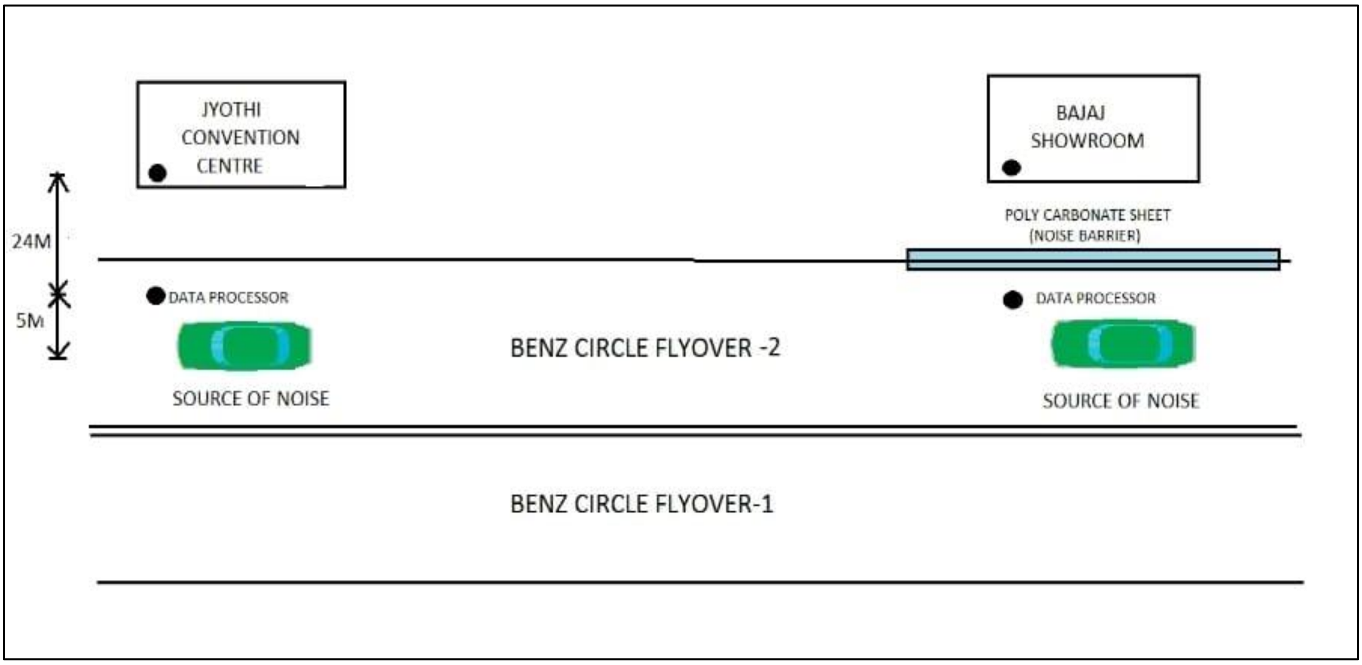


Figure 7.9. Polycarbonate noise barrier

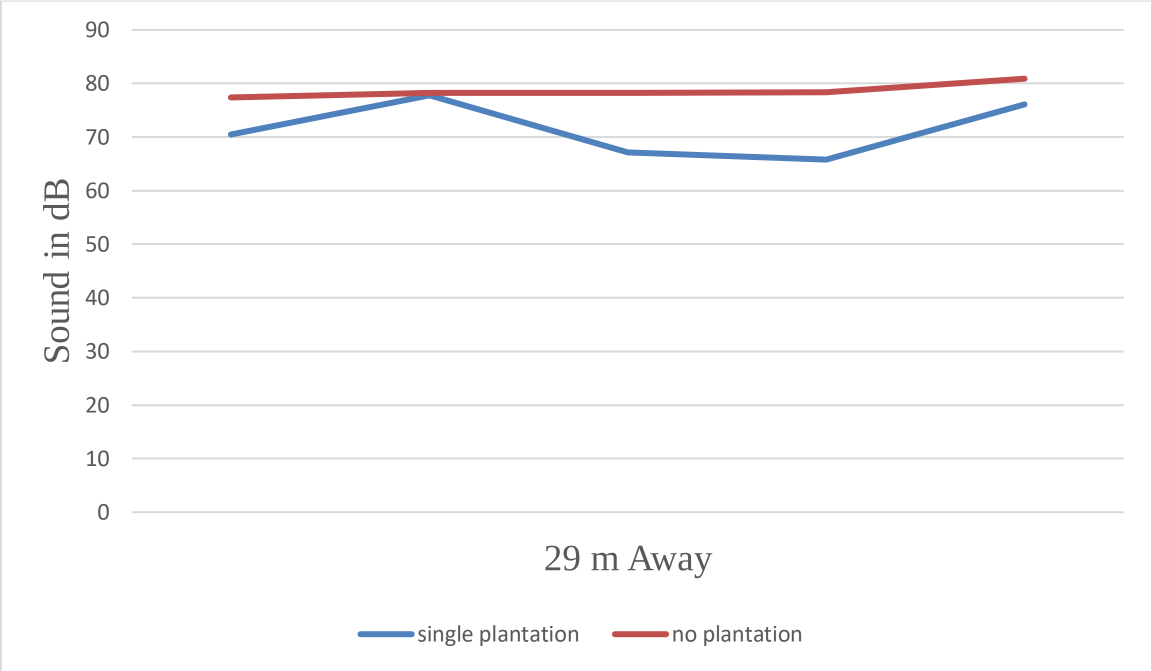
CHAPTER - IV

8. RESULT AND ANALYSIS OF DISCUSSION:

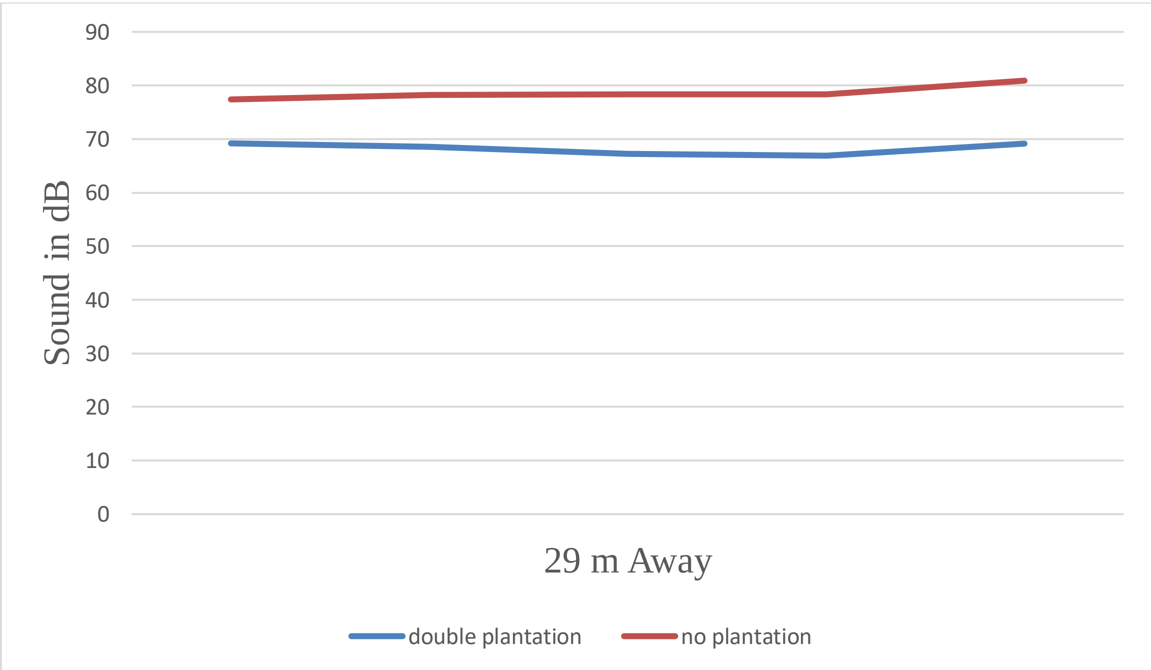
Table 4. Result and analysis of the reduced noise levels.

Barrier type	5m away from the source indB	29m away from the source	Noise reduction in dB
Single rowplantation	81.6	71.46	10.14
Double rowplantation	83.9	68.2	15.7
No plantation	84.14	78.64	5.50
Polycarbonate	85.26	74.52	10.74
No barrier	87.78	80.36	7.42

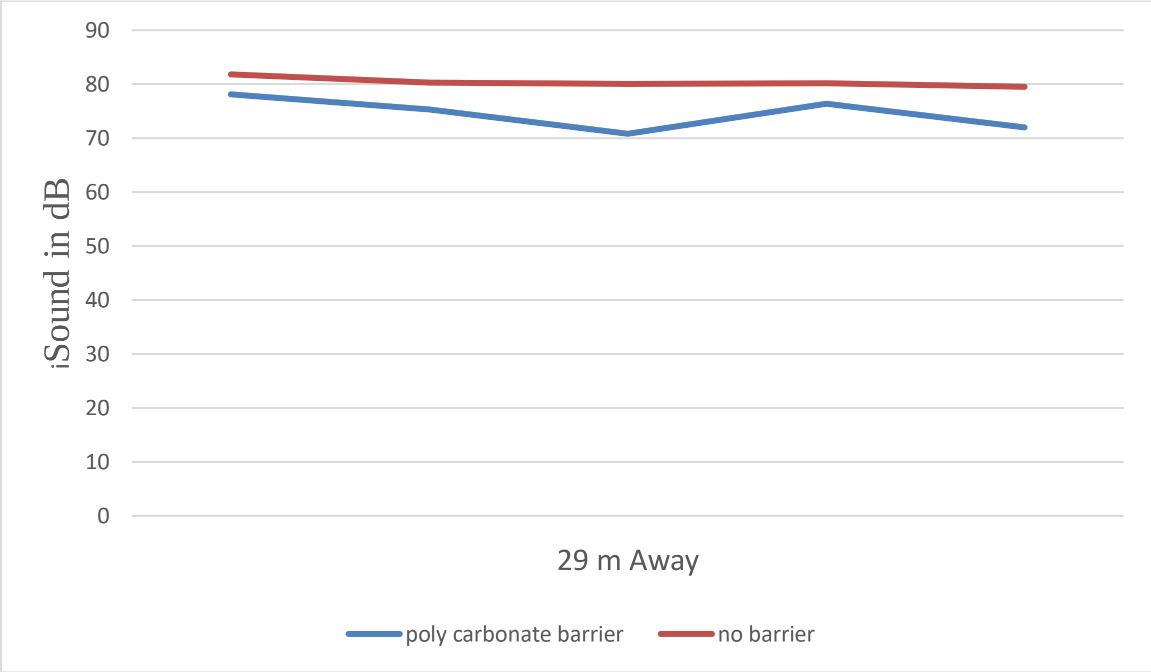
Studies have shown that noise barriers can significantly reduce the amount of noise that reaches nearby communities. A well-designed noise barrier can reduce noise levels by up to 15 decibels (dB). From Table 2&3 it is clearly visible that the noise reduction is more (15.7dB) near doubleplantation when compared to the single row plantation (10.14dB) and near polycarbonate barrier the noise reduction is about 10.74dB which is less compared to double row plantation.



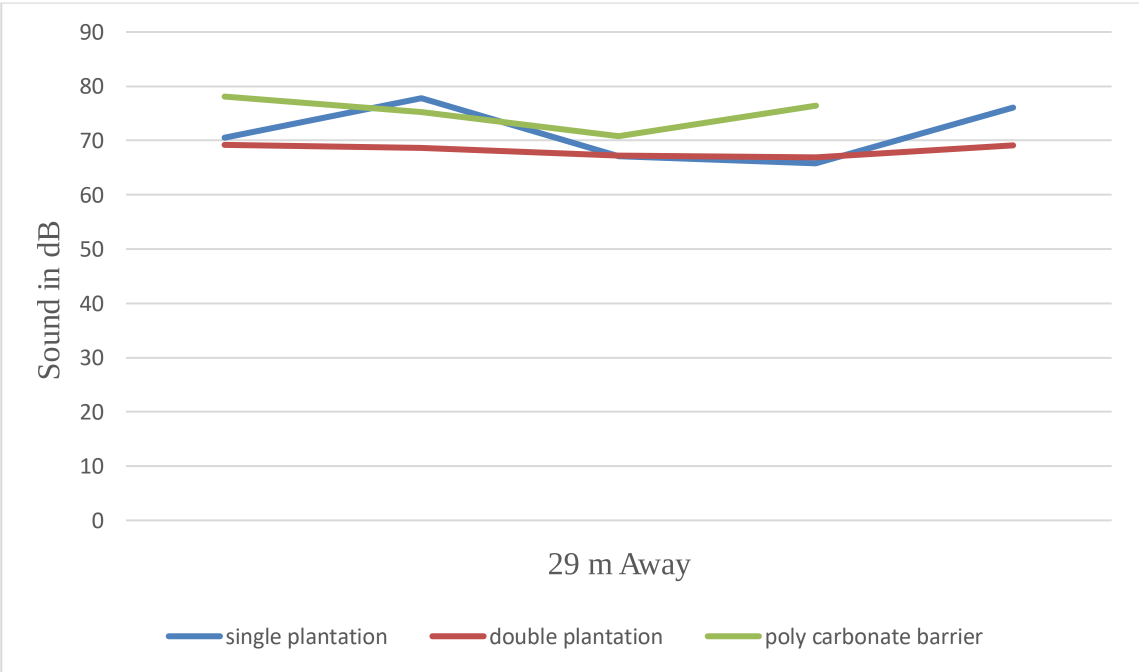
Graph 8.1. Comparison between single-row plantation and No plantation.



Graph 8.2. Comparison between double-row plantation and No plantation.



Graph 8.3. Comparison between Polycarbonate barrier and No barrier.



Graph 8.3. Comparison between Single row , Double row plantation and Polycarbonate barrier

CHAPTER - V

9. CONCLUSION:

In this study the comparison between single and double-row plantations, and polycarbonate noise barriers can be made in terms of their effectiveness, cost, maintenance, andenvironmental impact.

Effectiveness: Double-row plantations provide greater noise reduction compared to single-row plantations, and both are generally effective in reducing noise pollution. Polycarbonate noise barriers can also provide significant noise reduction, but their effectiveness may depend on factors such asmaterial properties, height, and angle.

Cost: Single and double-row plantations mayrequire an initial investment in terms of purchasing and planting vegetation, but theyhave low maintenance costs over time.

Polycarbonate noise barriers may have a higher upfront cost, but they may also last longer and require less maintenance compared to vegetation.

Environmental impact: Plantations have a positive impact on the environment, improving air quality, promoting biodiversity, and reducing the heat island effect. Polycarbonate noise barriers are made of synthetic materials and do not provide the same environmental benefits as vegetation.

In conclusion, the choice between single and double-row plantations, and polycarbonate noise barriers will depend on various factorssuch as budget, maintenance requirements, and desired environmental impact. Both options can effectively reduce noise pollution, but the use of plantations offers additional benefits to the environment also the plantation can be used if the noise barriercannot be afforded and the places where installing noise barriers is difficult.

CHAPTER - VI

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