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INCORPORATING ACOUSTICS PARAMETERS THAT ENHANCE THE PERFORMANCE OF A CITY HALL

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Abstract:

This research is centered on incorporating the best acoustics parameters that enhance the performance of a city hall. through design principles and the use of materials to forecast and control various characteristics of the sound produced in an acoustic enclosure like a (conference halls and lecture hall). The research inculcates in the proposed city hall for Port Harcourt various design parameters that allows the generation of revenue for the government and a befitting hall for the localities. through well designed and articulated acoustics on selected architectural spaces like the lecture hall, and conference hall. This is so essential in sustaining the relationship between the government and the masses and also generating revenue for the government. This also enhances a design that expresses interaction, transparency and democracy. The research also seeks to subdue reverberations and echoes in space, and also projecting architectural form that expresses the people's identity and interest. In course of the research, the elements of existing city halls with the same background have been studied through case studies. Foreign examples were included; however, caution was taken to ensure the use of materials related to the environment being planned for, and the site requirements would be taken into consideration too. Also, the space standard which includes the requirements and sizes of spaces would be considered alongside recommended materials and construction. Finally, the new City Hall will become the symbol of the city, a prominent landmark, and a focus of the community. A point where urban spread could be directed and focused on to achieve a downtown core and that would attract new business.

KEYWORDS: *acoustics, reverberation, materials, and hall.*

INTRODUCTION

Conference spaces are generally innovative over time due to the necessity to house participants in common activities and events. The purposes for which an environment is designed suggest structures of good visuals and acoustics. However, it is important for the acoustic design to define the expected ambience as well as the ability to choose the suitable choice of the acoustic materials and parameters with proper scrutiny with respect to reverberation time, definition, clarity, and STI (Speech Transmission Index). The ideal acoustic conditions required are attained by either means of proper acoustic correction interventions or inserting appropriate amounts of sound-absorbing material into a conference room. The space in question is the conference room of a city hall. The project as a whole comprised a city hall, a multipurpose hall, offices, a wing for the mayor of the city, and a parliament. Walls were used for the structures of the load-bearing facades and structural floors. The interior surfaces of the rooms (walls) will be covered in curtains, ceilings made with seamless acoustical ceiling with the choice of the material being connected to the need to obtain furnace and more domestic tones, which encourage a sense of calm, absorption, and warmth. Specific consideration was given to sound insulation (impact sound and plane noise) inserting a layer of sand (thickness 6.0 cm) inside the floors. Finally, given the size of the conference hall, the curtains were appropriately perforated to obtain a suitable sound-absorbing system to reduce unwanted reverberation. Figure 1 shows the external view of the city hall. Furthermore, attention was given to the acoustics of few spaces on the ground floor such as the conference room. The conference room is a regular volume of rectangular shape. Figure 2 shows the floor plan of the conference room with its dimensions. characteristics are summarized in Table 1. The shape of the room is bound to the complete building, with a steady geometry and large windows on one side for lighting needs with natural light. The perimeter wall towards the outside is made of large transparent glass surfaces, covering about 3m². The interior sidewalls and ceiling are covered with curtains and drapes and the floor is covered with a rug. The choice to use curtains and drapes due to aesthetic and functional requirements. The curtains and drapes can be perforated to give the walls appropriate sound absorption features or be unperforated and therefore reflect the incident sound waves to attain appropriate sound reflection characteristics.

ACOUSTIC PARAMETERS

One of the most used acoustical parameters for assessing the quality of a room is the reverberation time (measured in seconds). This parameter was introduced at the end of the 1800s by Clement W. Sabine and is defined as the time required for the sound in a room to decay over a specific active range, usually taken to be 60 dB, in the room, the longer the reverberation time, the greater the contribution of the components of the reflected sound compared to the direct one. The reverberation time value is a function of the room volume and the total sound absorption of its internal surfaces. The absorption of the materials changes with the variation of the frequency, the reverberation time also varies at the different frequencies considered. In architectural acoustics, for the acoustic correction of enclosed spaces, the frequencies in octave bands from 125 Hz to 4.0 kHz are considered. Frequencies above 4.0 kHz are not considered because sound absorption by air prevails. Frequencies below 125 Hz are not considered because the human voice produces very little sound energy below 125 Hz that would be useful or important for speech intelligibility. The acoustic parameters, for the purposes of the study and understanding of architectural acoustics, are reported in the ISO 3382-1 (2012) standards Acoustics - Measurement of room acoustic parameters. EDT, (Early Decay Time) is derived from the reverberation time decay curve; between 0 dB and 10 dB below the initial level. It is a time that considers the direct sound and approaches that which is the subjective perception of the time of decay. C80, index of clarity, measures the goodness of listening to music in a hall. It is also a function of the reverberation time and the distance of the listener from the orchestra and therefore is linked to the subjective intensity of the direct sound.

By selecting the appropriate materials sound can be sustained (reflected) or made to disappear (absorbed) and this is to a certain degree as no material is reflective or absorptive.

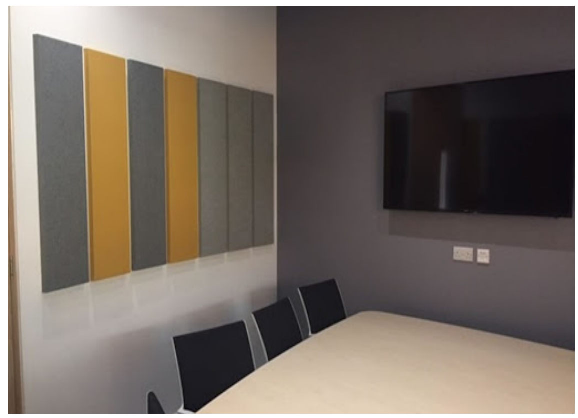
Acoustics range from one space to another for different functions for which they perform. Every building type has its unique acoustical feature which if not put in place, that space loses its acoustical balance and auditory to the hearing of its audience.

MATERIALS THAT PROMOTE ACOUSTICS IN A CONFERENCE HALL

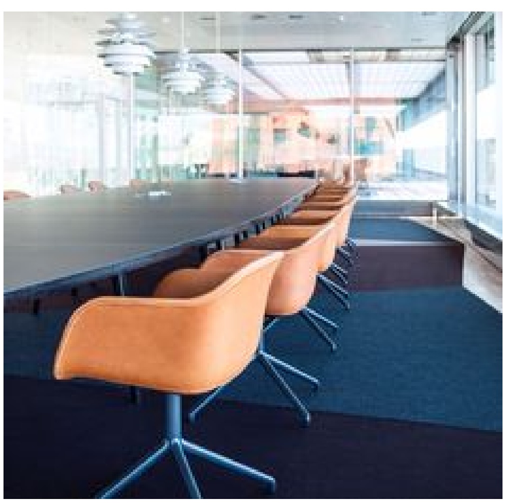
SOFT FURNITURE: Hard furniture should be avoided, or should be covered with soft furniture’s. Soft furniture helps to reduce the hard surface of the floor and wall. The sound waves are absorbed instead of reflected.

SOME EXAMPLES OF SOFT FURNITURES

Acoustic baffle panels: Hanging baffles, which are covered in soft acoustic fabric or made of foam, are designed to absorb sound waves rather than reflecting them. When placed at sound reflection points in a large room, a hanging baffle reduces sound reflections like echoes and reverberations.



Rugs and cover cloths: Rugs help with soundproofing. They dampen vibrations, reducing sound transfer to some extent. They are a fashionable way to deflect noise and add value to rooms. Shoes, furniture, toys, and pet feet are quieter on rugs.



Acoustic door panels: The door of a meeting room is always made strong appealing and elegant. They are made so to keep them professional. Now, to make them more important, there are acoustic door panels manufactured. They will absorb noise from a larger surface area. The panels will be placed on the surface of the door making it easy for them to extract the high-frequency sound waves. It will be a great idea to include acoustic door panels for an acoustic effect in the meeting room.

Curtains and drape: Curtains and drapes are another soft surface decor that will reduce unwanted noise. The windows are usually covered in the meeting rooms to make it more comfortable and minimize unnecessary sound waves.

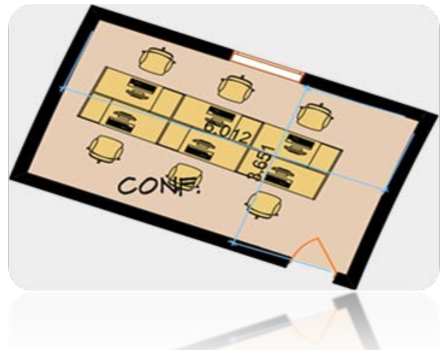


Figure 1.
Photo of the external view of the proposed of the proposed conference hall.

Figure 2.
Plan city hall in Port Harcourt local Government.

Table 1. Conference Room Dimensions

Length, m	6.02m
Large, M	3.65m
Maximum height	3.9
Minimum height	3.2
Volume, m	96
Maximum capacity	6 seated
Glass surface	

CONCLUSIONS

Having conducted a study on the parameters of acoustical performance and considerations of acoustic in a city hall through an analysis of selected spaces like the conference hall, offices and the council chamber through case studies, documenting of research findings and recommendations on improving the present amenities; conclusions from the study have been drawn.

The following values are recommended for maximum acceptance background noise level.

Conference hall	40 - 45 dB (A)
Offices	35 - 40
Concept hall	20 - 25

RECOMMENDATIONS

The recommended ceiling height in hall design is between 8m and 12.5m for useful sound reflection by the ceiling.

Proper choice of materials includes three main types of sound absorbent materials with different absorption co-efficient namely, porous absorbents, panel absorbents and resonators.

Proscenium walls, gallery beam surfaces, auditorium back wall, doors and floor finishes should be sound absorbing. In areas where ceilings and walls meet, one or both of them should be sound absorbing to eliminate sound reflection from one of the surfaces to the other.

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