

**ACOUSTIC CONTROL IN HIGH COURT BUILDINGS: PROPOSED DESIGN OF A
STATE HIGH COURT COMPLEX, ENUGU.**

BY

**AFAMUEFUNA EBUBECHUKWU EMMANUEL
GOU/U22/ARC/173**

**DEPARTMENT OF ARCHITECTURE
FACULTY OF NATURAL SCIENCES AND ENVIRONMENTAL STUDIES
GODFREY OKOYE UNIVERSITY, ENUGU**

JULY, 2026

**ACOUSTIC CONTROL IN HIGH COURT BUILDINGS: PROPOSED DESIGN OF A
STATE HIGH COURT COMPLEX, ENUGU.**

BY

**AFAMUEFUNA EBUBECHUKWU EMMANUEL
GOU/U22/ARC/173**

**DEPARTMENT OF ARCHITECTURE
FACULTY OF NATURAL SCIENCES AND ENVIRONMENTAL STUDIES
GODFREY OKOYE UNIVERSITY, ENUGU**

**A PROJECT RESEARCH SUBMITTED TO THE DEPARTMENT OF
ARCHITECTURE IN FULFILLMENT OF THE REQUIREMENT FOR THE AWARD
OF BACHELOR OF SCIENCE**

SUPERVISOR: ARC. OBIEFUNA JERRY

JULY, 2026

APPROVAL

This is to attest that this project has been carefully reviewed and has completed all necessary requirements for the award of the degree of Bachelor of Science (B.Sc.) in the department of Architecture, Godfrey Okoye University, Enugu, Enugu State

.....
Dr. Jerry Obiefuna
Supervisor

.....
Date

.....
Arc Chukwuchetam
Head of Department

.....
Date

CERTIFICATION

This is to certify that project titled Design of Effective Acoustic Control in High court was carried out by Afamuefuna Ebubechukwu Emmanuel (GOU/U22/ARC/173) under the supervision of Department of Architecture and has been found satisfactory for the fulfillment of the requirements for the award of Bachelor Degree in Architecture.

.....
Afamuefuna Ebubechukwu Emmanuel
Student

.....
Date

.....
Dr. Jerry Obiefuna
Supervisor

.....
Date

ACKNOWLEDGEMENTS

My gratitude is first directed to God Almighty, the maker of Heaven and Earth, for giving me strength, knowledge and understanding throughout the entire duration of the research.

I would like to thank Dr. Obiefuna Jerry & Dr. Arc. Chinechetam Chukwu (HOD) for assisting and guiding alongside all my wonderful lecturers whose efforts have guided us towards graduation from the university

I am very grateful to my best and lovely parents, Mr. and Mrs. Afamuefuna, who have been the best supporter financially and guiding and encouraging throughout my academic journey. The trust and believe that they have put in me it's what that has been guiding me and I will always appreciate all they have done for me.

To my fellow course mates, I will love to express how I feel for all the support and encouragement that you guys have shown towards me, your words will always push me further in life.

I acknowledge the Vice Chancellor of Godfrey Okoye University & the Deputy vice chancellor of Godfrey Okoye University and all the staffs for being such an inspiration to humanity.

TABLE OF CONTENTS

Title Page	i
Approval	ii
Certification	iii
Dedications	iv
Acknowledgements	v
Table of Contents	vi
List of Plates	viii
Abstract	ix
 CHAPTER ONE: INTRODUCTION	 1
1.1 Background to the Study	1
1.2 Statement of the Problem	2
1.3 Aim and objectives of the Study	5
1.4 Research Questions	5
1.5 Significance of the Study	6
1.6 Scope and Delimitation	6
1.7 Special Terminologies	8
 CHAPTER TWO: LITERATURE REVIEW AND CASE STUDIES	
2.1 Conceptual framework (if applicable)	13
2.2 Theoretical Framework (‘‘)	13
2.3 Review of related literature	13
2.4 Case studies	14
2.5 Summary of literature and case studies	31
 CHAPTER THREE: THE STUDY AREA	 34
3.1 Geographical Location and Setting	34
3.2 Site Selection Criteria	35
3.3 Brief history of the Study Area	36
3.4 Physiography, climate and vegetation	37
3.5 Population, Culture and Economic Development	38
 CHAPTER FOUR: RESEARCH METHODOLOGY	 40
4.1 Research Design – review, survey, case studies, quasi-experimental, experimental Research etc	40
4.2 Data needs and sources	41
4.3 Population of study and sampling procedure (if applicable)	41
4.4 Methods and instruments for data collection (if applicable)	41
4.5 Methods of data analysis and analysis (‘‘)	41

CHAPTER FIVE: DESIGN SYNTHESIS AND DEVELOPMENT	
5.1 The Design Brief	42
5.2 Design requirements for activities/planning data (standards, anthropometrics, etc)	43
5.3 Schedule of Accommodation	45
5.4 Special Consideration	46
5.5 Site Inventory and Analysis	46
5.6 The Ability to Analyse and Present Data	47
5.7 Design Concept and Proposal	47
5.8 Presentation Drawing and 3D Visualization	48
5.9 Detailed Drawing and Physical Model	53
 CHAPTER SIX: SUMMARY OF FINDINGS AND RECOMMENDATION	 54
6.1 Summary of Findings	54
6.2 Recommendations	55
6.3 Contribution to Knowledge	56
6.4 Conclusion	56
 REFERENCES	 58

LIST OF PLATES

Plate 2.1: Federal High Court, Abuja (main entrance)	15
Plate 2.4.1: Enugu State High Court (Detailed view of the road leading to the state High Court and also main entrance at the front)	18
Plate 2.3: Lagos State High Court, Ikeja (detailed view of the entrance of the court)	21
Plate 2.4: Royal Courts of Justice High Court, London(this is the front view of the Royal Courts of Justice, High Court)	24
Plate 2.5: Federal Court of Australia High Court Building	27
Plate 2.6 The New York county Supreme Court (main entrance of the building)	30

LIST OF FIGURES

Figure 3.1: Map of Enugu showing the 17 local Government Area [source: google	34
Figure 3.2: Map of Okpara Square, Independence Layout, Enugu (source: google)	36
Figure 3.3: Climate graph of Enugu State. (Source: google)	37
Figure 5.1: Site plan	48
Figure 5.2: Ground Floor	49
Figure 5.3: First floor	49
Figure 5.4: Second floor	50
Figure 5.5: Roof plan	50
Figure 5.6: East Elevation	51
Figure 5.7: North Elevation	51
Figure 5.8: West Elevation	52
Figure 5.9: South Elevation	52

ABSTRACT

The design of court buildings must take into account acoustic considerations to ensure clear speech, adequate privacy, and the efficient administration of justice. This study investigates the influence of architectural acoustics on High Court buildings, with particular emphasis on speech intelligibility, noise control, and spatial planning. Through a review of relevant literature, case studies, and site appraisal, several common acoustic challenges were identified, including excessive reverberation, external noise intrusion, sound leakage, and inadequate acoustic zoning. The findings informed the design of a proposed State High Court Complex at Okpara Square, Independence Layout, Enugu. Acoustic design solutions were incorporated through appropriate site planning, functional zoning, sound-insulating building elements, sound-absorbing finishes, and landscape buffers aimed at minimizing noise and enhancing the acoustic quality of the judicial environment. The design proposal demonstrates how architectural design can improve courtroom functionality, enhance user comfort, ensure confidentiality, and facilitate clear communication during judicial proceedings. The study concludes that acoustic control should be recognized as an integral component of courthouse design and incorporated from the early stages of the architectural design process.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The Oxford English Dictionary states that acoustics is "the science of the production, control, transmission, reception and effects of sound. It is the study of the way sound travels within a structure and the perception of sound in spaces such as courtrooms. Acoustics plays a vital role in courtrooms by ensuring accurate speech transmission, which is essential for judges, lawyers, and witnesses to hear and understand proceedings clearly (Zahorik *et al.*, 2016; Soulodre, Popplewell, & Bradley 1989).

In traditional African societies, conflicts were settled by elders in an informal manner. But the introduction of formal legal systems, as a result of colonial influence, resulted in the emergence of High Courts in Nigeria. Court buildings included functional space including courtrooms, chambers and registries. Acoustics now plays a more significant role in these areas. Acoustic design is essential for good communication between judges, lawyers, witnesses, and the audience.

Acoustic design shapes the auditory environment which inevitably affects the satisfaction of a user in space (Oluwatayo, & Adele, 2024). However, many High Courts in developing regions like Enugu lack proper acoustic design considerations resulting in echoes, poor speech clarity, and noise interference (Egan, 2007; Mehta, Johnson, & Rocafort, 1999). Sound is caused by human speech and is either transmitted through air or structure (walls, floor and ceiling). Acoustic issues are likely when there is a lack of control over transmission in high court buildings including sound leaks through walls, doors and ceiling, or through inappropriate building materials (hard reflective surfaces, poor room design, lack of acoustic treatment and weak sound insulation). Excessive noise in occupied spaces significantly reduces speech intelligibility, concentration, and overall

communication effectiveness, especially in environments where clear understanding is critical (Peng & Wang, 2016; Bradley *et al.*, 1999).

1.2 Statement of the Problem

The design and construction of courtrooms, as physical environment where the efficient dispensation of justice occurs relies so much on the transmission of meaningful information through intelligible verbal communication. The acoustic environment in some High Court building projects in Nigeria are, nevertheless, often have poor design with the emphasis on architectural function, aesthetics and the structural integrity of the building rather than its acoustic performance. As a result of poor audibility and intelligibility of speech in some courtrooms in Nigeria thus hinder effective communication amongst judges, lawyers, witnesses and the general public.

Poor speech intelligibility has been attributed to faulty architectural and spatial planning, inappropriate selection of building materials and finishes, poor sound insulation and lack of acoustic considerations at the initial planning and design stages.

This consequently compromises the quality of the courtroom environment as a comfortable and suitable working and information transmitting space. There is therefore an immediate necessity for a judicious integration of acoustic principles in the design and planning of High Court buildings due to the indispensability of verbal communication in their use. This study endeavors to access and propose strategies for the integration of architectural acoustic principles in the design of a state High Court Complex at Enugu State, Nigeria.

1.3 Aim and Objectives of the Study

The aim is to investigate acoustic control strategies in high court buildings with a view to proposing a state high court complex that provides an acoustically conducive environment for effective judicial proceedings.

The objectives:

1. To gain an understanding of the principles of architectural acoustics and their relevance to planning and design of high court buildings.
2. To identify the examples of how architects or architectural designs have dealt with issues of acoustics within interior public spaces and courtrooms.
3. To evaluate appropriate architectural acoustical control strategies for improving speech intelligibility in high court
4. Apply the principles of architectural acoustics and results of the study in a design proposal for effective acoustic control in high court in Enugu.

1.4 Research Questions

1. What are the principles of architectural acoustics and their importance to planning and design of High Court buildings.
2. What architectural designs strategies that has been utilized to overcome acoustics challenges in public spaces and courtrooms.
3. What architectural acoustics control principles or strategies that could be implemented to achieve good intelligibility in High court buildings
4. How can the principles of architectural acoustics be used to design a State High Court complex in Enugu to achieve good acoustics control.

1.5 Significance of the study

1. The study sought to find out the significance of the study.
2. This study is important as it provides insights into the role of acoustics in courtroom design. It helps to advance the discipline of architecture with a focus on the use of acoustics in the design of public buildings.

3. The research results will help architects, designers and policymakers develop strategies for enhancing courtroom environments. It will also improve the efficiency of the judicial system by facilitating the flow of information in the judicial process.
4. This study will also enhance the quality of speech intelligibility in the court room, this study will guide us acousticians to know how to control and minimize the surrounding noise in the court room and help in improving the knowledge in the room acoustic design. This study will provide us with knowledge as to why and how acoustics is important in courtrooms.

1.6 Scope & delimitation of the Study

The study is limited to the principles of acoustics in the design of a public institution such as a court, based on the principle of acoustic performance in a High Court in Enugu. It provides information on the court room design, building materials, acoustics, and noise control measures.

Detailed engineering calculations are not detailed in the study, but the principles of architectural design that affect acoustics are detailed.

The report is organized as follows:

The first chapter gives a complete background to the study, statement of the problem, and the general aim and objectives of the study. It also includes the research questions, the importance of a study, the scope of a study and its delimitation.

The second chapter is a literature and case study analysis which takes the existing literature and case studies to create a theoretical framework. It ends with a critical review of the literature and case studies, to identify the current gaps in the field.

The third chapter reviews the study area and its historical background, geographical surroundings and site selection criteria. It also discusses the physiography, climate and vegetation in addition to the population, culture, and economic development of the region. Also, it sets the design criteria,

including project objectives, legal/planning constraints, spatial needs and human-behavioural needs.

The fourth chapter explains the research methodology comprising research design, data needs and data sources. It outlines the approach used to gather and analyse the data, offering a framework that allows you to understand how the data was analysed and interpreted.

The design synthesis is presented in the fifth chapter, beginning with the design brief and requirements. It includes housing schedule, space planning and site inventory and analysis. This culminates with the presentation of the design idea, formal proposal and detailed 3D architectural drawings and physical models.

Last, the sixth chapter offers the findings from the research, as well as recommendations. It offers an overview of the study's results and identifies the peculiar contribution of the study in the field of architectural knowledge.

1.8 Special Terminologies

Acoustics: The science that deals with the study of sound and its behavior.

High Court: A higher court of law with jurisdiction over high civil and criminal cases.

Reverberation: Sound that continues after the source that made it has ceased.

Sound Insulation: prevention of passing of sound through structures.

1. Acoustics

The study of the generation, propagation, control and reception of sound is called acoustics. Within a high courtroom, acoustics involves the issue of speaking intelligibly to all parties (judges, attorneys, witnesses and an audience) without any echo, distortion or noise. An effective acoustic design is crucial for ensuring fair hearing and effective communication.

2. Sound

The sound is a type of mechanical energy which is generated by vibrating objects and passed through a medium like air. The term sound in a courtroom context is predominantly used to describe speech acts, such as legal arguments, witness statements and judicial declarations. Information is gathered and comprehended through the quality of sound.

3. Sound Waves

Sound waves are vibrations that move from a sound source to a sound receiver. These waves transmit speech signals and other sound signals throughout the courtroom. The acoustic quality of the space is determined by the behavior of sound waves like reflection, absorption and diffusion.

4. Frequency (Pitch)

Frequency is the measure of the number of vibrations that occur in one second of a sound wave, in units of Hertz (Hz). This influences the sound's pitch. A balanced frequency range is essential in courtrooms to be able to hear and distinguish both high and low pitched voices.

5. Amplitude (Loudness)

Loudness is how loud a sound is, which is related to its strength or intensity (amplitude). It is expressed in decibels (dB). When a sound is heard in a high court, there is a need to control the sound level for the speaker so that it may be heard but not be so loud as to become uncomfortable or distorted.

6. Reverberation

A reverberating sound is a sound that continues to echo in an enclosed space after the source of the sound has ceased after the sound has bounced multiple times off a wall, ceiling, floor etc. A small amount of reverberation can improve richness of sound; too much reverberation in a courtroom will make speech less clear, and result in overlapping of words.

7. Reverberation Time (RT)

The reverberation time is the time it takes for a sound to drop by 60 decibels (60 dB) once the source of the sound has ceased. An important parameter in acoustics. High courts require an optimum reverberation time to allow the voices to be heard to ensure clarity of speech without having to make the space “dead” or “echoey.

8. Echo

An echo is a separate repetition of sound which occurs when it reflects from a distant surface, with the reflected sound arriving later than the original sound. However, in the courtroom echo is not desirable as it can cause problems with communication or misunderstanding of speech.

9. Sound Reflection

Sound reflection is when sound waves collide with a surface and return to the space. Reflective surfaces such as concrete, glass, and marble can increase sound levels. Reflection is helpful in an even distribution of sound and too much can lead to reverb and echo.

10. Sound Absorption

The absorption of sound energy in material is called sound absorption. In courtrooms, the materials used to control reverberation and clarity of speech include carpet, upholstered seats, curtains, and acoustic panels.

11. Sound Insulation (Soundproofing)

The term sound insulation is used to describe the ability of the building elements (walls, doors, windows) to prevent sound from travelling between spaces. In high court buildings, acoustical performance helps to prevent the entry of outside noise (traffic, street activity), as well as to ensure privacy inside the courtroom.

12. Background Noise

Background noise is any noise that doesn't belong, for example, noises from air conditioning units, traffic, movement, etc. Background noise can affect intelligibility of speech and hinder focus during court proceedings.

13. Speech Intelligibility

Speech intelligibility is the ability to be intelligible in a space. The most essential acoustic requirement in a courtroom is that speech is misinterpreted which has an impact on the legal outcome. Good acoustical design can help ensure that all sounds made are heard and understood.

14. Acoustic Treatment

Acoustic treatment uses design strategies and materials to enhance the acoustics of a space. This involves the installation of acoustic panels, ceiling tiles, diffusers and sound absorbing finishes to manage reverberation and echo, as well as noise.

15. Diffusion

Diffusion, scattering of sound waves in many directions by irregular or specially designed surfaces. It evenly distributes sound around the courtroom and prevents sound concentration in certain areas.

16. Decibel (dB)

Decibel is a unit of measure for a sound's loudness or intensity. Avoid hearing fatigue, ensure comfort and clarity in court during trial proceedings.

17. Acoustic Panel

Acoustic panel is a material designed for absorbing sound and minimising the echo in a space. These panels are commonly used in courtrooms on walls and ceilings to enhance speech intelligibility.

18. Noise Control

Noise control: Methods to reduce or eliminate unwanted noise in a space. Noise control is important for a quiet and focused environment in high courts where legal proceedings are conducted.

19. Sound Transmission

The transfer of sound between spaces via walls, floors, ceilings or openings. In courtrooms, control of sound transmission is essential to ensure privacy and to ensure that sound is not transmitted from neighbouring rooms.

20. Acoustic Design

Acoustic Design is the planning and design of a space to obtain desired sound quality. Acoustic design for high court buildings will take into account building shape, materials, seating layout and sound systems to ensure optimal listening conditions.

21. Early Reflections

The first sound echoes that are heard after the direct sound are called early reflections. If their growth is not properly managed, they can be harmful to the clarity of the water; if they are kept under control, they can help to improve water clarity.

22. Flutter Echo

Flutter echo is a fast successive reflection of sound between two parallel surfaces, e.g. walls. It creates a buzzing or ringing sound and it is not desirable in court acoustics.

23. Acoustic Ceiling

An acoustic ceiling is a ceiling system made with materials that have a high absorption of sound and reverberation to reduce noise and reverberation. It is a very effective solution for enhancing acoustics in courtrooms.

24. Sound Clarity (C50/C80)

The clarity of sound is the ability to hear separate sounds without overlap. Acoustic indices (C50 or C80) are often used to measure it. In courtrooms, high clarity is a crucial factor for speech understanding.

25. Noise Reduction Coefficient (NRC)

NRC is a measure of the amount of sound that a material can absorb. High NRC values are used for materials in courtrooms to eliminate echo and reverberation.

26. Sound Reinforcement System

Microphones, amplifiers and loudspeakers designed to amplify sound in large courtrooms make up a sound reinforcement system. It makes it easy to hear the speaker in an open room, such as a large auditorium, or in a busy environment.

Green = high human impact, Red = high

CHAPTER TWO

LITERATURE REVIEW AND CASE STUDIES

2.1 Review of Related Literature

The research consisted of a review of related literature.

Architectural acoustics is an important consideration in court buildings as it relates to speech intelligibility, communications efficiency and the efficient running of court proceedings. Speech intelligibility is essential in courtrooms because judges, lawyers and witnesses rely primarily on oral communication to ensure the proper delivery of justice.

According to Makinde (2020), effective courtroom design should integrate both spatial planning and acoustic control, as poor sound conditions can negatively affect the understanding of court proceedings. He added that many public buildings in Nigeria, such as courtrooms, do not have proper acoustical planning and as a result, it results to reflections, echoes and lack of clarity.

Studies of public and multifunctional buildings indicate that the construction material plays a significant role on its sound behaviour. Hard surfaces, like concrete and glass, reflect sound waves; soft materials absorb sound waves and minimize reverberation. When reverberation is excessive, speech becomes unclear and difficult to understand, especially in large indoor spaces (Oniku & Bello, 2012).

Research has also indicated that numerous institutional structures in Nigeria depend on amplification system to address the salient issue of poor acoustics in their buildings. However, over-reliance on microphones and loudspeakers can lead to sound distortion and inconsistency in sound quality across different areas of a courtroom (Roberts *et al.*, 2025).

Moreover, urban court setting may suffer from external noise intrusion, as traffic and surrounding activities may interfere with the internal communication if adequate sound insulation is not ensured. This compromises the acoustic performance and impacts ease of use in these buildings. Finally, literature indicates that although there have been some advances in the design of modern court buildings, acoustic design remains a great challenge for many Nigerian courts. The effective incorporation of acoustical materials, space layout and acoustical controls are key factors in enhancing courtroom communication.

2.2 Case Studies

Case Study 1: Federal High Court, Abuja

The project is located in the Central Area of Abuja, Nigeria.

Year Established: 1979

Overview:

The Abuja Federal High Court which is located on Shehu hagari way Central district, Abuja FCT, Nigeria. Is a state-of-the-art complex to adjudicate on serious cases. It is equipped with large courtrooms and modern architectural details, along with embedded technology systems.

The Federal High Court in Abuja is an institutional building with a Modernist architectural form: double-volume court rooms (plate 2.1). It is a design that is typical of civic architecture in the Federal Capital Territory that combines monumental scale with the emphasis of vertical and horizontal fins.

Intelligibility, privacy and noise control are achieved in the courtrooms of the Federal High Court, Abuja, through the use of architectural acoustic treatments.

Core Acoustic Treatments are:

1. Perforated Wall Panels: The Courtroom walls are lined with Micro-Perforated Timber or Composite Panels to absorb any sound, Thus eliminating echoing.
2. Acoustic Ceiling Tiles: Mineral fiber or fiberglass tiles hung on the ceiling absorb the vertical reflection sound and reduce ambient noise.
3. Heavy Fabric Drapery: Curtains cover large window with thick, fire-resistant fabric to control echoing of sound from windows.
4. Heavy solid core wooden doors lined around the edges with sound isolating materials keep noise from escaping between courtrooms and the public corridors.
5. Carpet Flooring: Heavy-duty commercial carpeting in the court and gallery dampens foot traffic and furniture movement noises.
6. Upholstered Seating: Fabric covered seating in the gallery and jury areas do offer passive sound absorption even when the seats are empty.



Plate 2.3.1: Federal High Court, Abuja(main entrance)(Source: Wikipedia Commons, 2026)

Merits:

Good sound systems such as Microphones and loudspeaker provide clear sound from a distance to ensure proper communication in court proceedings for Judges, Lawyers & witnesses.

1. The courtrooms are set up to ensure proper seating for participants and an elevated seat for the judges to ensure that the sound is carried more evenly throughout the room, and important statements can be heard by the entire room.

Demerits:

2. Microphones and loudspeakers are very important in the court. Poorly adjusted or failure of these systems makes it hard to hear clearly the speech, disrupting the process.

2.2.2**Case Study 2: Enugu State High Court.**

Location: Court Avenue, independence layout, Enugu, Nigeria

Year Established: 1991

Overview:

The Enugu State High Court which is located in Court Avenue, Independence Layout, Enugu, Nigeria. Thus a court with design and shows limited application of the modern principles of acoustics.

The Enugu State High Court Complex is a mixture of Tropical Modernism and institutional neo-classical principles of layout. It was built by the Dr. Chimaroke Nnamani administration as a multi-building complex having a specific civic aesthetics that conveys the authority, order and dignity of the state judiciary (plate 2.2).

Architectural Form & Massing

Symmetrical Multi-Block Layout: The complex is designed in the form of four main functional buildings, not one monolith. This results in an open campus-style environment, designed to maximise space hierarchy and security spaces.

3. **Rectilinear Geometry:** The blocks are strongly dependant on horizontal massing of low rise. This includes administrative and judicial wings and structural grids housing individual judicial chambers.
4. **Integrated Courtyards:** There are open air central courtyards whose structural footprints are contained. They achieve maximum daylighting and natural ventilation, which is a crucial design solution to the tropical climate in Nigeria.

Facade Treatment

- 1 **Externally braced Post and Beam:** Deep beam profiles and large concrete columns, which are easily visible from the exterior. These offer both the structural expression and serve as passive solar shades.
- 2 **Large Fenestration and Sun Shading:** windows placed in a bay structure that is repeated in length. They are well recessed on the facade or screened by concrete overhangs to reduce the solar heat gain and yet allow daylight to reach the interior.
- 3 **Exterior Walls:** Durable and weather-proof textured masonry paint is applied to the exterior walls. These are mostly neutral shades of white, cream or light beige to reflect sunlight and withstand weathering from excess tropical moisture.
- 4 **Prominent:** The main entrances are on elevated canopies with multiple levels supported by stylised columns. This gives a great sense of welcome, with a sense of scale. The plate 2.2 below shows the entrance and front view of the building of Enugu State High Court



Plate 2.3.2: Enugu State High Court(Detailed view of the road leading to the state High Court and also main entrance at the front)(Source: Authors fieldwork,2026)

Merits:

Enugu State High Court are of medium size, hence sound travel a short distance. This helps the judge, attorneys and witnesses communicate with each other and improves communication between the judge and the witness.

Typically, the layout in the courtroom is simple and the judge, bar and witness box are well-defined. This helps to minimize the noise barriers and promotes efficient communication.

Demerits:

Some of courts that have a high tech material like acoustic panels or treated ceiling material, which results in poor clarity and uncontrolled reflection.

It may be difficult to hear what people are saying because sound is reflected off room walls, floors and ceiling.

2.2.3

Case study 3: Lagos State High Court, Ikeja

Location: Lagos, Nigeria

Year Established: 1979

Overview:

The Lagos State High Court Complex at Ikeja (Old Secretariat) has an architectural style that developed in two main phases: an older modernist block constructed in 1972, and a newer multi-level block for the chief judge's court constructed in 1995(plate 2.3).

Architectural Form & Massing

1. Double-Volume Courtrooms: Main courtroom block has a double-volume vertical design. By increasing this structural height, it assures an immediate sound path to the ceiling and allows the decay of direct sound, causing it to fade away in a natural manner without harsh reflections.
2. Spectator Galleries: This double volume allows for a mezzanine raised spectator gallery. Acoustically, these galleries divide the volume of the room and spread the public spectator horizontally in order to reduce the horizontal acoustic flutter echoes.
3. Internal Courtyard Configuration: The newer extension features courtyard configuration. The courtyard is designed as an acoustic enclosure that provides a multi-sided acoustic trap, allowing sound waves to escape and dissipate naturally, so as not to reflect directly back into other court rooms.

Facade Treatment (External Noise Control)

- 1 Aluminium Sun Breakers (Brise-Soleil): The sun breakers are a prominent part of the facade treatment, and are of aluminium material which runs horizontally and vertically

across the circulation corridors. These are mainly created for solar protection but they also serve as a physical sound barrier. They break incoming sound waves before they strike the inner glazing, thus preventing the inner glazing from vibrating against the incoming sound waves.

- 2 Deep Circulation Buffers: The building's envelope has long, wide perimeter corridors extending to the perimeter of the facade. The real courtrooms are located amidst the building's structural heart. These external corridors serve as an insulated air pocket barrier to street noise, which filters out noise from the street before it reaches the courtroom.

Fire Systems and Design

Specialised courtroom walls: The walls in the courtroom are not simply those used in regular municipal buildings, they are lined with special timber and composite panels that absorb sound. Such materials have been specifically developed to minimize reverberation time within the litigation and enable judges to hear the voices of the attorneys without the sounds overlapping.

The large ceilings above the judge's bench and legal arena are covered with acoustically treated ceilings, acoustic panels and mineral fiber tiles. This essential material treatment is able to absorb rising voice reflections directly, so that voice information is not confused by voice loops.



Plate 2.3.3: Lagos State High Court, Ikeja (detailed view of the entrance of the court)(Source: Wikipedia commons, 2026)

Merits:

The courtrooms are designed with spaces well organized – allowing a fair distribution of the sound from the judge to the rest of the room, making it easier to hear.

Very common too are microphones and PA systems because the judges, lawyers and witnesses can be heard in large courtrooms.

Demerits

A microphone and a loudspeaker are vital to the court. If these systems are misaligned or malfunction, it causes clarity problems, and may interfere with communication in proceedings.

Levels of sound can at times be recorded at too high a level – this is sometimes necessary in bigger courtrooms and this can lead to distortion, feedback or a poor quality of sound.

2.2.4

Case Study 4: Royal Courts of Justice High Court, London

Location: strand, london, WC2A 2LL, United kingdom

Origin: Great Britain

Year Established: 1882

Overview:

The Royal Courts of Justice High Court, London is an ancient building of Gothic architecture. Although the building was not designed with modern acoustical considerations in mind, several modifications have been made to enhance speech intelligibility in courtrooms without altering the heritage building. The Royal Courts of Justice (RCJ) on The Strand, London, designed by George Edmund Street and opened in 1882, is a masterpiece of High Victorian Gothic Revival architecture. Because the building was constructed before modern acoustic engineering existed, its acoustic management relies entirely on classical architectural physics, structural mass, and historic material layouts to achieve privacy and speech intelligibility(plate 2.4).

Architectural Form & Massing

- 1 Cathedral-Scale Public Buffering: The building features a monumental, 82-foot-high Great Hall (Central Concourse). This massive cubic volume acts as an intentional acoustic reservoir, swallowing up the echo and rumble of large crowds before they can penetrate the quiet courtroom blocks.
- 2 Deeply Nested Courtroom Cores: Rather than sitting adjacent to outer streets, the courtrooms are deeply pocketed within a maze of 3.5 miles of restrictive corridors. This complex layout places several structural layers between the judicial proceedings and the noisy London core.
- 3 Proportional Spatial Volume: The individual courtrooms feature highly specific, steep vertical geometry—frequently being as tall as they are wide. This excessive height allows the thermal energy and acoustic energy of speech to travel upward, decaying naturally into the roof void rather than echoing immediately off the rear walls.

- 4 Facade Treatment (External Noise Isolation)
- 5 Massive Load-Bearing Stone Walls: The exterior facade is a dense, heavily fenestrated layer of Portland stone and solid brick. The sheer physical density provides an exceptionally high Sound Transmission Class (STC) rating, completely blocking out low-frequency airborne traffic rumbles from Fleet Street and The Strandan echoing immediately off the rear walls.
- 6 Deeply Recessed Lancet Windows: Windows are tightly grouped, narrow Gothic lancets set deep into heavy stone embrasures. This recess means sound waves traveling horizontally down the street hit the stone piers and fragment, rather than striking the glass panes at a direct, vibration-inducing angle.
- 7 Arcaded Screen Barriers: Wrought-iron panels and grand stone arches form an external screen standing slightly ahead of the primary facade. This decorative boundary breaks up initial atmospheric sound waves before they hit the building's thermal and acoustic envelope.

Internal Architectural & Acoustic Treatments

- 1 The Portland Stone Sound Reflector: Built directly into the rear wall of the courtrooms (directly behind the judge's raised dais), a solid Portland stone reflector is integrated into the architecture. This features a carved Royal Coat of Arms and is strategically angled to project the judge's voice forward into the legal well.
- 2 Dampening Dado Timber Paneling: Hardwood timber paneling lines the lower half of courtroom walls. This breaks up direct, low-level sound reflections near the floor, while the remaining upper half transitions to porous, rough-textured white lime plaster to absorb high-frequency flutter echoes.

- 3 Deeply Coffered Sexpartite Ceilings: The overhead structures feature heavy sexpartite rib vaulting and timber beam networks. This massive architectural geometric depth creates highly effective acoustic diffusion, scattering rising sound patterns rather than reflecting cohesive echoes.
- 4 Bespoke Security & Acoustic Doors: Modern conservation overrides have carefully replaced historical interior access points with bespoke heritage security doors equipped with concealed acoustic perimeter seals. These maintain the 13th-century aesthetic while preventing sound leakage into the modern judges' corridors.



Plate 2.2.4: Royal Courts of Justice High Court, London (this is the front view of the the royal courts of Justice, high court)Source: Google source 2026

Merits:

High ceilings disperse sound, and (when properly managed) provide less echo.

To promote speech intelligibility, acoustic panels and modern sound systems have been embedded without impacting the historic interior.

Courtroom designs encourage direct sound transmission between the judges, attorney(s) and audience.

Demerits:

However, reverberation can be a problem in the large number of spaces, particularly in the older courts that lack adequate acoustic treatment.

The building's age and original construction techniques often allow external noises to intrude.

Case Study 5: Federal Court of Australia High Court Building

Location: Canberra, Australia

Year Established: 1980

Overview:

The High Court of Australia building in Canberra, designed by Edwards Madigan Torzillo & Briggs (completed in 1980), is a monumental masterpiece of Late Modern Brutalist architecture. Because the building pairs massive, raw concrete surfaces with an expansive 24-metre-high glass public hall, its architectural form and material finishes required highly advanced, integrated acoustic planning to maintain judicial dignity, privacy, and speech intelligibility.

Architectural Form & Massing (Acoustic Zoning)

- 1 The Monolithic Concrete Core: The building's form is essentially a massive, asymmetrical cube constructed from poured-in-situ, off-white reinforced concrete. This heavy, continuous concrete envelope provides an extraordinary amount of structural mass, which serves as a highly effective barrier against external airborne environmental noise.
- 2 The Great Public Hall Buffer: The southern face of the building opens into a vast public hall containing a soaring, open-air ramp promenade. This gargantuan volume acts as a gigantic acoustic reservoir. It absorbs and naturally dissipates the conversational echo of public crowds before those sound waves can ever reach the court proceedings.

- 3 Vertical and Core Isolation of Courtrooms: The three primary courtrooms are not lined up horizontally; instead, they are nested on completely different floor levels and arranged around a single, highly controlled structural circulation core of lifts and stairs. This vertical fragmentation ensures that noise from one active courtroom cannot transmit structurally to another.

Facade Treatment (Sound Isolation & Fragmentation)

- 1 High Glass Walls with Tube-Steel Bracing: The building features a striking, towering transparent glass facade. To mitigate the natural acoustic vulnerability of such massive expanses of glass, the heavy glazing panels are supported by a rugged tubular steel framework and structural backups. This heavy reinforcement dampens pane vibration, stopping low-frequency sound rumbles from entering the building.
- 2 Asymmetrical, Fragmented Facade Profiles: While the southern and eastern faces are disciplined planes, the northern and western concrete facades are highly fragmented, featuring recessed bays, deep overhangs, and jutting structural elements. Architecturally, these stepped concrete forms break up and scatter oncoming sound waves rather than letting noise hit a flat, reflective wall.
- 3 Interior Material and Acoustic Treatments
- 4 Towering Timber Acoustic Dispersers (Courtroom 1): In Courtroom 1 (the main ceremonial courtroom), the primary architectural feature is an imposing, 17.5-metre-high wall clad in Queensland Red Tulip Oak. This timber paneling is strategically slatted and backed by acoustic insulation to control early sound reflections, absorbing lateral echo while projecting the judges' voices directly down into the legal well.

- 5 Overhead Sound Absorption: The expansive courtroom ceilings are treated with specialized Blackwood timber and acoustic plaster tile configurations. These dense, multi-tiered panels absorb rising vertical sound waves, entirely eliminating flutter echoes in rooms with such extreme vertical height.
- 6 Woven Textile Tapestries: Courtroom 1 features a massive, custom-woven woolen tapestry spanning the wall. Beyond its artistic and civic symbolism, the heavy, porous textile serves a critical acoustic purpose by functioning as a high-efficiency mid-to-high frequency sound absorber.
- 7 Composite Laminated Entry Doors: Because the courtrooms open directly onto the public circulation tiers, the entry doors feature a specialized acoustic laminate design. They incorporate a silvered bronze grid partially recessed into heavy laminated plate glass, paired with heavy drop-seals to prevent sound leakage into the public hall. The plate 2.5 shows the entrance of the building.



Plate 2.5: Federal Court of Australia High Court Building (source: Google source 2026)

Merits:

Sound absorbing wall panels and carpets provide better clarity and absorb echoes.

Courtrooms are optimally shaped to ensure that the acoustics are equally distributed.

Very low external noise interference as a result of good building insulation and suitable site planning.

Demerits:

If not well-maintained, mechanical ventilation systems can add background noise.

Courtroom areas with large open public spaces can allow for sound transmission through doors, if they are not regulated.

Case study 6: The New York county supreme court, USA

Location: Manhattan

Year Established: 1945

Overview:

The New York County Supreme Court (60 Centre Street) features a hexagonal plan topped with a central rotunda. Designed by architect Guy Lowell, the massive Neoclassical granite building is dominated by a grand portico with 10 colossal Corinthian columns. The façade is heavily treated with rich, warm-toned masonry and classical details. Historically, the building relied on its inward-facing light courts and heavy masonry walls for natural acoustic and environmental control against street noise, (plate 2.5)

Building Form

- 1 Plan: The courthouse is a 10-story hexagonal edifice. Its unique geometry allows it to present a unified, continuous frontage to surrounding streets without a designated "back".

- 2 Central Massing: While the exterior is angular, the interior features an expansive, hidden circular rotunda bathed in natural light, signifying order and classical balance. Facade Treatment Materiality: The entire exterior is wrapped in warm-toned granite to provide a sense of civic permanence.
- 3 Entrance Portico: The grand westerly entrance is accessed via a flight of 32 wide steps that lead to a soaring Corinthian colonnade. The triangular pediment features sculptures of Law, Truth, and Equity. Fenestration & Composition: The remaining five sides rely on a symmetrical arrangement of recessed windows and flat surfaces rather than jutting projections to ensure courtrooms receive ample natural light.

Architectural Acoustic Treatment

Historical Design: The building's original design focused on passive architectural acoustics rather than synthetic treatments. The incorporation of inward-facing light courts allowed the courtrooms to be ventilated with operable windows while keeping them physically removed from the heavy, disruptive street traffic of lower Manhattan.

Interior Materials: The monumental interior spaces, including the great hall and courtrooms, utilize traditional classical elements such as dense masonry, vaulted ceilings, and marble wall panels, which traditionally define the echo and sound decay in large civic spaces.

Modern Upgrades: Periodic renovations (such as recent building envelope integrity and courtyard restoration projects by firms like SUPERSTRUCTURES) focus on preserving historic materials and upgrading exterior glazing to contemporary, sound-mitigating standards. The plate 2.1.5 below shows the entrance of The New York county supreme court



Plate 2.3.6: The New York County Supreme Court (main entrance of the building)**Source:** Google source, 2026

Merits of the Building's Acoustics

Effective Street-Noise Isolation: The primary architectural triumph of Guy Lowell's design is the hexagonal buffer configuration. By arranging the courtrooms in an outer ring and venting them through inward-facing, recessed light courts, street noise from lower Manhattan is drastically minimized.

.Low Impact Noise: To combat the sound of heavy foot traffic inside the courtrooms, the original layouts integrated cork-tile flooring. This material choice successfully dampens impact sounds (such as walking, moving chairs, or shuffling papers) near the gallery and bar.

Demerits of the Building's Acoustics

High Reverberation and Echo: The monumental courtrooms feature high ceilings, wood paneling, and dense plaster moldings. Without modern acoustic cloud panels, sound waves bounce excessively, creating long reverberation times that degrade speech intelligibility.

2.5 Summary of Literature and Case Studies

Literature Review The literature reviewed in this paper shows that acoustics is at the core of the design and function of a court building. This involves maintaining a clear and coherent space for communication by promoting sound transmission and enhancing intelligible speech, to safeguard the privacy and concentration required for both the judiciary, participants and the administration of justice. Common acoustic issues encountered in courtrooms found within the reviewed literature include high levels of reverberation, interference by background noise, sound leakage from other spaces, poor speech clarity and the lack of acoustic zoning.

The prevalent causes of acoustic issues were often found to be inadequate material selection, inefficient space planning and the lack of an acoustic strategy at the early design stage.

This suggests that Architectural Acoustics cannot be treated as a superficial aesthetic that is applied at the end of the design process. There has been an emphasis within the literature, that an acoustic plan should be integral to the design of a court room which could be comprised of sound absorbing materials and acoustic panels or ceiling, insulated walls, solid and soundproof doors and appropriate spatial dimensions and volumes for ideal sound diffusion and intelligibility. Additionally the creation of landscape buffer zones, appropriate orientation of building and the strategic placement of mechanical systems can all greatly improve the overall acoustic environment of a judicial building.

Case Studies

The Case Studies in this paper give a clear and comprehensive view of how the design principles can be applied in real life to improve the acoustics of a courtroom, through various locations.

The case studies the Federal High Court and Lagos State High Court in Nigeria have shown successful examples of incorporating acoustic wall panels and ceilings and, flooring like carpet, along with sound systems to improve speech intelligibility and minimize noise disturbances.

However it has been evident from the case of the Enugu State High Court, there has been deficiencies in their approach to acoustics and room layout to provide high level of speech intelligibility. There have been successful examples of acoustics within both traditional and contemporary court rooms, illustrated by case studies such as The Royal Courts of Justice, the High Court of Australia, and the New York County Supreme Court where a thoughtful arrangement of building layout, material selection, room proportions and soundproofing measures have resulted in high degrees of clarity and privacy. This shows that both historic and contemporary courtrooms can yield an excellent performance from acoustics alone.

Design Lessons from the Literature and Case Studies from the information acquired from the literature and case study investigation a list of key design lessons were concluded to be relevant to the development of the proposed State High Court Complex in Enugu State; they include a good distribution of space and functions, placement of a space plan that is efficient and provides separation between the busy and the quiet spaces, adequate use of sound absorbing materials within room, using a dual glaze system on windows with double and ideally laminated glass, use of solid sound proofing doors, placing sound buffers such as landscaped spaces around the building to minimize external noise, and finally designing acoustics as a key factor from concept through to

completion. The results and findings in this literature and case study have contributed greatly to establishing the theoretical and practical knowledge to design a state high court complex that provides optimal acoustic comfort for effective justice administration.

CHAPTER THREE

THE STUDY AREA

3.1. The setting or geographical location.

Proposed site is located in central urban area of Enugu in Enugu state, Nigeria.

In particular, the site is adjacent to Enugu State Planning Authority (S.P.A) and opposite to Opara Square one of the landmarks in the City of Enugu. Enugu is in the south eastern part of Nigeria and is the capital of Enugu state. The city is located roughly between latitude and longitude 6°21'N - 6°30'N and 7°26'E - 7°37'E. The site is strategically located and has good access through Presidential Road, and other major roads in the city.(Figure 3.1)

It is encircled by government offices, commercial establishments and institutional developments which would be appropriate for a state judicial complex.

Central location provides easy access for judges, lawyers, litigants and the public.

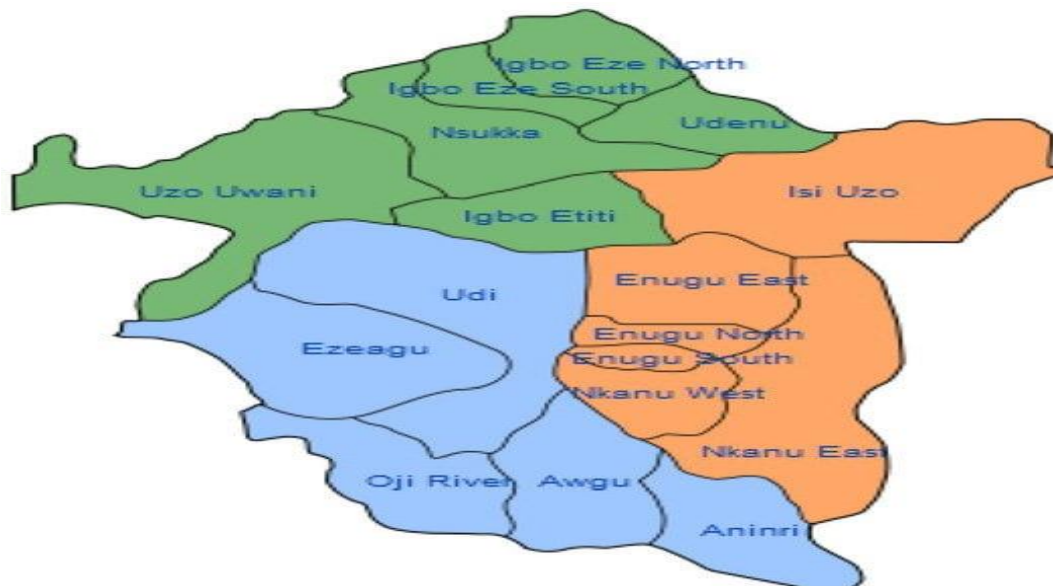


Figure 3.1: Map of Enugu showing the 17 local Government Area [source: Google]

3.2. Site Selection Criteria

The following considerations were used to select the site:

1. Accessibility: It should be accessible through the major routes of transport network in the city of Enugu thereby ensuring ease of movement for court users.
2. Proximity to Government Institutions: This should be in close vicinity of the relevant government facilities which aids administrative coordination and management.
3. Security: It has existing proper security architecture and is currently a government regulated area that should be appropriately safeguarded from environmental hazard and nuisance.
4. Adequate Land Area: The site should be large enough to allow for construction of courts, offices, function rooms, buffer acoustics, administrative support, parking, as well as landscaping, without ruling out provision for possible future expansion.
5. Acoustic Suitability: Although a site in an urban environment, it should be possible to create an acoustically appropriate judicial environment through, among other, effective design measures that include sound insulating walls, acoustic ceilings, buffer areas and landscaping.
6. Availability of Infrastructure: Its accessibility to municipal road, power supply, water, sewer and communication networks should be considered.
7. Symbolism the Court has to be visible and readily identified. Its location must be recognizable and visible.



Figure 3.2: Map of Okpara Square, Independence Layout, Enugu (source: google)

3.3. The Study Area

Briefly the city of Enugu was developed in 1909 following discovery of coal and it developed into the major commercial and administrative center during colonial days. Enugu derived from a popular Igbo name for the city; “Enu Ugwu” meaning the “top of the hill” and due to its strategic location and economic importance, it served as the former administrative capital of Eastern region and later Enugu State. The neighborhood Opara Square falls in an area which served as an administrative/governmental district for many public agencies. This is one of the main places in the city of Enugu where official business is conducted and it hosted many governmental functions and public gatherings

Many governmental establishments were sited in this vicinity, making it suitable for a State High Court Complex.(Figure 3.2)

3.4. Physiography, Climate and Vegetation

3.4.1. Physiography

Topography Enugu has an undulating topography, varying between an altitude of 180m and 300m above sea level. The city lies on the Udi Plateau geology region, and its geological terrain is generally stable, fitting for any form of construction activities.

- Relatively gentle slope, allowing good drainage, while limiting problems of earth movement and settlement in building construction.
- Relatively gently terrain of the site is beneficial in limiting problems related to water logging and allows for a simple solution for drainage.

3.4.2. Climate

Climate Enugu experiences a tropical wet and dry climate, with two well-defined seasons:

- The rainy season (April - October)
- The dry season (November - March)

Average annual rainfall ranges from 1,500 mm to 2,000 mm, while the average daily temperature varies between 22°C to 32°C throughout the year, with higher humidity levels occurring in the rainy season.

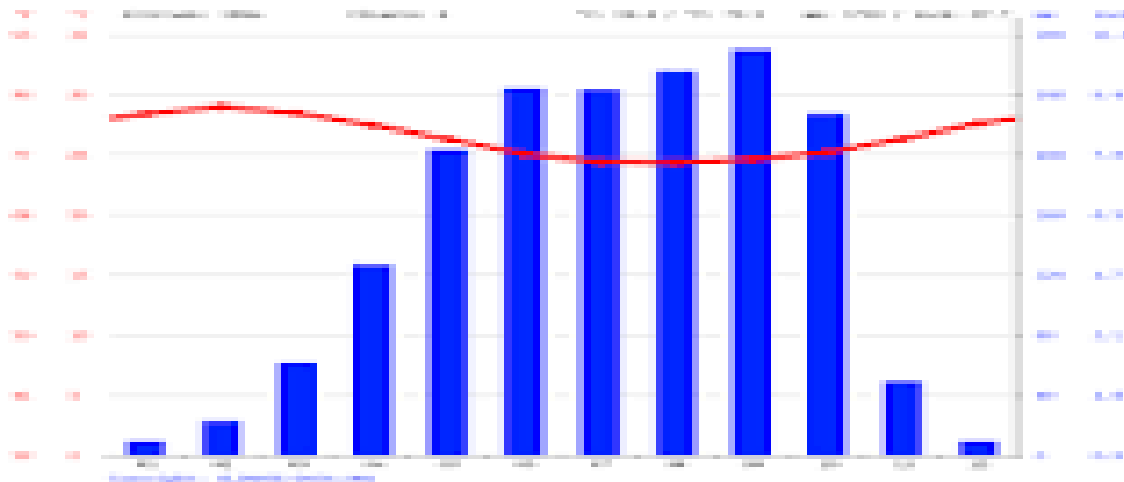


Figure 3.3: Climate graph of Enugu State. (Source: google)

3.4.3. Vegetation

These conditions influence the orientation and form of building, design of natural ventilation, material selection, and acoustics. Natural Vegetation. The natural vegetation of Enugu belongs to the derived savanna vegetation zone; this is as a result of human activities changing the initial rainforest to the savanna. Typical flora in the area includes

- Grasses
- Shrubs
- Ornamentals
- Scattered economic trees
- Public Administration
- Commerce and Trade
- Education
- Real Estate Development
- Transport Services

Professional Services: the volume of governmental and commercial activities occurring at the Okpara Square area has immensely contributed to the development of the region. The State High Court Complex at the area would further improve institutional growth and accessibility of the legal system for the populace

3.5. Population, Culture and Economic Development

3.5.1. Population

Population Enugu is one of the most populous cities in south eastern Nigeria. People have been attracted to the city due to high urban growth, better opportunities for educational, economic and

employment purposes. As more and more population comes into the city for seeking opportunities there has been a growing need for functional judicial infrastructure and services.

3.5.2. Culture

The major tribe in Enugu State is the Igbo. It is known for its culture, traditional institutions, community engagement and entrepreneurial tendencies. There are important cultural festivals which include:

- New Yam Festival

- Marriage ceremony
- Masquerade festivals
- Community development projects

3.5.3. Economic Development: The economy of Enugu is mixed and its major economic activities include; Government Administration, Trade & Commerce, Education, Real estate development, Transportation, Professional services etc.

CHAPTER FOUR

RESEARCH METHODOLOGY

This chapter explains the methodology used to complete the research project. It details the research type, nature of data sources, population, methods for collecting and analysing data to provide sufficient information to assist in the design of an acoustically efficient State High Court Complex for Enugu State.

4.1 Research Design

This research employ a qualitative research approach supported by descriptive and observational Method to identify how acoustics design can be used to improve clear speech and public addresses in adjudication buildings.

Literature Review: Relevant texts, journal articles, conference presentations, architectural and acoustics regulations were explored for theoretical knowledge of acoustics within court spaces and designs.

Case Study Approach

The acoustic features of existing court and public structures were analyzed to identify existing best practices for spatial organization, planning and sound attenuation.

Field Survey

A field study was conducted to collect data regarding the present site conditions, environmental noise pollution, the level of accessibility and the surrounding uses within the project area. **Observational Method** The site was observed to assess site details like the number of vehicles passing through the site, noise level on the site, built environment around the site, surface water drainage pattern and vegetation cover.

4.2 Data Requirements and Sources

Investigating the impact of sound on the functionality of a courtroom is of vital importance, as its understanding how to utilize acoustics within court spaces to facilitate courtroom procedures.

The environmental impact of the project site was assessed.

The assessment included measuring the environmental conditions on the site.

4.2.1 Primary Sources Case studies direct physical recordings were made for case studies on all key architectural aspects. Discussions with court members (judges, lawyers, registrars) Photographs and physical measurements of case studies.

4.2.2 Secondary Sources Architectural Acoustics Books Existing journals and research publications the relevant building codes and regulations Governmental documents Websites

4.3 Data Collection Instruments.

Interviews

Will be used to consult with staff (judges, registrars) and legal practitioners, and will help pinpoint particular problems encountered in the existing facilities.

Observation

This was used on site to record specific elements related to acoustics on site and surrounding sites as noise level, plant growth, and land use and drainage system of the site. Photography

On site photography was used to visually document existing buildings and relevant design details in order to further assist the analysis and design decision process. Site analysis

Site analysis was environmental factor that is likely to influence acoustic performance on site, and will guide design. Design Evaluation The data that will collected was analyzed to assist in making appropriate design decisions for the State High Court Complex.

CHAPTER FIVE

DESIGN SYNTHESIS AND DEVELOPMENT

Design Synthesis and Development of Proposed State High Court Complex in Enugu. The Design proposal for the State High Court complex is derived from literature study, case studies, Site Analysis and research methodology presented in chapters 2, 3 and 4 respectively.

The principal objective is to design a judicial facility that facilitates efficient acoustic performance, operational and security, comfort and Architectural Excellence.

The design addresses the challenge of speech intelligibility, excessive reverberation, external noise interference, lack of privacy and poorly zoned areas within numerous existing courts in general. The proposed High Court complex utilizes carefully programmed space organization, zoning, and selection of materials, treatments and mechanical system for acoustical control to produce the optimum environment for the conduct of legal proceedings.

5.1 Design Brief Project Title: Design of effective acoustic control in high court complex
CLIENT Enugu state government

Location: Independence layout, Enugu state

Project Aim: to design a state high court with proper acoustic control in enabling good speech intelligibility and proper hearing

Design Concept: The court will be based on the scale of justice. Balancing both sides represents equality and fairness which is the most important part of human law. The project aims to provide modern judicial facilities that would cater for judges, court staff, legal practitioners, litigants and the public. The facilities would ensure maximum acoustic performance throughout the complex by integrating well-planned court rooms, Judges' Chambers, administrative office, conference and

consultation rooms, archive, public lobby and waiting area, parking facility, and a security unit within a secure campus setting.

Emphasis would be on designing acoustically superior court rooms providing high levels of speech intelligibility and acoustical privacy for the proceedings.

5.1.1. Design Objectives

- i) To ensure good speech intelligibility in the courtrooms to facilitate effective communication between judges, lawyers, litigants, witnesses and other courtroom users
- ii) To provide optimal reverberation time to meet standard practice for speech communications in the courts
- iii) To mitigate the intrusion of external and internal noise into the judicial spaces.
- iv) To ensure privacy in judges' chambers, consultation and meeting rooms.
- v) To provide a logical and efficient circulation system for different user groups – judges, court staff, lawyers, litigants and public
- vi) To create a secure and dignified space for the judiciary reflecting its status in the society.
- vii) To implement sustainable design principles for natural lighting, ventilation, thermal comfort and energy efficiency.
- viii) To provide a landmark building that enhance the architectural character of Enugu metropolis.

5.2. Design Requirements and Planning Data

Based on the research and case studies conducted and established architectural design standards and guidelines, the following design requirements and planning data have been developed for the proposed State High Court Complex. The courtrooms are the most important spaces within the complex and are the prime focus of acoustic design due to their role in communication and the presence of large groups of people in enclosed spaces.

The key design requirements for courtrooms include:

- Proper seating and organization for judge, lawyers, jury members, witnesses and the public, ensuring adequate visibility and acoustics for all.
- Optimization of reverberation time for clarity of speech.
- Application of acoustic treatments for sound absorption and diffusion on walls, ceiling, floor and other surfaces.
- Inclusion of appropriate sound reinforcement systems (microphones and speakers) where needed.
- Soundproofing of external envelope, doors and windows to reduce external noise intrusion.
- Effective natural ventilation and lighting systems.
- Minimum capacity of 300 users Chambers; The judges' chambers require a high level of privacy and confidentiality for individual work and consultations. The design requirements for the judges' chambers include:

- Adequate sound insulation from surrounding spaces (offices, corridors, etc.)
- Secure access
- Comfortable and conducive work environment with sufficient space and natural lighting
- Efficient ventilation and lighting
- Provision for a private consultation area or a small meeting room.

Administrative Offices These offices would house the administrative staff, records department and other support personnel to ensure efficient operation of the High Court. The design requirements include:

- Functional and organized work space.
- Control of internal noise generated by office equipment and activities.
- Easy accessibility

- Sufficient storage facilities
- Integrated IT and communication systems. Conference and Consultation Rooms These are spaces for meetings, legal discussions, and private consultations. They require:
 - Soundproof construction and high acoustical privacy.
 - Integration of audiovisual equipment.
 - Flexible seating configurations.
- A quiet and confidential meeting atmosphere. Public Waiting Areas The public lobby and waiting areas would provide a comfortable space for visitors before their scheduled appointments. Key requirements include:
 - Comfortable seating arrangements.
 - Low ambient noise levels.
 - Clear circulation routes to other parts of the building and amenities.
 - Access to public information and restroom facilities.

5.3. Schedule of Accommodation

	<i>SPACE</i>	<i>QUANTITY</i>
1.	Courtrooms	13
2.	Judges Chamber	13
3.	Registrar Offices	2
4.	Administrative Offices	8
5.	Conference Rooms	2
6.	Library	1
7.	Record Storage	2
8.	Security Control Unit	3
9.	Public Waiting Area	4
10.	Restrooms	Multiple
11.	Parking Zone	Adequate Capacity

5.4. Special Considerations

Accessibility The site has excellent accessibility through major roads within Enugu metropolis. This provides easy access for judges, lawyers, litigants and visitors. Accessible entrance for everyone including people with disability Available provision of ramps, elevators, staircases Courtroom acoustics To ensure the speech intelligibility through the utilization of well sound absorbing materials Materials like acoustic ceiling, carpet

5.5. Site Inventory and Analysis

The proposed site is situated opposite Okpara Square and next to the Enugu State Planning Authority, this site location is known for presidential activities, commercials, It is well known for serene environment and for quality of life it offers to its inhabitant's.

Orientation

The site is overall orientated towards Enugu North. Accessibility The site has excellent accessibility via major roads within Enugu metropolis. This provides easy access for judges, lawyers, litigants and visitors. Topography The site is generally not flat; this lends itself to institutional development.

Little excavation is required during the construction phase.

Climate the tropical climatic conditions in Enugu are taken into consideration when developing building orientation, shades, ventilation systems, and materials. Existing Noise Sources The major existing noise sources are: Traffic noise Commercial activities. Public gathering around Opara square Govt.

Office activity the acoustic design strategies utilized for this project were shaped by these sources of noise. Opportunities. Proximity to government institutions, Strategic location, Public transport network.

Availability of infrastructure.

Constraints. Traffic noise, urban activity, potential parking demand

5.6. The Ability to Analyze and Present Data

Research and analysis on the site produced the following design requirement for the project.

Firstly, it is necessary to implement control of noise, since the site is in an urban context.

Secondly, acoustic zoning must be carried out in order to create distinct zones of judicial activity, and spaces that separate private and public zones. Thirdly, building orientation, and landscaping could considerably help reduce exposure to noise. The findings also established the need for speech intelligibility within courtroom environment by the use of sound absorbent materials, well-proportioned room space, and acoustic treatments.

These findings guided the eventual design solution provided in this thesis.

5.7. Design Concept and Design Proposal

Design concept: "scale of justice" Design concept is a representation of the notion of equity, balance, fairness and justice in legal administration.

The overall layout plan, will consist of symmetrical wings on each side of a central spine with a courtyard for circulation as well as for natural light and ventilation to the interior spaces.

Concept Development The concept has been translated to architectural form in the following manner; acoustic zoning spatial hierarchy controlled circulation, building orientation sound buffering landscaping integration of acoustic materials. Design strategies Separation of private and public spaces. Locate the courtrooms away from the noise sources. Use landscaping as green buffers to minimize exposure to noise, use acoustic ceiling and wall panels, use acoustic partitions between different courtroom, employ soundproof construction methods for doors and windows. Separate circulation route.

Design spaces in a dignified and judicial way. As a result, the design will successfully combine functions, security, environment friendly architecture and acoustic design.

5.8. Presentation Drawings and 3d Visualization

The presentation drawings of the proposed state high court complex shall include the following.

1. Site plan.

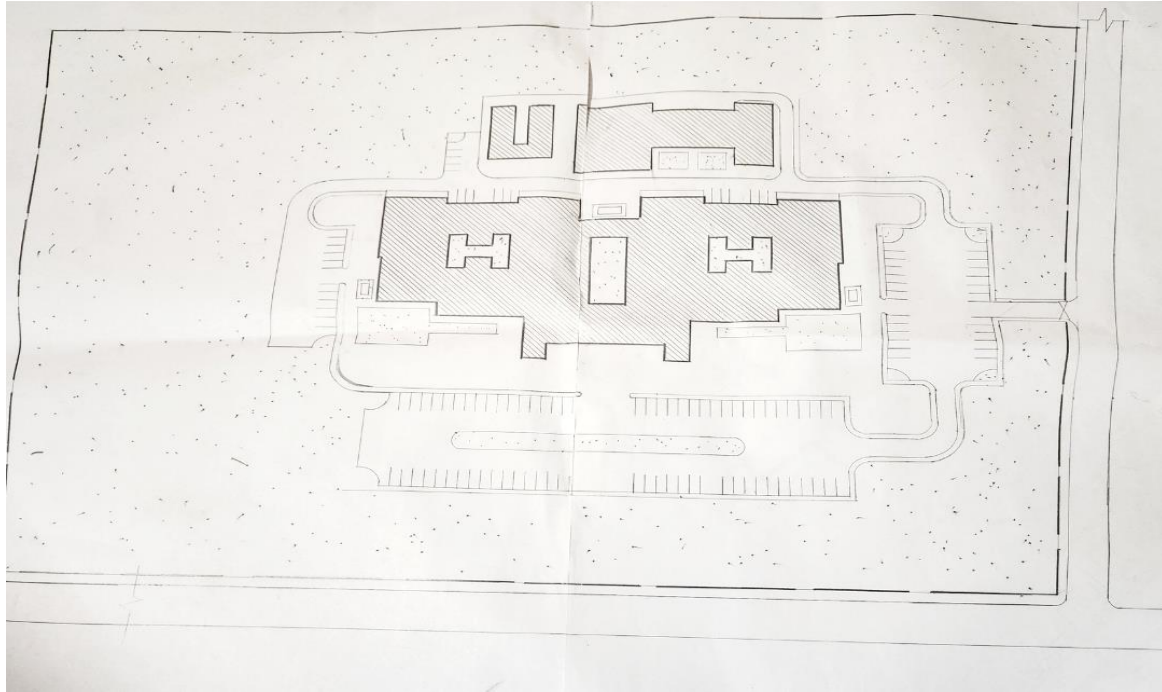


Figure 5.1: Site Plan

2. Floor plans: this consist of floor plans of the building which include high complex plan, ground floor, first floor, second floor and the third floor

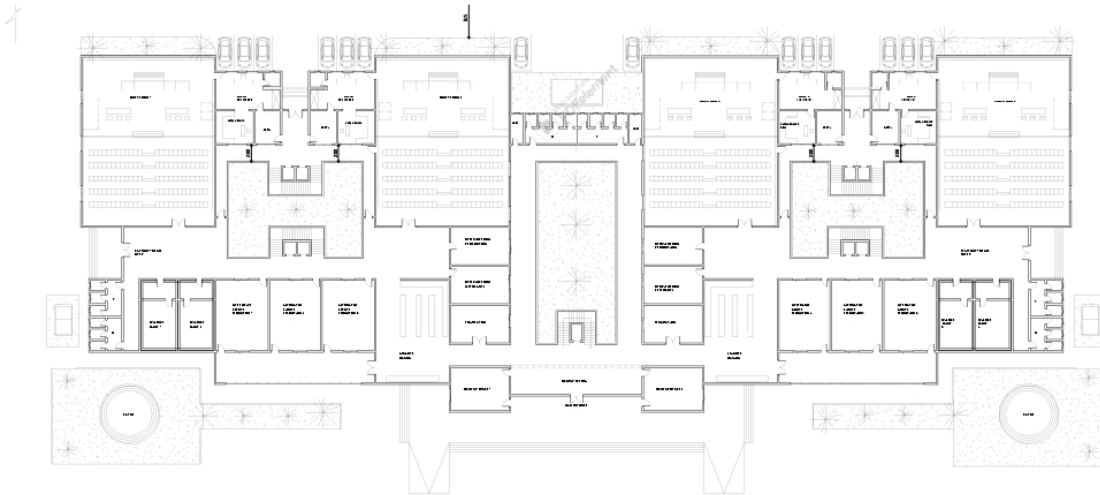


Figure 5.2: Ground Floor Plan

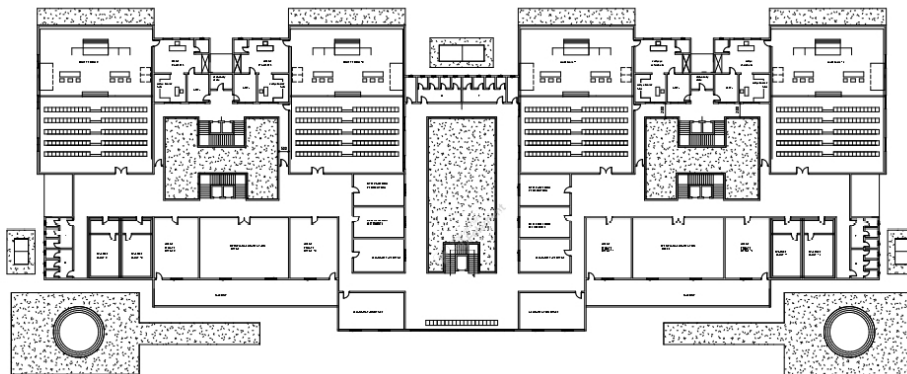


Figure 5.3: First Floor plan

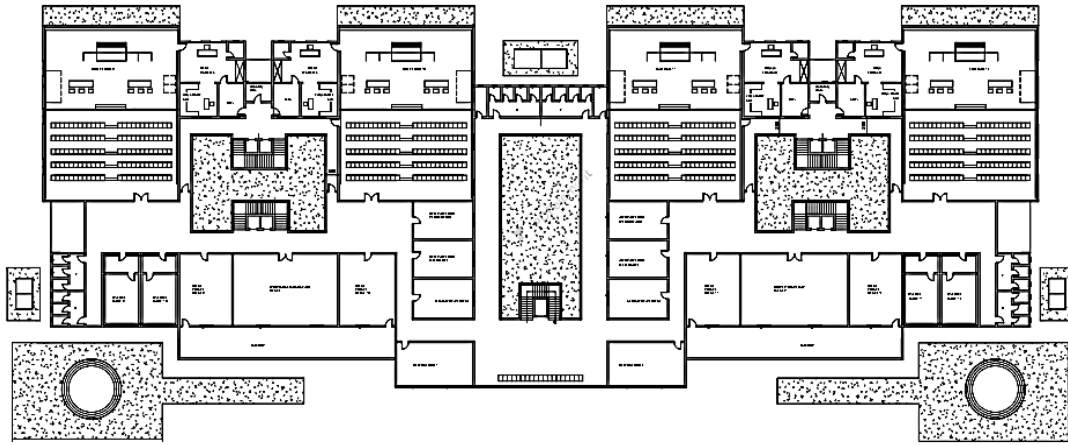


Figure 5.4: Second floor

1. Roof plan.

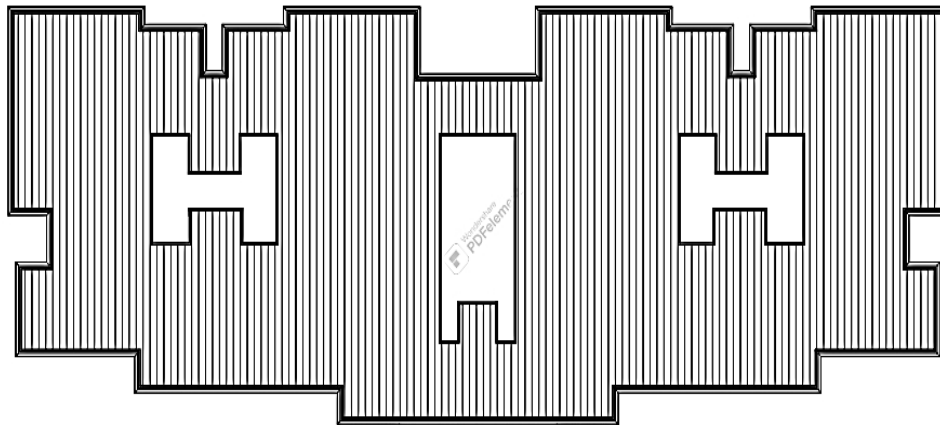


Figure 5.5: Roof plan

2. Elevations.

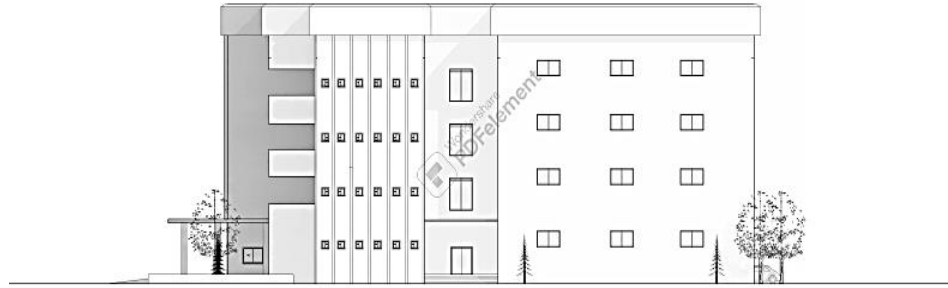


Figure 5.6:

East Elevation

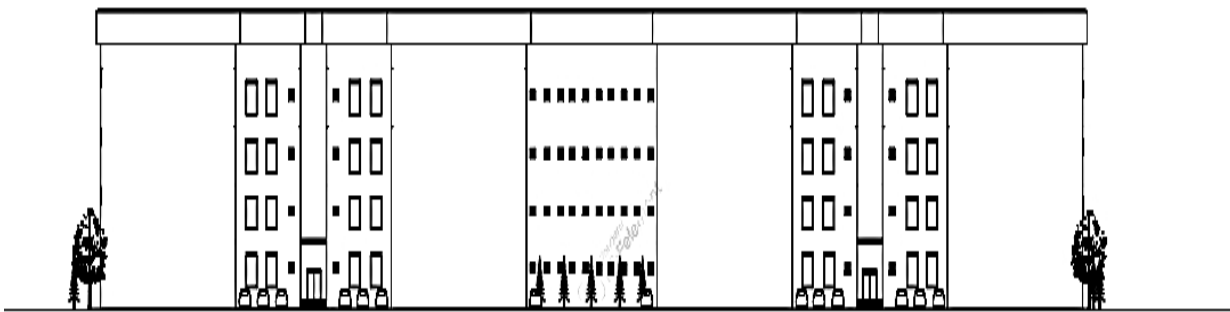


Figure 5.7: North Elevation

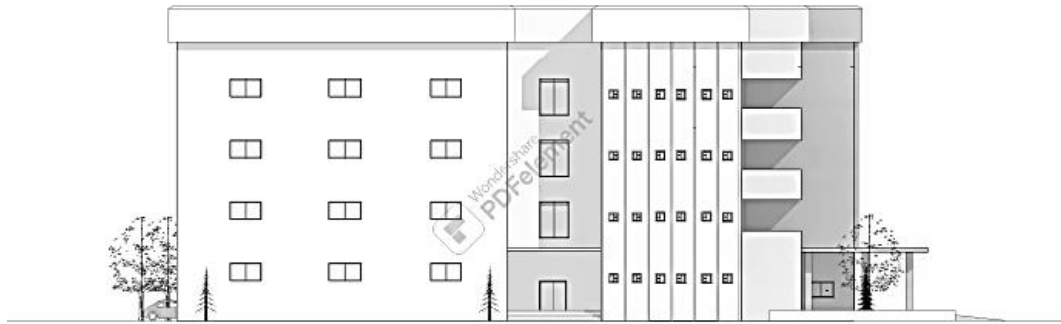


Figure 5.8: West Elevation

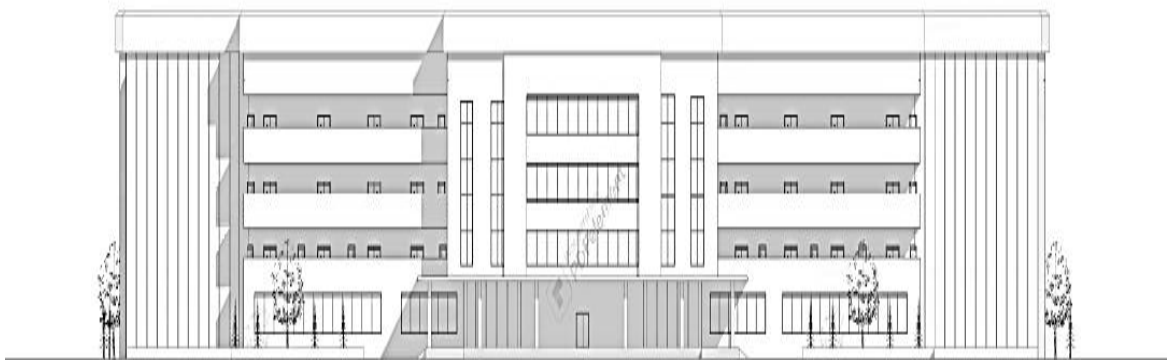


Figure 5.9: South Elevation

3. Sections.
4. Landscape Plan.
5. Acoustic detail drawings.
6. 8.3D exterior visualization.
7. 3D interior visualization of courtroom. These drawings will illustrate spatial organization, design character, and acoustic characteristics of the project.

8. Model



Figure 5.10: Model

5.9. Detailed Drawings and Physical Model

The final package of documents should contain the following: Detailed architectural drawing, Acoustic wall construction, Acoustic ceiling construction, Doors and windows schedule, and Structural details Landscape details Physical scale model of State High Court Complex.

CHAPTER SIX

SUMMARY OF FINDINGS, RECOMMENDATIONS

6.1 Summary of Findings

This study was carried out to evaluate the use of acoustics in designing of public buildings, with special reference to courtrooms of high courts and design of a responsive acoustic state high court complex in Enugu State. The study has proved that quality acoustics are essential in the building for clear communication, speech intelligibility, privacy and the administration of justice. From literature review, the major causes of poor acoustic quality of courtrooms include: high levels of reverberation time, introduction of intrusive background noise, poor acoustic zoning, sound leakages and absence of adequate sound-absorbing materials and acoustic measures at the design stage.

The study found that all this have detrimental effect on communication within courtrooms and on the administration of justice.

The case studies also demonstrated the factors required to achieve a good acoustic performance of courtrooms, they include: appropriate acoustic materials such as acoustic ceiling panels, insulated walls, carpets and rugs on floor, soundproof doors, good space layout and a well-integrated sound reinforcement system. In a case of FHC Abuja, State High Court Lagos, Royal courts of Justice London, High Court of Australia, and New York county Supreme Court, they all exhibited an array of architectural considerations in their design for noise control and clarity of speech. Further, the research found that the present State High Court, Enugu lacks a comprehensive acoustic treatment, which leads to reverberation and poor clarity of speech. Furthermore, the site analysis revealed that the site is a relatively busy street where traffic noise is dominant and ambient conditions of

the surrounding area are noisy and hence a detailed acoustic consideration is very crucial for a functional judicial complex.

Hence the design of the project addressed these issues by proposing acoustic zoning, sound-buffer landscaping, use of acoustic ceiling materials, insulated wall and door and the optimum design of space and sound system in courtrooms.

6.2. Recommendations

In light of the findings of this study, the following recommendations were made:

1. Acoustic features in courtroom and public building design should be an integral part from inception stages not only as reactive or corrective approach.
2. Architect and designers of building should ensure the inclusion of various acoustic materials in courtroom design such as acoustic ceiling panel, perforated wall panels, carpets, and rugs on floor, use of sound proofing doors and windows etc.
3. Proper acoustic zoning should be carried out to prevent acoustic conflict between different spaces like library and circulation space.
4. The design of building exterior should be incorporated around building such as tree plantations to minimize impact of external sound on buildings
5. Mechanical systems of the building like generators, ventilation and Air conditioning services must be designed in such way to reduce the generation of noise.
6. Existing court buildings in Enugu State be upgraded to modern acoustic performance standards.
7. Government bodies and policies makers in Nigeria should enforce the establishment of acoustic design standards for the planning and design of buildings especially judicial and public institutional buildings.

8. Quantitative measurements of acoustics like reverberation time, Speech Transmission index and sound pressure levels in existing court buildings in Nigeria should be a priority research to assess current performance.

6.3. Contribution to Knowledge

This research has contributed to knowledge of architectural design by drawing attention on acoustics as one of the fundamental considerations in designing a functional and efficient judicial buildings. It demonstrated how architectural acoustics principles can be effectively applied to court design in order to optimize communication, privacy, focus, and judicial operations. Also it presents a guideline for the designing of acoustically responsive court buildings in Nigeria by integrating various aspects of literature review, case studies and site analysis.

The study also provides insight on the practical architectural strategies needed to control reverberation time, reduce background noise, enhance speech clarity, and ensure user comfort within court spaces.

The proposal for the State High Court Complex in Enugu provides a modern judicial design solution that incorporates architectural acoustic features in a sustainable design approach.

6.4. Conclusion

In any building that is primarily concerned with the ability for speech to be clearly understood (such as courts of law), the importance of the acoustics in its design cannot be over emphasised. This research has successfully proven the impact of poor acoustics on speech intelligibility, speech privacy, focus, and general performance in judicial environments.

Based on literature, case studies and site analyses, the research identified the main factors contributing to the prevalence of poor courtroom acoustic quality, and proposes various

architectural solutions aimed at alleviating the identified issues and creating acoustically responsive design for the State High Court Complex in Enugu State.

The study conclude that designing a building that its acoustical method is an architectural necessity for the effective administration of justice in the country.

REFERENCES

- Ashrae. (2021). ASHRAE handbook, HVAC applications. *American Society of Heating, Refrigerating and Air-Conditioning Engineers*.
- Barron, M. (2010). *Auditorium acoustics and architectural design* (2nd ed.). Spon Press.
- Beranek, L. L. (2012). *Acoustics*. *Acoustical Society of America*.
- Bistafa, S. R., & Bradley, J. S. (2000). Reverberation time and maximum background-noise level for classrooms from a comparative study of speech intelligibility metrics. *The Journal of the Acoustical Society of America*, 107(2), 861–875.
- Bradley, J. S. (1986). Predictors of speech intelligibility in rooms. *The Journal of the Acoustical Society of America*, 80(3), 837–845. (2008). Some temporal and spatial effects of room acoustics on speech privacy
- Bradley, J. S., Apfel., & Gover, B. N. (2007). Speech privacy in buildings: Performance assessment of sound insulation. *Canadian Acoustics*, 35(3), 52–53.
- Bradley, J. S. (2003). Acoustics for speech in classrooms and meeting rooms. *National Research Council Canada*.
- Bradley, J. S., Reich, R. D., & Norcross, S. G. (1999). On the combined effects of signal-to-noise ratio and room acoustics on speech intelligibility. *The Journal of the Acoustical Society of America*, 106(4), 1820–1828.
- Cavanaugh, W. J., Farrell, W. R., Hirtle, P. W., & Watters, B. G. (1962). Speech privacy in buildings. *The Journal of the Acoustical Society of America*, 34(4), 475–492.
- Egan, M. D. (2007). *Architectural acoustics*. J. Ross Publishing.
- Everest, F. A., & Pohlmann, K. C. (2015). *Master handbook of acoustics* (6th ed.). McGraw-Hill Education.
- Gover, B. N., & Bradley, J. S. (2004). Measures for assessing architectural speech security. *Canadian Acoustics*, 32(3), 46–47.
- International Organization for Standardization. (2009). *ISO 3382-1: Acoustics—Measurement of room acoustic parameters—Part 1: Performance spaces*. ISO.
- Kuttruff, H. (2016). *Room acoustics* (6th ed.). CRC Press.
- Latham, H. G. (1979). The signal-to-noise ratio for speech intelligibility: An auditorium acoustics design index. *Applied Acoustics*, 12(4), 253–320.
- Long, M. (2014). *Architectural acoustics* (2nd ed.). Academic Press.
- Long, M., & Winer, R. (2018). *Sound system engineering and acoustical design*. Routledge.

- Mehta, M., Johnson, J., & Rocafort, J. (1999). *Architectural acoustics: Principles and design*. Prentice Hall.
- Oniku, S. A., & Bello, T. A. (2012). A review of acoustic consideration in public and multifunctional building design. *FUTY Journal of the Environment*, 6(2), 104-118.
- Oluwatayo, A. A., & Adele, N. S. (2024). Influence of the adoption of acoustic design strategies on user satisfaction in convention centres in Lagos, Nigeria. *Covenant Journal of Research in the Built Environment*, 12(1).
- Park, B., Bradley, J. S., & Gover, B. N. (2007). Speech privacy in buildings: Performance assessment of sound insulation. *Canadian Acoustics*, 35(3), 52–53.
- Peng, Z. E., & Wang, L. M. (2016). Effects of noise, reverberation and foreign accent on native and non-native listeners' performance of English speech comprehension. *The Journal of the Acoustical Society of America*, 139(5), 2772–2783.
- Rossing, T. D. (Ed.). (2007). *Springer handbook of acoustics*. Springer.
- Soulodre, G. A., Popplewell, N., & Bradley, J. S. (1989). Combined effects of early reflections and background noise on speech intelligibility. *Journal of Sound and Vibration*, 135(1), 123–133.
- Templeton, D. (Ed.). (2001). *Acoustics in the built environment*. Architectural Press.
- Visentin, C., Prodi, N., Cappelletti, F., Torresin, S., & Gasparella, A. (2018). Using listening effort assessment in acoustical design of rooms for speech. *Building and Environment*, 136, 38–53.
- Zahorik, P., Brandewie, E., Kumpik, D. P., *et al.* (2016). Speech intelligibility in rooms: Effect of prior listening exposure interacts with room acoustics. *The Journal of the Acoustical Society of America*, 140(1), 74–86.