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# OPTIMAL ACOUSTIC DESIGN STRATEGIES FOR A CULTURAL CENTER IN YENAGOA, BAYELSA STATE

*Elena Rodriguez<sup>1</sup> and Dr. Marco Rossi<sup>2</sup>*

<sup>1</sup>Department of Architecture, Technical University of Madrid, Madrid, Spain

<sup>2</sup>Department of Architecture, Politecnico di Milano, Milan, Italy

**Email:** elena.rodriguez@tumad.es;

marco.rossi@polimi.it

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In many states where diverse ethnic groups exist, like Bayelsa State for example, Cultural centres serve as focal points for people of the different ethnic groups, both within and outside the state, to promote cross-cultural understanding and social interactions. Bayelsa State lies in the heart of the Niger Delta in the Southern part of Nigeria and it is a home of a variety of cultures that reflect the history, beliefs, values and traditions of the different ethnic groups in the State. The existence of Cultural centres is essential in order to safeguard the customs and traditions of the people. The influence of acoustics in moulding the tourist experience is an aspect that is often overlooked or neglected in the design of these cultural centres. This research addresses the significance of acoustics in various spaces within the cultural centre, from performance halls and exhibition areas to communal gathering spaces. It explores the effective application of acoustic principles within the facility to create an immersive and engaging environment for the people and discusses how the design of the spaces in the facility, materials used for the construction, soundproofing techniques and acoustic treatments can enhance the quality of auditory experiences. Through qualitative and quantitative research methods, such as case studies and survey, the study explores several acoustics inclined construction materials and how it is integrated in the design of. Cultural Centre. Since technology has been constantly evolving and improving with time, new techniques of utilising it as a tool for improving architectural acoustics have begun to emerge. The effective application of acoustics in cultural centres serves to create a sound ambience where cultural expressions are celebrated, and the rich tapestry of traditions is woven into the fabric of the experience of all who visit.

**Keywords:** Acoustics, Culture, Cultural Centre, Sound

## 1. INTRODUCTION

Wikipedia defines a cultural centre as an organization, building or a complex that promotes cultures and arts. It can also be said to be a designated space devoted to supporting the artistic expression promoting and preserving cultural heritage and facilitating cross-cultural learning and exchange. Cultural centres serve as tools for the rejuvenation of culture and understanding of cultural expression as an integral element of economic and social development (Quraishi, 2003). Nigeria is one of the most culturally diverse countries in the continent, having over

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350 ethnic groups, each with its distinguished cultural heritage, languages, traditions and beliefs. Some of the major ethnic groups in Nigeria are the Hausa-Fulani, the Igbo, Edo, Yoruba, Ijaw and Efik. Each with its own distinctive dressings, languages and traditions. Bayelsa state, in the Niger Delta region of Southern Nigeria, is majorly known for its role in Nigeria's oil industry and its vibrant and diverse cultural heritage. It houses numerous ethnic groups, the majority being the Ijaw, Ogbia and the Nembe, each with its unique languages and traditions. Like other environmental factors to be considered and regulated in the design of a cultural centre, such as lighting, humidity, air temperature etcetera, in order to accomplish comfort in the cultural centre, acoustics also plays an important role in the balance of comfort and over all functionality of staff and visitors alike.

Architectural acoustics is the science and engineering of achieving good sound quality within a building (Archify). Acoustics is the branch of engineering that deals with sounds; the study of its production, transmission and effects on living organisms and objects in and on our environment. It is crucial in the design of spaces like concert halls, theatrical spaces, religious spaces etcetera, as understanding sound perception is essential for creating environments that are not only acoustically functional but also pleasing to the occupants. Effective acoustics is essential in the design of a cultural centre in order to create an environment where lectures, performances and cultural events among other activities can be enjoyed to the fullest, and ensuring the comfort of both the performers and the audience. The main goal of effective acoustics in a cultural centre is to ensure that the listening experience or sound quality for both spectators and performers in that space or room is improved and enjoyable. **Statement of the Problem**

Rich cultural heritage are being eroded, traditional architecture is giving way to modern and contemporary architecture, and cultural arts and crafts are being replaced by modern design, leaving a future generation without the knowledge of their roots (Falola, 2003). This statement further stresses the requirement and necessity of cultural centres to be built across the nation in order to preserve, advance and project our culture. This is because they often offer programmes like art exhibitions, lectures, workshops, performances and discussions to promote the engagement of individuals and intercultural dialogue.

Libraries and archives are necessary within a cultural centre as they serve as a repositories of knowledge, history and artistic expressions. They are essential for preserving cultural heritage as they store and protect materials like books, manuscripts, documents, photographs and other historical artifacts from deterioration and ensure that they are accessible for future generations. These materials can provide resources for scholars, students and the general public to explore and learn about the culture, history and traditions of a community or region.

Not including or neglecting the importance of archives and libraries in the planning and design of a cultural centre can result in the loss of cultural heritage, reduced access to information and research opportunities, diminished community engagement and missed economic and cultural enrichment opportunities. These disadvantages can have long term effects on the preservation and promotion of a community's cultural identity and heritage, and hence should be avoided at all costs.

Cultural centres are essential for encouraging creativity, gathering people together and also supporting the generational transmission of customs or traditions and beliefs, and artistic practices and a major concern is the decreased participation in traditional cultural activities and events by the younger generations due to lack of interest. This disengagement entails an imminent threat to the enthusiasm of the culture's heritage. Also, insufficient resources and financial support restrict the centre's capacity of organizing engaging and diversified events that may attract and captivate residents as well as tourists.

### **Aim and Objectives of the Study**

The aim of this study is to design a cultural centre for Yenagoa, Bayelsa State that ensures acoustic comfort for all categories of users.

The research intends to achieve the aim through the following objectives:

1. To describe the historical development of cultural centres globally and locally.

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2. To identify the design requirements for achieving acoustic comfort in cultural centres.
3. To examine how the existing cultural centres within and outside Nigeria have addressed the issue of acoustics in their designs.
4. To evolve a architectural design for a cultural centre in Bayelsa State that provides acoustic comfort for the users.

## **2. LITERATURE REVIEW**

### **2.1 CONCEPT AND ELEMENTS OF CULTURE**

Historians, Professors and Anthropologists alike all dispute on the exact origin of culture to this day. There is no single, conclusive explanation, but a number of theories that may shed light on how the human society has evolved with the passing of time. The word 'culture' was derived from the Latin word 'colere' which means to 'cultivate'. American Social scientist, Ethnographer and Professor of Anthropology at Macalester College, Author of 'The Cultural Experience: Ethnography in complex Society(1972)', 'The Ethnographic Interview(1979) among other works, James P. Spradley(1933-1982) defined culture as 'the acquired knowledge people use to interpret experience and generate behavior'.

Culture encompasses both material and non-material elements, which together shape the way of life and identity of a particular group of people. Elements of culture refers to all the aspects that make up a society's way of life including its material and non-material components. Both material and non-material culture interact and influence each other. For instance, technology (a material element) can impact communication patterns and social norms (non-material elements). Together, these elements provide a comprehensive understanding of a culture's way of life, beliefs, and identity.

#### **MATERIAL CULTURE**

Material culture is the totality of physical objects and belongings of members of a group of people(Study.com). Material culture encompasses the concrete and visible components of a society's way of life, such as tools, buildings, and artwork. It is an essential aspect of cultural anthropology that allows us to understand how people lived in the past and present. Material culture can provide valuable insights into a society's values, beliefs, and practices by examining the objects they created and used to navigate their daily lives. From ancient pottery to modernday smartphones, material culture serves as a window into human history and evolution. It refers to the physical objects and artifacts that are created, used and valued by a particular group of people.

#### **NON-MATERIAL CULTURE**

Non-material culture deals with the intangible aspects of culture, including beliefs, values, customs, norms, and symbolic elements. These elements guide behavior, shape identities, and are transmitted through language and socialization.

### **2.2 HISTORY OF CULTURE IN NIGERIA**

The history of culture in Nigeria is a rich, diverse and dynamic story of resilience, adaptation, and creativity, and it spans thousands of years. It reflects the complex tapestry of ethnic groups, languages, traditions, and historical influences that have shaped the nation and continues to evolve as Nigerians celebrate their diverse heritage and work to preserve their cultural legacies for future generations. The culture of Nigeria is shaped by Nigeria's multiple ethnic groups. Nigeria, with its tapestry of ethnicities, languages and traditions, boasts a history of culture that spans thousands of years. The evolution of culture in Nigeria reflects a complex interplay of indigenous heritage, external interactions and socio-political transformations. Nigeria's location played a crucial role in the trans-Saharan trade routes, which brought goods, ideas, and cultures from North Africa and the Middle East. This trade facilitated cultural exchange and influenced art, religion, and architecture

Nigeria witnessed the rise of notable kingdoms and empires, each with its own distinct cultural identity. An example being the Benin kingdom which flourished from the 13th to the 19th century. It was renowned for its

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intricate bronze sculptures and artistic craftsmanship. Also, the Sokoto Caliphate, which was founded in the early 19th century, showcased Islamic influence alongside indigenous cultural elements. Nigeria is also home to some of Africa's oldest known civilizations, including the Nok civilization (around 500 BC to 200 AD), known for its distinctive terracotta sculptures, and the Kingdom of Ife (around 4th to 15th century AD), renowned for its exceptional bronze and terracotta art. The medieval period saw the rise of powerful empires in Nigeria, such as the Kanem-Bornu Empire in the northeast and the Oyo Empire in the southwest. These empires were centers of trade, governance, and cultural development.

Nigeria came under British colonial rule in the late 19th and early 20th centuries. The colonial period had a significant impact on Nigerian culture, including the introduction of Western education, religion, and governance systems. The arrival of European powers in the 15th century ushered in a new phase of cultural dynamics. The colonialism brought about foreign languages, religions and societal institutions. While the colonial rule caused cultural rifts and identity conflicts, it also sparked cross-cultural exchanges that resulted in the blending of indigenous and European components in the Arts, Literature and Music. Nigerian literature has made a significant impact on African and world literature. Authors like Chinua Achebe, Wole Soyinka, and Chimamanda Ngozi Adichie have produced acclaimed works that explore Nigerian culture and society while Nigerian art, including traditional sculpture, textiles, and contemporary visual arts, is internationally renowned. Nigerian music genres like Afrobeat, Highlife, and Juju have gained global recognition through artists like Fela Kuti and King Sunny Ade. Nigeria gained independence from British colonial rule in 1960. And when Nigeria gained Independence from the British colonial rule, it marked a pivotal moment in its cultural evolution. The postindependence era witnessed the revitalization and celebration of Nigerian culture, including traditional art, music, literature, and festivals. During this time, modern Nigerian music, Literature and Film began to emerge as revenues for cultural assertion.

Nigeria is known for its vibrant cultural festivals, such as the Durbar festival, New Yam festival, Eyo festival, and Osun-Osogbo festival. These celebrations showcase traditional music, dance, and ceremonies. Currently, Nigeria's cultural heritage faces challenges from urbanization, globalization, and environmental changes. Efforts are being made to preserve and promote traditional cultures while embracing modernity. The country's numerous ethnic groups faced the task of preserving their own cultural traditions while establishing a cohesive national identity. The protection and celebration of Nigeria's rich heritage remains essential to the country's identity and its contribution to the world's cultural diversity as it continues to explore its own cultural path.

### **MAJOR ETHNIC GROUPS IN NIGERIA**

While it is unlikely to be able to list all the ethnic groups currently existing in Nigeria, due to its remarkable ethnic diversity, some of the major ethnic groups found in Nigeria are listed and explained. They include; i. Hausa-Fulani ii. Igbo iii. Yoruba iv. Ijaw v. Efik vi. Ibibio vii. Edo viii. Tiv

Others include the Itsekiri, Nupe, Igede, Ogoni, Anang, Jukun, Kambari, Okrika, Kaje, among others. These are some of the minor ethnic groups existing in Nigeria.

### **CULTURAL BACKGROUND OF BAYELSA STATE**

In the heart of Nigeria's Niger Delta, lies the state of Bayelsa, with its capital as Yenagoa. It is the home to a wide variety of culture, lively traditions and a significant amount of the country's past. The state's cultural heritage, which encompasses numerous ethnic groups, creates an enthralling tapestry that captures the essence of its residents and their relationships to the land and waterway. Each of these ethnic groups has its own distinctive rituals, languages and practices. Despite this cultural richness, Bayelsa lacks a centralized cultural institution or space where these traditions can be preserved, promoted, and shared.

Bayelsa State is a diverse region with a rich tapestry of cultures, each contributing to the state's unique cultural landscape. These cultures reflect the history, traditions, and values of the different ethnic groups that call Bayelsa

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home. Some of the major arts and crafts known in the state include; pottery, wood carving and weaving. These crafts often offer a glimpse into the history, tradition and beliefs of the people.

The history of Yenagoa is deeply intertwined with the broader history of the Niger Delta region. The Ijaw people, predominant in Yenagoa, have a rich heritage of fishing, trading, and community life. Their cultural practices encompass storytelling, music, dance, and craftsmanship, which have been passed down through generations. Additionally, Yenagoa boasts a vibrant festival calendar, including the Izon-Ibe Festival, which showcases the cultural diversity of the region. Nevertheless, the rapid urbanization and modernization in Yenagoa have posed challenges to the preservation of these cultural elements.

Bayelsa State is home to several distinct ethnic groups, each with its own unique culture and traditions. Languages such as Izon(Ijaw), Ogbia, Nembe and others are spoken in Bayelsa State with Izon being the most widely spoken due to the Ijaw people, who form a significant portion of the state's population. The major religion is Christianity, with Islam taking a small percentage. Some of the prominent cultures that can be found in Bayelsa State include; The Ijaw clan, The Nembe clan and The Ogbia clan.

### **2.3 CULTURAL CENTRES**

The Art Culture Inside defines a cultural centre as “a space created with the intention of serving as a means for the dissemination of different artistic, philosophical, educational, cultural, etc expressions, open to a community with the aim of representing and promoting artistic-cultural values and interests within the territory of a community”.

A cultural centre is an organization, building or complex that promotes culture and arts(Wikipedia). A Cultural centre is an institution designed to facilitate the preservation, promotion and celebration of cultural heritage, artistic expression and community engagement. It serves as a hub for various cultural activities, programs, events and exhibitions that aims to foster cross-cultural understanding, creative exploration and social interaction. They play a major role in building and sustaining local communities.

The specific spaces within a cultural center can vary depending on its size, budget, and mission. The goal is to create a versatile facility that can host a wide range of cultural and artistic activities while providing an engaging and welcoming environment for both artists and the public. A cultural center typically consists of various spaces designed to accommodate a wide range of cultural and artistic activities. These spaces cater to the needs of artists, performers, visitors, and the community at large.

### **ROLE OF A CULTURAL CENTRE**

Cultural centres play a vital role in societies and communities around the world. They serve as focal points for preserving, promoting and celebrating cultural heritage, fostering understanding among diverse communities and contributing to the overall growth and development of a society.

They provide platforms for musicians, artists, performers, writers and creators to express themselves through their music, art exhibitions, performances, workshops and literary events where their talents can be shared with the public.

Cultural centres enhance public awareness and promotes critical thinking. It offers opportunities for people from different backgrounds to come together, share experiences and learn each other's traditions. They also serve as forums where pressing matters can be discussed and the solutions to those problems can be explored. They contribute to the economic growth of a community by attracting tourists and visitors interested in experiencing authentic cultural expressions. These visitors often end up supporting local economies by engaging in cultural tourism, purchasing handicrafts and participating in cultural events. Cultural centres create spaces where people can come together in a spirit of mutual respect. The contributions of cultural centres extend beyond cultural enrichment, positively impacting the social harmony, education, economy and overall societal development.

### **2.4 SOUND AND ACOUSTICS**



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Sound is an omnipresent and dynamic phenomenon that shapes our perception of the world. From the soothing melodies of a favorite song to the gentle rustling of leaves in the wind, sound surrounds us and connects us to our environment. Acoustics is the scientific study of sound, encompassing its generation, transmission, reception, and the effects it has on both living organisms and the physical world.

Acoustics is a field of study that bridges the gap between science and art, technology and culture. It touches virtually every aspect of our lives, from the way we experience music and interact with architectural spaces to how we diagnose medical conditions and monitor the health of our planet. Understanding acoustics is akin to unraveling the intricate threads of a vast sonic tapestry that envelops us. It is the unseen architect of our auditory world, shaping the way we perceive and experience the spaces we inhabit. Within the realm of architecture, it is the art and science of harnessing sound to create environments that resonate with beauty, functionality, and emotional resonance. Acoustics in architecture is not just about controlling noise; it is about orchestrating an auditory symphony that enhances human well-being and elevates the quality of our lives within the built environment. It extends beyond the boundaries of physical spaces. It is a vital component of sustainable design, where energy-efficient materials and innovative technologies harmonize with acoustic principles to create environmentally responsible structures.

In order to enhance and reinforce desired sounds in the auditorium and to reduce eliminate intrusive and undesirable noises, the auditorium must be able to achieve the following conditions: 1. Reduced undesirable background noises while still preserving and reinforcing desired sounds. 2. Reflective surface should be chosen and placed for the purpose of directing and distributing sound throughout the auditorium.

3. Absorptive surface should be designated and placed to prevent the continued presences of reflected sounds that are no longer useful for reinforcement.

4. Evaluate possible direct transmission paths for structure-borne as well as airborne noise.

5. Employ construction detailing and available technologies and plan to isolate and impede these various noise paths.

6. Select appropriate sound transmission class rated construction based upon the deserved degree of attenuation between spaces. One of the fundamental concepts in architectural acoustics is the balance between reverberation and absorption within a space. Reverberation refers to the persistence of sound reflections in an enclosed area after the sound source has ceased emitting sound. Absorption, on the other hand, is the ability of surfaces and materials within the space to absorb sound energy, reducing its intensity and preventing excessive reverberation.

### **SOUND AND ITS CHARACTERISTICS**

Sound is the result of mechanical vibrations traveling through a medium, typically air, but also through solids and liquids. These vibrations create changes in air pressure, which our ears perceive as sound. Sound waves are characterized by several key attributes:

1. **Frequency:** Frequency refers to the number of oscillations per second and is measured in Hertz (Hz). Higher frequencies are associated with higher-pitched sounds, while lower frequencies produce lower-pitched sounds. The human audible range typically spans from 20 Hz to 20,000 Hz.

2. **Amplitude:** Amplitude represents the strength or intensity of a sound wave and is related to its loudness. It is measured in decibels (dB). Greater amplitude results in louder sounds.

3. **Wavelength:** Wavelength is the physical length of one cycle of a sound wave, and it is inversely proportional to its frequency. Higher-frequency sounds have shorter wavelengths, while lowerfrequency sounds have longer ones.

### **ACOUSTIC TERMINOLOGY**

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Understanding the fundamental principles of acoustics is crucial for architects and designers as they seek to create spaces that optimize sound quality, comfort, and functionality. To understand acoustics fully, one must be familiar with specific terminology:

1. Sound Source: The origin of a sound, such as a musical instrument, a speaker, or a person speaking.
2. Sound Pressure Level (SPL): SPL is a measure of sound intensity in decibels (dB). It quantifies the variation in air pressure caused by sound waves.
3. Sound Field: The space in which sound waves propagate. It can be categorized as a near field (close to the sound source) or a far field (further from the source).
4. Diffraction: The bending of sound waves around obstacles, which can impact the distribution of sound within a space.
5. Reflection: The process by which sound waves bounce off surfaces, potentially causing echoes or affecting the perceived loudness of a sound.
6. Absorption: The ability of materials or surfaces to dissipate sound energy, reducing its intensity and preventing excessive reverberation.
7. Reverberation Time: Reverberation time is the time (in seconds) that it takes sound to decay 60 decibels from its original level within the 500 Hz octave band frequency. Typically, Long reverberation times can result in a buildup of overall sound energy, creating a very harsh and cacophonous environment, especially in large occupied spaces.

Reverberation time, often denoted as RT, is a critical metric used to describe the acoustics of a room. It is defined as the time it takes for sound to decay by 60dB after the sound source stops.

RT is influenced by several factors, including the volume of the space, the shape of the room and the acoustic properties of its surfaces. Different types of spaces, such as concert halls or lecture rooms, require specific RT values to optimize their acoustic performance.

### 8. Sabine's Formula

Sabine's formula is a widely used equation for calculating reverberation time. It relates the volume of the room, the total absorption in the room, and the speed of sound.

The formula is as follows:  $\{RT = 0.161(V)/(A)\}$  Where:

- RT is the reverberation time (in seconds).
- V is the volume of the room (in cubic feet or cubic meters).
- A is the total absorption in the room (in Sabins).

Designers can adjust the amount and type of absorbent materials within a space to achieve the desired RT.

### 9. Sound Transmission Class (STC):

(STC) is a rating system used to quantify the sound isolation performance of building elements, such as Walls and floors. The higher the STC rating, the better the sound isolation. Designers use STC values to ensure privacy and minimize disturbances between rooms in residential and commercial buildings.

## ROLE OF ACOUSTICS IN ARCHITECTURE

*Architectural acoustics is the science of how to achieve a good sound within a building.* The role of acoustics in architecture cannot be overstated, as it profoundly impacts the functionality, comfort, and overall experience within built environments.

*It typically involves the study of speech intelligibility, speech privacy and music quality in the built environment.*

Here are some key aspects where acoustics is crucial in architecture:

1. Sound Quality: Acoustics influence how sound is perceived and experienced in a space. In environments like concert halls, theaters, and lecture rooms, good acoustics ensure that audiences can hear and understand speech, music, and other sound sources clearly.

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2. **Communication:** Effective communication is essential in various settings, from classrooms and meeting rooms to offices and conference centers. Proper acoustics improve speech intelligibility, minimizing misunderstandings and facilitating effective information exchange.
3. **Auditory Comfort:** Unwanted noise and poor acoustics can lead to discomfort and stress. Well-designed acoustics in offices, homes, and public spaces contribute to a more peaceful and pleasant atmosphere.
4. **Privacy:** Noise control is vital in multifamily housing, offices, and healthcare facilities. Properly designed acoustics help maintain privacy by preventing sound transmission between rooms or units.
5. **Performance Spaces:** In venues like theaters, concert halls, and recording studios, acoustics play a critical role in optimizing sound quality for performers and audiences alike. The ability to control sound reflections, reverberation, and diffusion is essential for achieving exceptional performances.
6. **Health and Well-being:** Excessive noise and poor acoustics can have adverse effects on health, including stress, sleep disturbances, and reduced cognitive performance. Architectural acoustics contribute to healthier indoor environments.
7. **Sustainability:** Sustainable architecture includes considerations for acoustic performance. Using environmentally friendly materials that also provide acoustic benefits contributes to sustainable design practices.
8. **Innovation:** Advancements in acoustic technology and materials continue to drive innovation in architectural design. Architects and designers are exploring creative ways to integrate acoustics into their projects, enhancing both form and function.
9. **Legal Compliance:** Building codes and regulations often include requirements for acoustic performance in certain types of spaces, such as residential buildings, theaters, and schools. Compliance with these standards is essential to ensure safe and functional buildings.

*Acoustical design plays an important role in developing many features in a performance facility. Acoustics impact everything from the size and shape of the house, the location of mechanical rooms, and the selection of sound equipment to the density of materials enclosing the performing hall, the sizes of the ducts, and the requirements for doors and windows.*

### 3. METHODOLOGY

For this study, the main source of data collection involved conducting fieldwork and visiting the Rivers State University Central library to access documented data related to Cultural Centre developments and review past thesis works on the topic. These activities allowed for the gathering of firsthand information from existing sources and explore the available literature. Additionally, case studies were employed as another method of gathering primary data for this study. This involved in-depth analysis and examination of specific cases or examples relevant to the research topic, providing valuable insights and data specific to the study's objectives.

### 4. RESULTS AND DISCUSSIONS

#### 4.1. ACOUSTICS

As already mentioned, Acoustics is essential in the design of a cultural center to ensure optimal sound quality, speech intelligibility, and flexibility for different types of events. Acoustical conditions in an enclosed space is achieved when there is clarity of sound in every part of the occupied space. For this to occur, the sound should rise to a suitable intensity everywhere with no echoes or distortion of the original sound, and with a correct reverberation time. Therefore, it is important to identify, analyze and correct any defects that may affect the acoustics within a building. In order to enhance and reinforce desired sounds in the auditorium and to reduce eliminate intrusive and undesirable noises, the auditorium must be able to achieve the following conditions:

1. Reduced undesirable background noises while still preserving and reinforcing desired sounds.
2. Reflective surface should be chosen and placed for the purpose of directing and distributing sound throughout the auditorium.



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3. Absorptive surface should be designated and placed to prevent the continued presences of reflected sounds



Figure 1 Showing the definition of Acoustic Materials that are no longer useful for reinforcement.

4. Evaluate possible direct transmission paths for structure-borne as well as airborne noise.
5. Employ construction detailing and available technologies and plan to isolate and impede these various noise paths.
6. Select appropriate sound transmission class rated construction based upon the deserved degree of attenuation between spaces.

*One of the fundamental concepts in architectural acoustics is the balance between reverberation and absorption within a space. Reverberation refers to the persistence of sound reflections in an enclosed area after the sound source has ceased emitting sound. Absorption, on the other hand, is the ability of surfaces and materials within the space to absorb sound energy, reducing its intensity and preventing excessive reverberation*

### 4.2 SOUND REINFORCEMENT SYSTEMS

Sound reinforcement systems have evolved to provide precise control over audio distribution in various architectural contexts:

1. **Digital Signal Processing (DSP):** DSP technology allows for fine-tuning of audio systems to match the acoustic characteristics of a space. This ensures consistent sound quality in auditoriums, concert halls, and other performance venues.
2. **Line Array Speaker Systems:** Line array speakers are designed to deliver sound evenly throughout large spaces, such as stadiums and arenas. They offer improved sound coverage and clarity.
3. **Immersive Audio Technologies:** Immersive audio systems, like Dolby Atmos and Auro-3D, provide three-dimensional sound experiences in cinemas, entertainment venues, and home theaters.

### 4.3 CONSTRUCTION MATERIALS AND FINISHES THAT AID ACOUSTICS

Acoustical materials are a variety of foams, fabrics, metals, etc. used to quiet workplaces, homes, automobiles, and so forth to increase the comfort and safety of their inhabitants by reducing noise generated both inside and outside of those spaces. They are used in two major ways: as soundproofing, by which noise generated from outside a given space is blocked from entering the space; and, as sound absorbing, where noise generated within a space is reduced inside the space itself. Materials with various absorption coefficients are used strategically in architectural design to control reverberation. Examples of acoustic materials include fabric-covered panels, acoustic ceiling tiles, and sound-absorbing wall treatments. These materials can be selected and placed to fine tune the acoustics of a space.

Source: SlideShare.com

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There are generally four types of Acoustic Materials in Construction. They include:

1. Sound Absorbers
2. Sound Diffusers
3. Sound Reflectors
4. Noise Barriers

### SOUND ABSORBERS

The sound absorbing acoustical panels and soundproofing materials are used to eliminate sound reflections. These materials vary in thickness and in shape to achieve different absorption ratings depending on the specific sound requirements and eliminate sound reflections and are generally porous, with many pathways that redirect sound and cause it to lose energy. Typical sound absorbing materials are fiberglass, rock wool, open cell polyurethane foam, cellular melamine foam, heavy curtain blankets and thick fabric wall coverings. Absorber materials do not substantially block sound, but absorption can enhance isolation by stopping air movement that would otherwise allow sound and noise to travel. Conversely, flexible non-porous barriers can act as low-frequency, bass absorbers.

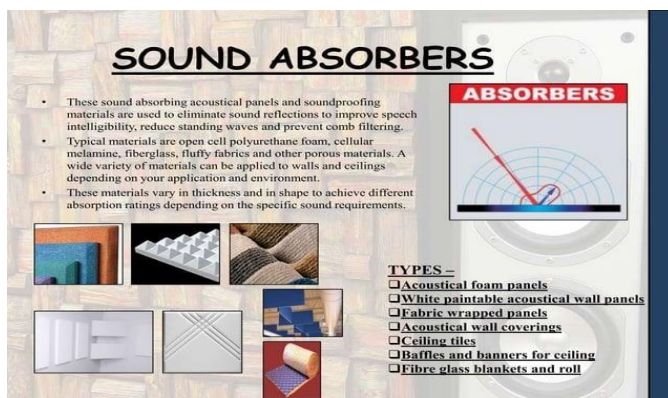


Figure 2 Sound Absorbers

Source: Slideshare.com

### SOUND DIFFUSERS

These devices reduce the intensity of sound by scattering it over an expanded area, rather than eliminating the sound reflections as an absorber would. Traditional spatial diffusers, such as the poly-cylindrical (barrel) shapes also double as low frequency traps. Temporal diffusers, such as binary arrays and quadratics, scatter sound in a manner similar to diffraction of light, where the timing of reflections from an uneven surface of varying depths causes interference which spreads the sound.

### NOISE BARRIERS

These materials range from dense materials to block the transmission of airborne sound to devices and compounds used to isolate structures from one another and reduce impact noise. Sound barrier materials are used to reduce the transmission of airborne sound.

These materials are heavy, dense and massive to prevent sound penetration. A common material is drywall (gypsum, sheetrock). Thin materials with high sound blocking characteristics are lead foil and mass loaded vinyl. A sandwich of dissimilar materials such as five-eighths inch gypsum, one-eighth inch vinyl barrier, and a half-inch finish layer of drywall will block more effectively than an equivalent thickness of drywall alone. More energy is lost as sound must change its speed for each different material.

Other materials used to carry out the function of blocking sounds could be anything like bricks, concrete, steel, plastic, insulating-wool etc. Trees are also effective in acting as sound barriers.

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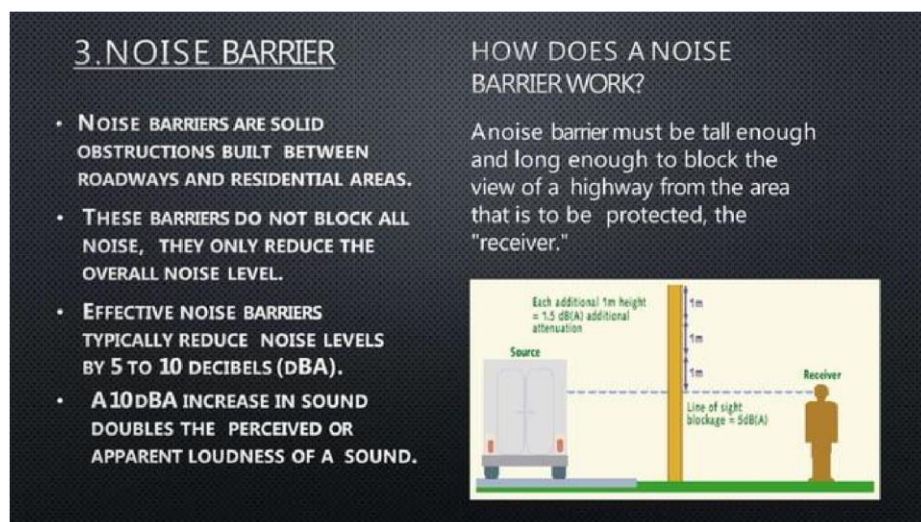


Figure 3 Sound Barriers

Source: Slideshare.com

### SOUND REFLECTORS

Sound reflectors are acoustical materials used to reflect and concentrate waves of sounds to a particular point. This property helps in amplifying sounds without the use of artificial amplifiers. This is generally avoided in smaller spaces as concentration of sounds results in high intensity sounds which are harmful. Gypsum boards, vinyl or fabric-finishes are commonly used reflective materials.

Acoustical reflectors or diffusers evenly distribute the sound within a building to provide a balanced sound quality throughout the space. It also helps to improve the clarity and sound quality for speeches and music productions in auditoriums by providing a wider sound coverage.

#### 4.4. Design Strategies for the Application of Acoustics in a Cultural Centre

Acoustical materials are a variety of foams, fabrics, metals, etc. used to quiet workplaces, homes, automobiles, and so forth to increase the comfort and safety of their inhabitants by reducing noise generated both inside and outside of those spaces. They are used in two major ways: as soundproofing, by which noise generated from outside a given space is blocked from entering the space; and, as sound absorbing, where noise generated within a space is reduced inside the space itself. Materials with various absorption coefficients are used strategically in architectural design to control reverberation. Examples of acoustic materials include fabric-covered panels, acoustic ceiling tiles, and sound-absorbing wall treatments. These materials can be selected and placed to fine tune the acoustics of a space.

For seating, Timber upholstered chairs can be used to provide seating for the audience. The cushioned chairs not only provide viewers with comfort, it is also an excellent sound absorbent, which helps reduce the overall reverberation time in the auditorium. It adds to the acoustic quality of the auditorium and allows the space to achieve a similar quality of sound whether the auditorium is filled to partial or maximum capacity.

For lighter, lower frequency noises such as footsteps of people walking around and also the sound that is produced by the subwoofers and speakers in the speaker system, thick carpeted flooring should be used, as it contributes to sound absorption. Carpet is an outstanding sound absorber which serves as an acoustical aid, as well as a floor cover. Carpet absorbs airborne noise as efficiently as other specialized acoustical materials. A rubber underlay further improves absorption. Carpet is also wrapped around all the steps along the aisles of the auditorium to reduce the noise produced by the footsteps of people walking up and down.

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The rear wall of the auditorium is flat and covered with absorptive wall panels which not only reduces the reflection of sound but also absorbs the sound waves after they reach the wall to prevent a second delayed wave or echo from occurring. The surface of the wall paneling is the fabric, followed by the sponge or foam that functions as a porous material that absorbs high frequency sounds. The wall is finished with plywood and rockwool, which is useful in absorbing the low frequency sound waves that hit the wall. Ceiling panels can be made of gypsum board as their smooth surfaces help in sound reflection.

For spaces like meeting and exhibition rooms, the library and archive in the facility, the use of products such as wall and ceiling panels and baffles is necessary as these products have high Noise Reduction Coefficient (NRC) to reduce reverberation and echo. Acoustic foam can also be used. Acoustical foam is a fascinatingly simple approach to sound and reverberations. Essentially, it absorbs the sounds that hit it, minimizing any echoes.

### **5. CONCLUSION**

In the beginning of this study, several topics were reviewed, such as the definition and concept of culture, elements of culture, both the material and non-material, cultural centres and the evolution of cultural centres. The study area (Yenagoa, Bayelsa State) was also studied, including some information on the people and some the different ethnic groups and cultures found in the state. It also emphasizes on the role and importance of cultural centres in the community and of acoustics in the design of cultural centres. In conclusion, the establishment of a cultural centre in Yenagoa, Bayelsa State, marks a pivotal step towards enriching the cultural landscape of the region and this study underscores the importance of such a facility, the cultural centre, in fostering community identity, preserving local heritage and promoting cultural exchange and community engagement. Acoustics in a cultural centre is very important as it is considered in order to achieve a proper sound quality in the different spaces. The design consideration indicates that the project will improve the experience of the visitors through the effective and efficient implementation of acoustics by creating a space that is auditorially pleasing and optimizing the sound quality for performers and visitors alike.

### **6. RECOMMENDATION**

The consideration of acoustics is a factor that is often neglected or overlooked in the design of buildings or facilities despite it playing an important role especially in buildings with large halls or spaces designated for performances like theatres or auditoriums in facilities like convention or cultural centres. Acoustics in a cultural centre is very important as it is considered in order to achieve a proper sound quality in the different spaces. The design consideration indicates that the project will improve the experience of the visitors through the effective and efficient implementation of acoustics by creating a space that is auditorially pleasing and optimizing the sound quality for performers and visitors alike.

While the prospects are promising, challenges such as funding, infrastructure and sustained community involvement must be addressed. In order to solve issues like Unemployment, Youth restiveness and social problems, the project can be funded and run by both the government and private sector as the project is also a profitable venture. Due to spaces like the museum, archive and library found in the cultural centre, it is also recommended for students of any level for cultural research material.

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