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NATURAL LIGHTING AS A COMPONENT OF SUSTAINABLE ARCHITECTURE IN PSYCHIATRIC HOSPITALS

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Abstract

The integration of natural lighting in a design is a fundamental principle in sustainable architecture. This paper investigates the lighting conditions of psychiatric hospitals, arguing that controlled natural light is an essential and often overlooked component for achieving sustainable and restorative healthcare settings. The study examines existing psychiatric hospitals in Nigeria and around the world, employing a mixed-methods approach that includes fieldwork, interviews with hospital staff in Nigeria, and secondary sources for foreign case studies. It explores the multifaceted biophilic benefits of natural lighting, which regulate the occupants' circadian rhythm, improve mood, enhance productivity, and support the mental and physical well-being of both patients and staff. The research identifies that the current absence or inadequate control of natural light in many psychiatric facilities is an issue and has adverse effects on both patients and the staff. Findings from the case studies demonstrate that hospitals that effectively integrate controlled daylighting using strategies like appropriate window placement and courtyards are generally well-ventilated and well-lit, providing better views of nature, which is integral to the healing process. The outcome underscores that the strategic integration of controlled natural lighting must be considered from the inception of design for psychiatric hospitals to reduce energy dependence and maximise therapeutic outcomes.

Keywords: Daylighting, Natural lighting, Psychiatric hospital, Sustainable architecture

INTRODUCTION

Natural lighting serves as an environmental and therapeutic element in the design of buildings. As an important component of sustainable architecture, natural lighting reduces the energy consumption and operational costs of the building's dependence on artificial lighting (Gago *et al*., 2015). In psychiatric hospitals, daylight can improve the patients' psychological stability, mood and reduce stress, thereby improving their recovery outcomes (Okkels *et al*., 2020; Park et al., 2018; Ulrich, 1984).

Evidence suggests that poor daylight conditions in mental health facilities are associated with measurable clinical and economic burdens. For instance, studies of psychiatric inpatients with affective disorders show that rooms with brighter daylight and greener window views are linked to significantly shorter lengths of stay than darker rooms with limited natural light (Mascherek *et al*., 2022). Research in general hospital wards similarly reports that patients near windows or on the "bright" side of a ward tend to have shorter admissions and lower hospital costs than those on the darker side (Li *et al*., 2022; Park *et al*., 2018). Large-scale observational studies also indicate that adults exposed to lower daytime light are at higher risk of depression and other psychiatric disorders, highlighting inadequate light exposure as a modifiable environmental risk factor (Acharya *et al*., 2025; Burns et al., 2023). Given that people now spend up to 90% of their day indoors, often in poorly daylit institutional spaces, the consequences of under-designed daylighting in psychiatric hospitals extend beyond visual comfort to affect mood, recovery trajectories and health-system expenditure.

Given this evidence, there is a need to examine how daylighting is actually integrated into the design of psychiatric hospitals, especially in low- and middle-income contexts where both energy constraints and mental health burdens are acute (Rathod *et al*., 2017; Umeora & Onwuzuligbo, 2021). This study, therefore, investigates the daylighting strategies and related environmental features of selected psychiatric hospitals locally and internationally. The study will further compare how natural light is brought into wards and shared spaces across these cases and identify strengths and gaps in current practice to draw out design recommendations for integrating daylighting as a deliberate component of sustainable and therapeutic psychiatric hospital architecture.

LITERATURE REVIEW

The non-visual and therapeutic effects of daylighting

The primary health benefits of natural light are rooted in its capacity to regulate the human **circadian system**, which is the internal clock governing sleep-wake cycles, mood stability, and cognitive performance (Akinbami, 2024; Blume *et al*., 2019). Light impacts the body through non-visual photoreceptors (intrinsically photosensitive retinal ganglion cells or ipRGCs) that signal directly to the suprachiasmatic nucleus (SCN) in the hypothalamus, also known as the body's master pacemaker (Figueiro *et al*., 2006).

Several studies show that insomnia, mood instability, agitation and sleep disturbance are common among psychiatric patients (Abamara *et al*., 2025; Anderson & Bradley, 2013; Makanjuola & Olaifa, 1987; Talih et al., 2018). For such a vulnerable population, aligning the body's internal clock with the 24-hour day-night cycle is clinically vital. Exposure to bright, blue-enriched light during the day supports alertness and melatonin suppression, while warm, blue-depleted light in the evening promotes sleep. Studies conducted in psychiatric wards have demonstrated that implementing a blue-depleted lighting standard in the evening successfully improved the onset of melatonin secretion and increased total sleep time (Vethe *et al*., 2021). Thus, controlled diurnal lighting supports physical health and contributes to a more normalised and less clinical environment, which enhances patient psychological safety and orientation.

Architectural strategies for optimal daylighting control

Achieving therapeutic daylight requires architectural planning that integrates optimal building envelope design and daylighting control devices to balance solar gain, glare control, and light uniformity. According to Wong (2017), the goal is to maximise the beneficial effects of light while mitigating negative impacts such as overheating and visual discomfort.

Building envelope design

i. *Building Orientation and Form:* For most Northern Hemisphere locations, orienting the long facade along the East-West axis is optimal, maximising exposure to the controlled, indirect light from the North and South facades (Oluwatayo & Pirisola, 2021; Onwuzuligbo *et al*., 2025; Wong, 2017). This orientation makes solar control and shading simpler than on harsh East and West exposures, allowing for deeper light penetration while minimising direct glare and unwanted heat gain (Echeta et al., 2023a). Figure 1 illustrates the optimal building orientation to maximise daylight.

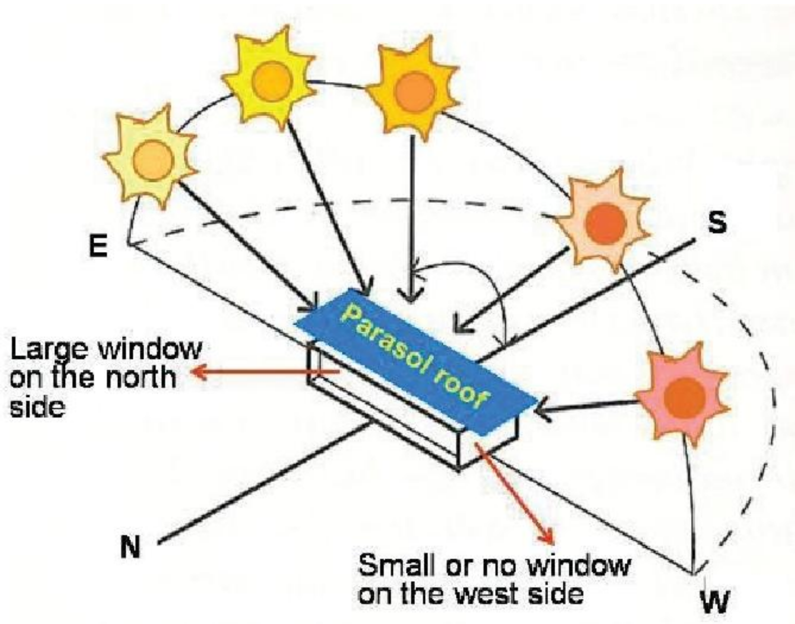

Figure 1: Optimal building orientation to maximise daylight
Source: Oluwatayo and Pirisola (2021)

ii. *Glazing Ratio and Specification:* The optimum glazing ratio (the ratio of window area to external wall area), typically suggested to be between 25% and 50% must be contextual. This ratio is highly dependent on climate, building orientation, glazing properties, and building type/use and requires careful balancing of daylighting provision with thermal comfort and energy efficiency (Sayadi *et al*., 2021). High-performance glass, such as low-emissivity (low-E) or tinted glass, is often necessary to increase thermal resistance, although this may sometimes reduce the visual light transmission (Teixeira *et al*., 2025).

iii. *Material Interaction:* The internal and external surfaces of the building influence the quantity and quality of light penetration through the physical processes of transmission, reflection, absorption, and refraction. Makaremi *et al*. (2017).

Anyanechi and Alabor (2024) note that light-coloured exterior surfaces reflect solar radiation away from the building, while highly reflective interior surfaces (walls, floors, ceilings) diffuse daylight deep into the space, improving uniformity and reducing harsh shadows.

Daylighting Devices and Control

Daylight redirection devices are essential for distributing light deeper into core areas while managing near-window glare. According to Demirkol and Meral (2024), a well as Kontadakis *et al*. (2017), horizontal daylight redirection devices, often called light shelves, perform two primary functions: they shade the lower portion of the window to eliminate direct glare from the sun, and they reflect incoming sunlight onto the ceiling plane, distributing illumination further across the room and improving daylight uniformity. Figure 2 shows the different positions these light shelves can take to adjust for varying angles of incident sunlight.

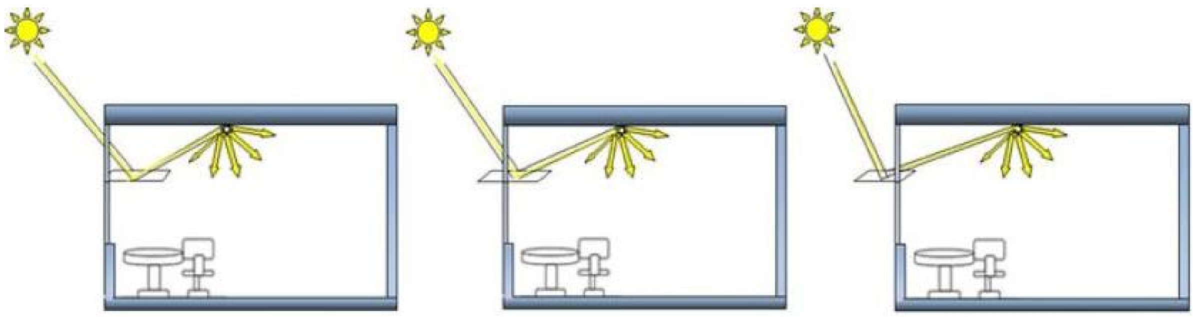

Figure 2: Different possible positions of a light shelf for redirecting light into the room
Source: Mohapatra et al. (2019)

Interior design for psychiatric facilities must also integrate lighting control with patient safety. Daylighting systems must be designed to avoid shadowy areas, which can affect perceived control and psychological safety, while also eliminating ligature points by using specialised tamper-proof fixtures (Norouzi *et al*., 2023). Chen et al. (2023) further notes that the natural lighting scheme must be integrated with tunable artificial lighting systems to maintain consistent, therapeutic light levels regardless of external conditions.

METHODOLOGY

A descriptive multi-site study was conducted of five psychiatric hospitals (two local and three foreign cases). For each hospital, the architectural layout and observable environmental features were recorded, focusing on natural lighting and related aspects of the therapeutic setting. Using a structured observational checklist, the hospitals were qualitatively assessed on natural ventilation, access to daylight, use of natural materials, presence of greenery, visual access to nature, and privacy, after which a cross-case comparison was carried out to highlight similarities and differences in their daylighting and environmental qualities.

Case Studies

Case Study 1: Federal Neuropsychiatric Hospital, Chime Avenue, Enugu

Location: Chime Avenue, New Haven, Enugu state.

Figure 3: Emergency/crisis unit of Federal Neuro-psychiatric hospital, Enugu
Source: Fieldwork (2025)

Figure 4: Male Hostel of Federal Neuro-psychiatric hospital, Enugu
Source: Fieldwork (2025)

Federal Neuropsychiatric Hospital Enugu was built to stabilise and support people experiencing intense psychological distress and behavioural issues that are threatening their safety and well-being, or the safety and well-being of others (*Federal Neuropsychiatric Hospital Enugu*, n.d.). The clinical buildings are organised in one- and two-storey low-rise blocks. In some wards, large window openings and relatively shallow room depths provided good access to daylight. However, other blocks had deeper floor plates with more modest window sizes and additional security devices on openings, which constrained daylight penetration, especially in corridor zones.

Observations

a) The hospital complex is well landscaped.

b) The wards have generally good natural and artificial lighting, although daylight quality varies between blocks.

c) Well-ventilated buildings

d) The window placement is well proportioned to let in natural lighting.

e) Good spatial arrangement.

Case Study 2: State Neuropsychiatric Hospital, Nawfia

Location: Nawfia, Anambra state.

Figure 5: Ward image of the state Neuropsychiatric hospital, Nawfia
Source: Fieldwork (2025)

Figure 6: OPD Block of the state Neuropsychiatric hospital, Nawfia
Source: Fieldwork (2025)

Nawfia Psychiatric Hospital is located at Nawfia along the old Onitsha-Enugu road. It was built to care for and cure psychiatric patients in Anambra state and to serve as an outreach to general hospitals and private ones alike. Nawfia psychiatric hospital comprises one main entrance, wards, an administrative block, including a multi-purpose hall pharmacist, etc.

Observations

a) The hospital is easily accessible to the patients and staff.
b) The outpatient department is well located with enough windows for natural lighting.
c) The ward is well zoned, which makes circulation easy for patients, staff and visitors.

Case Study 3: Worcester Recovery Centre and hospital, Worcester

Location: Worcester, MA, USA

Figure 7: Exterior view of the Worcester Recovery centre and hospital, USA
Source: Fieldwork (2025)

Figure 8: Site plan of the Worcester Recovery centre and hospital, USA
Source: Fieldwork (2025)

The goal of the hospital was to create a therapeutic program in order to promote the emergence and recovery of patients in the hospital facility. The downtown provides an active space containing resources that are shared by the entire hospital. The program encourages patients to take an active role in their treatment. The implementation of a wide variety of interior finishes, use of scale, warm earth and wood tones and abundant natural light promotes a healing environment

Observations

a) The hospital is easily accessible to the patients and staff.

b) The building is well located in a quiet area with enough windows for natural lighting.

c) The ward is well zoned, which makes circulation easy for patients, staff and visitors.

Case Study 4: Psychiatric hospital, Erstein

Location: Erstein, France

Figure 9: Exterior view of Psychiatric hospital, Erstein
Source: Fieldwork (2025)

Figure 10: Aerial view of Psychiatric hospital, Erstein
Source: Fieldwork (2025)

The inspiration for the form of the building is the caterpillar that turns into a butterfly, as psychotherapy very much involves being able to crawl before you can fly. This design aims to give the Erstein hospital a new, contemporary, environmentally friendly image that will set the tone for new buildings on the site.

Observation

a) The facility promotes openness and transparency about mental health.

b) Green areas were added, which help improve the overall mental health of the patients.

c) The building has courtyards which provide natural light and ventilation.

d) The windows are long, which lets in light easily.

Observation Data Summary

The key findings of these case studies are documented in Table 1 as follows:

Table 1: Structured Checklist

1	Natural Ventilation: All hospitals are naturally ventilated because they have sufficient windows. Erstein psychiatric hospital has courtyards which assist in the circulation of natural ventilation, but it also rely on artificial air conditioning systems.
2	Natural Lighting: The buildings are all naturally lit but hospitals like Worcester recovery hospital and Erstein hospital also rely on artificial lighting systems.
3	Use of natural materials: All hospitals used synthetic materials like tiles and concrete walls.
4	Greenery: Worcester recovery centre and Erstein hospital provided patient access to gardens.
5	Visual Access to nature: The views in the wards of Neuropsychiatric Hospital Enugu, and Neuropsychiatric Hospital Nawfia were largely of other buildings or boundary walls. The Worcester hospital and Erstein hospital provided therapeutic views of nature for their patients.
6	Privacy: The hospitals are all located in busy areas except Worcester Recovery Centre and Hospital.

Source: Fieldwork (2025)

These findings are further compared in Table 2.

Table 2: Cross-Case Comparative Highlights

Feature	FNPH Enugu	SNPH Nawfia	WRCH USA	PH France
Natural light	Good	Good	Good	Good
Ventilation	Good	Good	Good	Good
Green views	Moderate	Moderate	Good	Good

Source: Fieldwork (2025)

DISCUSSION

Given the unreliability of power supply in Nigeria and the abundance of sunlight in Nigeria, using natural light is an essential design strategy for energy efficiency and the promotion of human health and well-being. Findings from this study indicate that all five psychiatric hospitals already make substantial use of daylight through window openings, yet the quality, control and therapeutic potential of this light differ markedly between facilities.

Natural lighting reduces dependence on artificial lighting, which accounts for 20–40% of total building energy use in many developing countries (Gago et al., 2015). The use of natural light substantially reduces the need for electric lights during the day, which translates to energy savings and lower utility costs. Similarly, integrating daylight-responsive systems in buildings can achieve up to 20%-60% reduction in lighting energy consumption, especially in commercial buildings (Al-Ashwal & Hassan, 2017). These systems work by using sensors to automatically adjust electric lights based on the amount of natural light available, reducing consumption while maintaining desired light levels (Odiyur Vathanam *et al*., 2021).

In the foreign case studies, daylighting is integrated into the architectural design through features such as courtyards, atriums, roof gardens and large glazed areas, allowing for deeper light penetration while still supporting privacy and safety. By contrast, the two local hospitals depend mainly on perimeter windows in one- and two-storey low-rise ward blocks, with fewer courtyards and more restricted outward views, which limits opportunities for controlled, biophilic daylighting even when illuminance levels are judged to be "good".

Lower energy use means fewer greenhouse gas emissions, aligning with global climate goals and LEED/BREEAM certification requirements. Natural lighting also integrates with passive design strategies such as shading, orientation, and material reflectance to reduce carbon footprints (Echeta *et al*., 2023b; Kalu et al., 2025; Syed & Hachem, 2019). The Worcester Recovery Centre and Hospital, for example, was conceived as a LEED Gold psychiatric facility where generous glazing, a village-like layout and internal shared spaces are deliberately used to create a recovery-focused environment that also performs well in terms of energy and resource efficiency (architecture+, 2025). This illustrates how mental health facilities can simultaneously pursue environmental and clinical goals. For Nigeria, a low- and middle-income setting, where hospital services often rely on costly diesel generators due to grid unreliability, improved daylighting in wards can reduce dependence on fossil-fuel back-up power and contribute to both operating-cost savings and national climate commitments (Saka et al., 2024).

Daylight exposure supports circadian rhythm regulation and enhances sleep quality, which leads to alertness during the day, productivity in the office space, and mental and overall health (Figueiro *et al.*, 2006). Recent studies on light and circadian rhythms emphasise that high daytime light exposure from daylight, together with reduced nocturnal light levels, is crucial for stabilising sleep and mood, and disruptions in these patterns are strongly linked with depression, anxiety and bipolar disorder (Blume *et al.*, 2019**)**. Hospital-based studies further show that patients in brighter rooms or in beds nearer to windows have shorter lengths of stay, lower pain medication use, better self-reported mood than those in darker rooms, and higher positive perceptions among patients who view outdoor green spaces (Jafarifiroozabadi *et al*., 2023; Onwuzuligbo et al., 2025; Park et al., 2018). This further supports the clinical relevance of daylighting decisions in ward design.

Reduced electricity demand lowers operational costs. Over a building's life cycle, daylighting systems yield a positive return on investment by decreasing energy bills and maintenance (Raji *et al*., 2017). This economic consideration is compelling for psychiatric hospitals, where long average lengths of stay and 24-hour operation mean that lighting and cooling loads are sustained over time. Daylighting strategies that reduce the need for artificial lighting in corridors and wards can therefore free up scarce health budgets for drugs, staffing and psychosocial programmes, while also lowering the environmental footprint of care (Saka *et al*., 2024).

RECOMMENDATIONS

The Government and professional bodies in Nigeria should update building codes to include minimum daylighting standards in new buildings.

Architects should prioritise site orientation and make sure the windows face directions that maximise useful daylight. They should also incorporate shading devices (e.g., louvres, light shelves) to balance daylight penetration and minimise glare. When designing and constructing, make use of atriums, courtyards, skylights, and clerestory windows to improve daylight access in dense urban environments. Similarly, when designing, perforated walls can be used in the design to throw in natural light and aid cross-ventilation in the hospital.

Automated daylighting systems (sensors and dimmers) should be implemented to automatically reduce artificial lighting when the daylight is sufficient. Professional training and workshops should be organised for architects, engineers, and builders on cost-effective daylight techniques.

CONCLUSION

Integrating natural light into the design of buildings is an important component of sustainable architecture. Natural lighting reduces the reliance on artificial lighting, thereby reducing energy usage and greenhouse gas emissions while improving cost efficiency. Additionally, access to daylight improves occupant health, productivity, and overall satisfaction, thus creating environments that are sustainable and healthy.

For rapidly urbanising contexts like Nigeria, where energy insecurity and rising construction demands are notably a challenge, natural lighting strategies provide a low-cost, high-impact solution. When combined with passive design measures such as orientation, shading devices, and reflective surfaces, daylighting becomes an effective driver of resilience in the built environment.

Ultimately, integrating natural light ensures that buildings contribute positively to the environment, economic productivity, and human well-being, all of which are hallmarks of a truly sustainable built environment.

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