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Assessment of day lighting and soundproofing strategies in conference center: A case study of Lagos State

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Abstract

Conference centers in Lagos State play a crucial role in hosting various events, emphasizing the importance of factors such as daylighting and soundproofing in enhancing user experience. This study aims to assess the strategies employed in conference centers in Lagos State, focusing on the two main case study (Case study A and B). The research problem addresses the need to enhance user satisfaction through effective daylighting and soundproofing strategies. The study's purpose is to identify and evaluate these strategies, considering their impact on user comfort and satisfaction. The study utilizes a qualitative method, primarily through observation, to analyze the daylighting and soundproofing strategies in the selected conference centers. The findings reveal varying levels of efficiency and implementation in the two case studies. While both centers incorporate key daylighting strategies such as building orientation, skylights, and external shading devices, differences exist in their effectiveness. Similarly, soundproofing measures like acoustic insulation and double glazing are observed, yet the absence of HVAC noise control systems indicates room for improvement. Integrating effective daylighting and soundproofing strategies is essential for creating comfortable and engaging conference environments. Recommendations include prioritizing the integration of these strategies in conference center design and operations, considering factors such as building orientation and the use of appropriate materials. The adoption of automatic lighting controls and HVAC noise control systems is also recommended to further enhance user satisfaction and comfort levels in conference center.

Keywords: Daylighting, soundproofing, conference centers and Lagos state

1. Introduction

Conference centers which serve as basic spaces for hosting meetings, seminars, and events, accommodating diverse groups of attendees with varying needs and expectations. These center are also consider as urban public facilities (Liu *et al.*, 2023) ^[13]. Within these environments, considerations such as daylighting and soundproofing play a significant role in shaping the user experience and overall satisfaction. The influence of natural light and effective sound insulation within the building on the comfort, productivity, and engagement of conference center users cannot be over emphasized. Daylight availability impacts the overall energy demand for heating, cooling, and lighting in building (Rucińska & Trząski, 2020) ^[18]. Daylighting in buildings which involves capturing sunlight and delivering it to interior spaces that cannot be illuminated through windows, providing health, visual comfort, and productivity benefits to occupant of the building (Ullah *et al.*, 2019) ^[21]. Daylighting in most buildings is based on illuminance levels, which are important criterion in rating building performance and impact occupants' visual comfort (Kandar *et al.*, 2019) ^[11].

In conference centers, ample daylight not only enhances aesthetics but also contributes to a more stimulating and invigorating environment for attendees.

Access to daylight has been linked to improved mood, productivity, and cognitive function, making it a critical consideration in conference center design. Daylighting in buildings makes them more comfortable, efficient, and promotes people's well-being, while reducing electrical energy consumption (Drago *et al.*, 2020) ^[9]. Daylighting in office spaces can reduce energy consumption and improve wellbeing, but glare, overheating, and privacy issues must be addressed (Erika, 2019) ^[10], daylighting strategies incorporate into these centers can help reduce energy consumption by minimizing the need for artificial lighting, thereby enhancing sustainability and reducing operational costs. Individuals who express greater contentment with their ability to access natural light tend to exhibit heightened levels of productivity and satisfaction. However, enhancing comfort can be achieved through a deeper comprehension of daylighting tactics and shading technique (Day *et al.*, 2019). Optimizing harvesting daylighting in buildings can lead to a balance between harvesting daylighting and thermal gain, reducing cooling load and improving visual comfort (Reda & Tamer, 2022) ^[15].

Effective soundproofing is essential for creating acoustically comfortable conference environments that facilitate clear communication and minimize distractions. Sound-absorbing materials, such as sound-insulating panels and sound-absorbing sponges, can effectively reduce noise levels in buildings ensuring a quieter environment (Simion *et al.*, 2022) ^[19]. Conference centers often host multiple concurrent events or sessions, requiring careful attention to sound isolation to prevent noise interference between spaces. Excessive reverberation, external noise intrusion, and inadequate speech intelligibility can hinder the effectiveness of presentations and discussions, leading to decreased user satisfaction and engagement. Thus, implementing soundproofing measures such as acoustic insulation, sound-absorbing materials, and strategic layout design is crucial for optimizing the auditory environment within conference centers. Acoustic panels using suitable material effectively reduce reverberation time in conference rooms, improving the acoustic environment (Taira *et al.*, 2023) ^[20]. Lighter concretes, like cellular concrete, absorb more sound than high-density concretes, improving sound insulation in conference rooms (Amran *et al.*, 2021) ^[2].

Poorly conceived daylighting designs may lead to issues such as glare, headaches, or eye strain, impacting building occupants' productivity and satisfaction (Day *et al.*, 2019). Insufficient sound insulation in apartments can lead to neuroses, changes in biorhythms, digestive system disorders, headaches, memory impairment, and problems with color perception (Babiy & Kalchenia, 2022) ^[4]. Therefore, this study is target at exploring the influence of daylighting and soundproofing on user satisfaction in conference centers in Lagos state, considering factors such as visual comfort, auditory clarity, and overall experience. The study objectives involve identifying daylight strategies and soundproofing measure employed within the case study, evaluating the effectiveness of different daylighting strategies and shading techniques in enhancing user satisfaction and comfort levels within conference center space, considering factors such as visual comfort, productivity, and the investigating the relationship between soundproofing measures and user satisfaction in conference center settings, focusing on factors such as acoustic comfort, speech intelligibility, and auditory clarity. By assessing these objectives, the study established a

approach that integrates considerations of daylighting, soundproofing, and user satisfaction is essential for creating conference centers that effectively cater to the needs and preferences of diverse user groups, ensuring memorable and impactful event experiences.

2.0 literature Review

2.1 Daylighting strategies in conference centers

Integrating Daylighting Systems appropriately into building windows can reduce energy consumption by effectively utilizing daylight as a renewable resource, contributing to green, sustainable, and energy-efficient buildings (Reffat & Ahmad, 2020) ^[16]. These strategies include Building Orientation and Layout which involves Proper building orientation and layout are fundamental considerations for maximizing daylight penetration in conference centers. Orienting the building's longest façade to face north or south helps to minimize direct solar heat gain while optimizing daylight exposure. positioning of conference rooms, common areas, and circulation spaces can ensure equitable distribution of daylight throughout the building, reducing the need for artificial lighting. A moderate window-to-wall ratio of 30% in Saudi Arabian conference buildings provides the best balance between daylight availability and glare reduction, while reducing cooling energy demand and visual discomfort (Asfour, 2020) ^[3]. Glazing and Fenestration strategies which involves the selection and placement of windows, skylights, and other glazed elements are critical aspects of daylighting design in conference centers. High-performance glazing with low solar heat gain coefficients and high visible light transmittance helps to control heat gain and glare while maximizing daylight transmission. Moreover, strategically sized and positioned fenestration can provide views to the outdoors and create a connection with the surrounding environment, enhancing the overall user experience. Daylighting strategies have a minor impact on embodied carbon emissions, while window head height, glazing type, interior surface reflectance, and window-to-wall ratio significantly affect daylight access potential (Rezaei Oghazi *et al.*, 2021) ^[17]. Selecting the right glazing type can significantly reduce energy consumption and improve building performance in hot climates (Alhagla *et al.*, 2019) ^[1].

Daylight harvesting systems utilize sensors, controls, and automated shading devices to regulate natural light levels in response to changing external conditions. In conference centers, these systems can adjust artificial lighting levels and window shades based on daylight availability, maintaining optimal lighting conditions while minimizing energy consumption. By seamlessly integrating natural and artificial lighting, daylight harvesting systems enhance visual comfort and support sustainable building practices. Daylight harvesting using intelligent lighting control systems can significantly reduce energy consumption and help achieve Sustainable Development Goals in sustainable office buildings (Odiyur Vathanam *et al.*, 2021) ^[14]. Daylight harvesting systems in lighting systems can effectively reduce energy consumption and greenhouse effect by controlling artificial lighting dimming levels based on different sky conditions. Light Shelves and Reflective Surfaces strategies such as Light shelves which is horizontal elements installed above windows to reflect and redirect daylight deeper into interior spaces, reducing the need for overhead lighting. incorporating reflective surfaces such as light-colored walls,

ceilings, and floors can help diffuse and distribute daylight more effectively throughout the conference center, minimizing glare and enhancing visual comfort. A light shelf and translucent ceiling guide daylight deep into an office room, improving uniformity and reducing glare when combined with an adaptive shading system (Brzezicki, 2021) [7].

2.2 Soundproofing Strategies in conference centers

Soundproofing strategies and techniques are essential elements in the design of conference centers, as they ensure that occupants can communicate effectively without disturbance from external noise sources or from adjacent spaces within the building. Effective soundproofing not only enhances the quality of presentations, discussions, and meetings but also contributes to the overall comfort and satisfaction of users. The employed of building envelope design such as solid construction by utilizing solid construction materials with high mass and density, such as concrete or masonry walls, helps to minimize the transmission of airborne sound between indoor and outdoor environments. Lighter concretes, like cellular concrete, absorb more sound than high-density concretes, improving sound insulation in conference rooms (Amran *et al.*, 2021) [2]. Double-wall construction with an air gap between layers can provide additional sound insulation, reducing the transfer of sound vibrations through the building envelope. Double-leaf facades can provide adequate sound insulation by dislocating openings and increasing sound absorption in the cavity, offering natural ventilation while maintaining sound insulation (Bajraktari, 2023) [5]. Proper sealing of doors, windows, and other penetrations in the building envelope helps to prevent the infiltration of external noise sources and ensures airtightness, enhancing overall soundproofing performance.

Partition Design and Layout such as installing soundproof partitions between conference rooms, meeting spaces, and other areas within the conference center helps to isolate sound and minimize cross-talk between adjacent spaces. These partitions may incorporate high-performance materials such as acoustic-rated gypsum board, sound-insulating foam, or specialized soundproofing membranes. Multifunctional partitions can significantly reduce noise levels in open space offices, but only when the premises are fully enclosed and the partition material is selected carefully (Berezutskyi *et al.*, 2019) [6]. Implementing floating floor and ceiling systems with resilient underlayment or isolating mounts helps to decouple the structure from vibrations and impact noise, reducing sound transmission between floors and rooms. Adding floating floor and suspended ceiling can improve impact sound insulation performance, with the latter being more effective (Zhang *et al.*, 2020) [23]. Enhancing the insulation properties of partition walls, floors, and ceilings with sound-absorbing materials such as mineral wool or fiberglass batts can improve soundproofing performance and mitigate reverberation within conference spaces.

Acoustic Treatments and Finishes which include Installing acoustic panels on walls and ceilings absorbs sound reflections, reduces reverberation, and improves speech intelligibility within conference rooms. These panels may be made of fabric-wrapped fiberglass, perforated wood, or other sound-absorbing materials. Different combinations of lightweight wall panels can improve sound insulation in sandwich constructions, aiding noise control engineers,

builders, designers, and residents/consumers in selecting suitable wall panels for use in buildings (Kumar & Singh, 2019) [12]. Incorporating carpeting, area rugs, and upholstered furniture helps to dampen sound transmission and minimize noise levels within conference spaces. Soft materials absorb sound vibrations and reduce reverberation, creating a more comfortable acoustic environment for occupants. Optimizing the type, thickness, mass density, and dynamic stiffness of elastic materials and floating plates can significantly improve the sound insulation performance of building (Wang & Du, 2021) [22]. Applying soundproofing paints or coatings to walls and ceilings enhances their sound-absorbing properties, reducing the transmission of airborne sound and improving overall acoustic comfort.

Other strategies include Mechanical Systems Design which involves HVAC Noise Control system such as duct silencers, vibration isolators, and acoustically lined ductwork, helps to minimize the transmission of mechanical noise and maintain a quiet indoor environment also equipment Enclosures such as housing noisy equipment, such as air handlers, chillers, or generators, within soundproof enclosures or equipment rooms isolates sound sources and prevents their transmission to occupied spaces, improving overall soundproofing performance.

3.0 Study Methodology

The primary source of data was observation using observation guideline to identify the daylighting strategies and soundproofing measure employed within the conference building, the study adopted the used of qualitative method of analysis. the case study for the study comprises of selected conference centers within Lagos state. Selecting the case study employed the use of several criteria such as accessibility to the building, building height and locations.

3.1 Case study A

Case study A is the conference and exhibition centre located at Lagos state. used as a multilevel training facility for seminars and other kinds of events. It is a 5-Storey building which has features include fully air-conditioned conference rooms and office space, large parking space. It is mostly used for official purposes such as trade shows, conferences, seminars, exhibitions and training, the centre can contain about 500 people.

3.2 Case Study B

Case study B is a private conference purpose-built centre, offers the perfect venue for private meetings, conferences, training sessions and retreats. Situated around Lagos state, the centre provides an excellent meeting point. It is a most accessible centre from all corners of Lagos and from both the local and international airports. Case study B is also an ultra-venue that provides a suitable setting for hybrid events for up to 3000 attendees. It has a plausible event space comprising different meeting rooms that are ideal for conferences, training, and meetings. With a great scorecard in traditional conference hosting, more importantly, the venue beats big points in hybrid conferencing.

4.0 Study Finding

The study finding was obtained from observation within the building entities the finding is showed in the pie chart below

4.1 Daylighting strategies available within case study A

and B



Fig 1: Daylighting Strategies available in Case study A

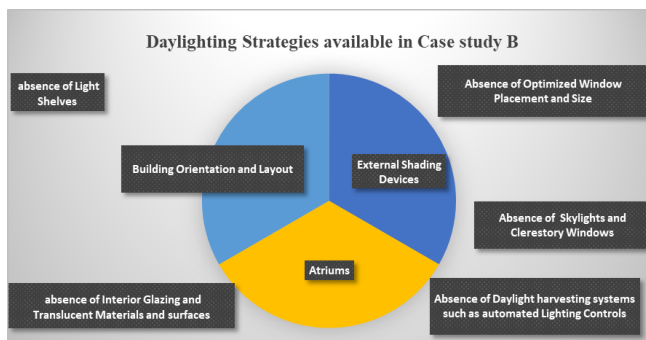


Fig 2: Daylighting Strategies available in Case study B

4.2 Soundproofing Strategies Available within the case study A and B



Fig 3: Soundproofing Strategies available within Case study A and B

4.3 Efficiency of the available strategies within the case study

The efficiency of the available strategies in the respective case study was also observed. Daylight strategies such as building orientation and layout was assess, the main auditorium of the conference centers was located and position within the north and south façade to minimize natural light entering the building and also minimize heat gain from excess exposure to sunlight, thereby contributing to high efficiency in the design of the building layout supporting daylighting. skylights and clerestory windows at high points in the building allows natural light to penetrate deep into the interior spaces, reducing the need for artificial lighting during daylight hours as seen in figure i of the case study A. this feature was not observed in case study B. Thereby limited it efficiency to daylight. Light shelves as horizontal wall for reflection of sun light was observed greatly in case study A,

but limited in case study ii because of it building layout design. both building has large open space within the building which aid in natural light harvesting demonstrating high efficiency in atrium the same within the auditorium of the building. external shading devices such as overhangs, louvers, were placed within the case study control the amount of direct sunlight entering the building, reducing glare and heat gain while still allowing diffused daylight to enter, this external shading device were more efficient in case study I as observed than case study B which employed fewer shading devices. Interior gazing and translucent material and surface were more installed in case study A as observed which was highly efficient in daylighting harvesting than on case study ii which has no installation of these strategies, both case study has no installation of automatics lightening control system. These observed strategies within the case study promotes visual comfort and productivity of users as observed.

The efficiency of the soundproofing measure was also assessed within the case study. soundproofing strategies which are hardly integrated in building and conference centers due to high cost and availability in market. As observed in case study A, the installation of acoustic panel was observed within the building of the case study. These material act as sound insulations within the building spaces minimizing both outside and inside noise. Efficiency of the sound panel was more pronounced in case study A than B, the design partition of wall and layout also helps in the control of noise and sound within the building as observed in Case study A and B and were efficient in both of the case study. Double gazing was also observed within the walls of the conference centers of the case study both of them showing high efficiency. Floating floors and ceiling were also observed within some section of the building showing high efficiency within the centers. Proper sealing of doors, windows, and other penetrations in the building envelope was also efficient in noise and sound controlling. Soundproofing doors also shows high efficiency. Both case study does not employ the use of HVAC noise control systems in soundproofing.

5.0 Conclusion

The assessment of daylighting and soundproofing strategies in conference centers in Lagos State, as exemplified by the case studies of A and B, reveals varying levels of efficiency and implementation. The availability of daylighting strategies such as building orientation and layout, skylights, light shelves, atriums, and external shading devices in both case studies demonstrates a commitment to maximizing natural light penetration and reducing reliance on artificial lighting. However, there are differences in the extent of implementation, with case study A showing more comprehensive use of these strategies compared to case study B. Regarding soundproofing strategies, both case studies exhibit a range of measures including acoustic insulation materials, partition design, double glazing, floating floors and ceilings, and proper sealing of doors and windows. These strategies contribute to creating acoustically comfortable environments for conferences and events. However, the absence of HVAC noise control systems in both case studies suggests a potential area for improvement in future designs to further enhance soundproofing efficiency. Based on these findings, it is recommended that conference center designers and operators prioritize the integration of daylighting and soundproofing strategies to enhance user

experience and satisfaction. This can be achieved through careful consideration of building orientation, layout, and the use of appropriate materials and technologies. Additionally, the adoption of automatic lighting controls and HVAC noise control systems can further improve the efficiency of these strategies, ensuring that conference centers in Lagos State and beyond are equipped to provide optimal environments for conferences and events

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