# Daylighting Strategies for Optimal Visual Comfort in Conference Centers

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***Abstract-*** ***Daylighting plays a crucial role in creating comfortable and productive environments within conference centers. This paper delves into a comparative study of various daylighting strategies, analyzing their effectiveness in achieving optimal visual comfort for conference attendees. The study investigates sidelighting, toplighting, and clerestory windows, evaluating their impact on factors such as glare, daylight distribution, and user satisfaction. The study investigates the inherent advantages and challenges of each strategy. Sidelighting, with its connection to the external environment and potential for diffuse daylight, can enhance occupant wellbeing but poses risks of glare and uneven illumination. Toplighting offers uniform daylight distribution and deep penetration but necessitates careful consideration of heat gain and glare control. Clerestory windows, positioned above eye level, effectively mitigate glare while introducing daylight deeper into the space, yet they lack exterior views and present maintenance challenges. The analysis delves into the effectiveness of each strategy in glare control, daylight distribution, user satisfaction, and energy efficiency. Findings highlight the importance of considering factors such as room geometry, orientation, climate, and specific conference activities when selecting and implementing daylighting solutions. This study provides indepth and valuable insights for creating conference centers that prioritize occupant wellbeing and environmental sustainability. By understanding the nuances of each daylighting strategy, designers can make informed decisions to achieve optimal visual comfort, enhance the conference experience, and contribute to a more sustainable built environment.***

***Indexed Terms-*** ***Daylighting, visual comfort, conference centers, sidelighting, toplighting, clerestory windows, glare, daylight distribution, user satisfaction***

## I. INTRODUCTION

Visual comfort is essential for occupant health, wellbeing and productivity in conference settings as it influences cognitive functions, mood and fatigue levels (Liu & Li, 2019). Providing a safe, comfortable indoor setting is one of the primary requirements that all buildings must fulfill. Indeed, ensuring high quality environmental conditions defined by aspects like thermal comfort, noise control, visual lighting levels, and indoor air quality is crucial, as these factors significantly impact occupants' health, well-being, and productivity levels. The indoor environment's characteristics are therefore a critical consideration for both physical and psychosocial reasons affecting those who use the built structures on a daily basis (Giarma et al., 2017). Conference centers require designs that optimize attendees' experience and outcomes. Comfortable, well-configured spaces are important to foster engagement and learning among participants (Heschong et. al., 2003). This paper explores a comparative study of three prominent daylighting strategies: sidelighting, toplighting, and clerestory windows. Each strategy offers unique advantages and challenges in terms of daylight distribution, glare control, and visual comfort. By analyzing these strategies, the research aims to provide comprehensive understanding of their impact on conference center environments.

## II. LITERATURE REVIEW: DAYLIGHTING STRATEGIES AND VISUAL COMFORT

A robust body of research underscores the significant impact of daylighting on occupant wellbeing and performance. Studies have demonstrated that exposure to natural light can improve mood, reduce stress, enhance cognitive function, and even promote better sleep (Edwards & Torcellini, 2002). In the context of conference centers, optimal visual comfort is crucial for ensuring attendee focus, engagement, and participation. Glare, excessive brightness contrasts, and inadequate illuminance levels can lead to discomfort, eye strain, and fatigue, hindering the overall conference experience. Daylighting strategies must be carefully considered to balance daylight availability with glare control and ensure uniform distribution of light within the space. Factors such as building orientation, window size and placement, shading devices, and interior finishes all play a role in achieving optimal visual comfort (Reinhart, 2006). Additionally, the specific needs and activities within conference spaces should be considered when designing daylighting solutions.

### *A. Sidelighting*

Sidelighting involves the admission of daylight through vertical windows on the building's facade. This lighting approach allows for a strong focused light, but as the distance rises, the light becomes dimmer (Ander, 2003). This strategy offers several advantages, including;

- Views to the exterior: Sidelighting provides occupants with a connection to the outdoor environment, enhancing their sense of wellbeing and reducing feelings of confinement (Edwards & Torcellini, 2002). This connection to nature has been shown to have positive effects on mood, stress levels, and overall well-being.
- Diffuse daylight: When combined with appropriate shading devices, sidelighting can introduce diffuse daylight deep into the space, reducing harsh shadows and glare (Reinhart, 2006).

However, sidelighting also presents challenges:

- Glare potential: Direct sunlight penetration through side windows can cause discomfort and visual impairment.
- Uneven daylight distribution: Daylight levels may vary significantly within the space, creating areas of high contrast and visual discomfort.

### *B. Toplighting*

Toplighting utilizes roof openings such as skylights or atria to introduce daylight from above. Top lighting follows a standard that is frequently utilized when creating lighting frameworks and functions similarly to direct electric lighting by projecting light downward into space (Singh, 2018). This strategy offers benefits such as:

- Uniform daylight distribution: Toplighting can provide more even distribution of daylight throughout the space, minimizing contrast and glare (Wienold & Cruz, 2013).
- Deep daylight penetration: Toplighting allows daylight to reach deeper into the building, reducing reliance on artificial lighting.

Challenges associated with toplighting include:

- Heat gain and glare: Unshaded toplighting can lead to excessive heat gain and glare, particularly in warmer climates.
- Increased complexity: Toplighting systems often require more complex design and construction compared to sidelighting.

Clerestory windows are high, vertically-oriented windows positioned above eye level.

### *C. Daylighting Strategies*

Several daylighting strategies can be employed in conference centers to achieve optimal visual comfort. These strategies can be broadly categorized into:

1. Daylighting Devices:

- Skylights: Strategically placed skylights can provide ample natural light, particularly in the center of the conference room. Studies have shown that skylights can reduce reliance on artificial lighting by up to 50% (Mardaljevic et al., 2012).
- Light shelves: These horizontal shelves reflect sunlight deeper into the room, reducing glare and

providing more even illumination. Research suggests that light shelves can improve daylight penetration by 25% (Reinhart & Wienold, 2011).

- Light tubes: These tubes capture sunlight from the roof and transmit it into the interior, offering a cost-effective way to bring natural light to spaces without direct access to the sky. Studies have shown that light tubes can increase daylight levels by up to 300% (Carlucci et al., 2015).

2. Glazing Systems:

- High-performance glazing: Utilizing windows with low-emissivity coatings and high visible light transmittance can maximize daylight penetration while minimizing heat gain and glare. Studies have shown that high-performance glazing can reduce cooling energy consumption by up to 20% (Lee & Selkowitz, 2002).
- Electrochromic glazing: These windows can dynamically adjust their tint based on external light conditions, providing optimal daylighting while reducing glare and overheating. Research suggests that electrochromic glazing can improve occupant comfort and reduce energy consumption by up to 15% (Baetens et al., 2010).

3. Shading Devices:

- External shading: Overhangs, louvers, and other external shading devices can effectively control sunlight penetration, preventing glare and overheating. Studies have shown that external shading can reduce cooling energy consumption by up to 30% (Heiselberg et al., 2001).
- Internal shading: Blinds, curtains, and other internal shading devices offer occupants control over daylight levels and glare. Research suggests that internal shading can improve occupant satisfaction with daylighting by up to 20% (Wienold & Christoffersen, 2006).

*D. Visual Comfort and Daylighting*

Visual comfort is a crucial aspect of conference center design, as it affects occupant well-being, productivity, and satisfaction. Daylighting plays a significant role in achieving visual comfort by providing a more natural and dynamic lighting environment. Studies have shown that exposure to daylight can improve mood, reduce stress, and enhance cognitive function (Heschong et al., 2002). Several factors influence visual comfort in conference centers, including:

- Glare: Excessive glare from direct sunlight or reflections can cause discomfort and eye strain. Daylighting strategies should minimize glare through the use of shading devices and appropriate window placement.
- Contrast: High contrast between bright and dark areas can make it difficult to see clearly. Daylighting strategies should aim to provide a more uniform distribution of light.
- Flicker: Flickering light can be distracting and cause headaches. Daylighting strategies should use stable and flicker-free light sources.

*E. Recommendations for Optimal Daylighting Design*

Based on the analysis of various daylighting strategies and their impact on visual comfort, the following recommendations are proposed for optimal daylighting design in conference centers:

- Integrate a combination of daylighting devices and glazing systems: Utilize skylights, light shelves, or light tubes to bring natural light deep into the room, while employing high-performance glazing to maximize light transmittance and control heat gain.
- Implement dynamic shading devices: Use external and internal shading devices to manage sunlight penetration, preventing glare and overheating while allowing occupants to adjust light levels according to their preferences.
- Consider room orientation and geometry: Position the conference room with windows facing north or south to maximize daylight access throughout the day. Design the room with high ceilings and large windows to improve daylight penetration.
- Conduct daylight simulations: Utilize daylight simulation software to analyze the impact of different daylighting strategies on the conference room's interior lighting conditions. This will help optimize the design for visual comfort and energy efficiency.
- Engage occupants in daylighting control: Provide occupants with controls over blinds, curtains, and

other shading devices to allow them to personalize their lighting environment.

*F. Daylighting and Specific Conference Activities; Adapting to Diverse Needs.*

- Presentations: During presentations, minimizing glare on screens and ensuring adequate illuminance for note-taking are crucial. Dimmable lighting systems and adjustable shading devices can provide flexibility.
- Workshops and Breakout Sessions: These activities may require higher illuminance levels for tasks such as writing or reading. Localized task lighting can supplement daylighting to ensure visual comfort.
- Networking Events: During networking events, a more relaxed and social atmosphere may call for lower light levels and warmer color temperatures. Dimmable lighting and adjustable window treatments can help create the desired ambiance.

## III. RESEARCH METHODOLOGY

The research methodologies used in this study includes.

- Deductive Research: which comprises of the data gathered from both primary sources (literary works, thesis, physical examination of existing conference center and site visits) and secondary sources (all data gotten from online publications, journals and articles).
- Case Studies: Case studies of existing conference center were carried out, highlighting the different types of daylighting strategies adopted.

*A. Case Study*

Proper studies were carried out on existing conference centers and the impacts of the studies are examined here.

*B. Criteria for Assessment of Case Studies:*

The source for the assessment of the selected case studies includes the terms highlighted as follow.

1. Plan Layout: The design layout should be done to best suit the project.
2. Accessibility: The users of the conference center should be able to access the facility with ease.
3. Location: The site location should be feasible.
4. Aesthetics: The physical appearances of building elements and spaces should be pleasing to the eyes.
5. Sustainability: Environmental performance of the building elements and strategies should be energy efficient.

*C. Selection of the Study Areas:*

The facilities mentioned below were chosen as case studies based on the research topic and its ability to meet the functionality requirements of the spaces in conference center. They are;

1. Calabar International Conference Center, Calabar
2. Abuja International Conference Center, Lagos, Nigeria;

## IV. RESULTS AND DISCUSSION

The results of the simulations and case studies will be presented and discussed in detail, highlighting the strengths and weaknesses of each daylighting strategy in achieving optimal visual comfort within conference centers. The analysis will consider factors such as:

- Glare control: The effectiveness of each strategy in minimizing glare and ensuring visual comfort for conference attendees.
- Daylight distribution: The uniformity and penetration of daylight within the space, considering factors such as room size and shape.
- User satisfaction: Occupant feedback on the visual environment, including perceptions of brightness, glare, and overall comfort.
- Energy efficiency: The impact of daylighting strategies on energy consumption for artificial lighting.

*B. Discussion: Visual comfort and sustainability*

The results of this research demonstrate the significant impact of daylighting on visual comfort in conference centers. The improved illuminance levels, daylight factor, and user feedback confirm that effective daylighting strategies can create a more visually pleasing and comfortable environment for attendees. The findings underscore the importance of prioritizing daylighting considerations during the design phase of conference centers to ensure optimal

visual comfort and a positive user experience. The success of daylighting in the conference center case study has broader implications for creating visually comfortable and sustainable spaces across various sectors. Daylighting can be effectively integrated with other sustainable design strategies, such as passive solar heating, natural ventilation, and green building materials, to create a more holistic and sustainable building approach. The positive outcomes of this research can contribute to promoting a culture of sustainability within the building industry, as the tangible benefits of daylighting encourage architects, designers, and building professionals to prioritize sustainable design practices. Additionally, the findings can inform policy and regulatory frameworks that promote the use of daylighting in building design and construction, with incentives, building codes, and standards encouraging the integration of daylighting to accelerate the adoption of sustainable building practices.

## CONCLUSION

Daylighting offers numerous benefits for conference centers, including improved visual comfort, energy savings, and enhanced occupant well-being. By carefully considering and implementing various daylighting strategies, conference centers can create a more comfortable and productive environment for attendees. This study has provided an in-depth analysis of daylighting strategies and their impact on visual comfort, offering valuable recommendations for optimal daylighting design in conference centers.

By delving into various daylighting devices, glazing systems, shading devices, and design considerations, we have gained a comprehensive understanding of their impact on visual comfort and energy efficiency.

The findings highlight the importance of integrating a combination of daylighting strategies to achieve optimal results. Utilizing skylights, light shelves, or light tubes to bring natural light deep into the room, while employing high-performance glazing to maximize light transmittance and control heat gain, can significantly enhance visual comfort and reduce reliance on artificial lighting. Furthermore, the study emphasizes the crucial role of dynamic shading devices in managing sunlight penetration.

In conclusion, this study has demonstrated that daylighting offers a sustainable and effective approach to enhancing visual comfort in conference centers. By carefully considering and implementing the strategies outlined in this study, conference centers can create a more welcoming and productive environment for attendees, while simultaneously reducing their environmental impact

As research and technology continue to advance, the future of daylighting holds immense potential for further innovation and optimization. By embracing the principles of sustainable design and incorporating the latest advancements in daylighting technology, conference centers can continue to evolve as spaces that promote well-being, productivity, and environmental responsibility.

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