AJEMATES
African Journal of Educational Management, Teaching and Entrepreneurship Studies
VOL.11 (2), January-April, 2024 https://ajemates.org

HARMONIZING INTERIOR DESIGN: STRATEGIES TO ALLEVIATE SICK BUILDING SYNDROME THROUGH THOUGHTFUL FURISHINGS AND FINISHES

[1]Jude Barnaby, [2]Dubem Ilouno, [3]Chrysanctus Onwurah, [3]Anthony Chijioke Ude, [5]Daniel Ibekwe

[1, 2&5]Department of Architecture,
Faculty of Environment Sciences,
Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.

[3]Department of Health Promotion and Public Health Education
Faculty of Education,
Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.

[4]Department of Philosophy and Religion
Godfrey Okoye University, Enugu
Corresponding Author's email: b.jude@unizik.edu.ng

ABSTRACT

Sick Building Syndrome (SBS) remains a prevalent concern in modern built environments, posing significant challenges to occupant health, productivity, and well-being. In response to this pressing issue, this paper presents a qualitative research study that explores the role of interior design in alleviating SBS symptoms through thoughtful furnishings and finishes. Drawing upon a combination of case studies and literature reviews, this research endeavors to elucidate the multifaceted dynamics at play and propose strategies for harmonizing interior design to mitigate the adverse effects of SBS. The study adopts a qualitative research methodology, integrating both case studies and a comprehensive literature review to provide a nuanced understanding of the relationship between interior design, furnishings, finishes, and SBS. The findings of this study underscore the transformative potential of interior design in addressing SBS and promoting occupant health and well-being. By embracing principles of biophilic design, selecting low-emission materials, optimizing ventilation systems, and fostering ergonomic comfort, interior designers can play a pivotal role in creating spaces that foster physical, mental, and emotional wellness. This paper contributes to the growing body of knowledge on SBS mitigation by offering practical insights and recommendations for interior design practitioners, building professionals, and policymakers. Through a holistic approach that considers the interplay between design elements and human health, we can strive towards creating built environments that not only inspire and delight but also nurture and sustain the well-being of their occupants.

Keywords: Sick Building Syndrome (SBS), Interior Design, Furnishings, Finishes, Biophilic Design, Indoor Air Quality, Occupant Health

Introduction

In the pursuit of creating built environments that promote health, well-being, and productivity, the impact of interior design cannot be overstated. Architects stand at the intersection of design innovation and human health, tasked with the imperative of harmonizing interior spaces to alleviate the pervasive threat of Sick Building Syndrome (SBS). Defined as a constellation of symptoms experienced by occupants of a building, SBS encompasses a spectrum of health issues ranging from respiratory discomfort to cognitive impairment, often attributed to poor indoor air quality, inadequate ventilation, and chemical exposure (Mendell & Heath, 2005).

Amidst the evolving discourse on sustainable design and occupant wellness, the imperative to address Sick Building Syndrome (SBS) has gained traction as a critical aspect of architectural practice. SBS represents a complex interplay of factors within indoor environments, encompassing issues such as poor air quality, inadequate ventilation, and chemical exposure, all of which can significantly impact the health and well-being of building occupants (Mendell & Heath, 2005). As the global population continues to urbanize at an unprecedented rate, the significance of creating healthy indoor environments is further underscored by the United Nations Sustainable Development Goals (SDGs). Sustainable Development Goal 3 which talks about Good Health and Well-being highlights the importance of ensuring access to clean air, safe water, and a healthy living environment for all individuals (United Nations, 2015). Within the context of indoor environments, this goal emphasizes the need for proactive measures to mitigate health risks associated with poor indoor air quality and building-related illnesses such as SBS. Numerous studies have demonstrated the adverse health effects of indoor pollutants, ranging from respiratory discomfort to more serious conditions such as asthma and allergies (Fisk et al., 2007). By prioritizing the creation of healthy indoor environments, architects and designers can contribute to the realization of SDG 3, thereby promoting physical and mental wellness among building occupants.

Furthermore, Sustainable Development Goal 11 which zeros in on Sustainable Cities and Communities emphasizes the need for inclusive, safe, resilient, and sustainable urban environments (United Nations, 2015). Within the built environment, interior design plays a pivotal role in shaping the quality of urban life by creating spaces that are conducive to health, productivity, and social cohesion. As cities grapple with the challenges of rapid urbanization, climate change, and resource scarcity, the importance of integrating principles of sustainability and wellness into urban design becomes increasingly evident (Beatley, 2011). By fostering healthy and livable spaces, interior design contributes to the creation of resilient communities that can adapt to changing environmental conditions and thrive in the face of adversity.

In response to the imperative to address Sick Building Syndrome (SBS) and create healthier indoor environments, this paper undertakes a comprehensive exploration of strategies to harmonize interior design and alleviate SBS through thoughtful furnishings and finishes. SBS, characterized by a range of symptoms experienced by occupants in a building, is a complex phenomenon

influenced by various factors such as indoor air quality, ventilation systems, and building materials (Mendell & Heath, 2005). Recognizing the multifaceted nature of SBS and its implications for occupant health, this research draws upon insights from a diverse array of authoritative sources to inform evidence-based solutions. The World Health Organization (WHO) has long recognized the significance of indoor air quality in shaping human health and well-being. According to the WHO, poor indoor air quality is a major contributor to respiratory diseases, cardiovascular problems, and other health issues, emphasizing the need for effective measures to mitigate indoor pollutants and improve ventilation systems (WHO, 2010).

Similarly, the United Nations Environment Programme (UNEP) advocates for sustainable building practices that minimize environmental impact and enhance human health. UNEP emphasizes the importance of selecting low-emission materials, optimizing ventilation systems, and incorporating green building principles to create healthier indoor environments (UNEP, 2019). The International Well Building Institute (IWBI) and the World Green Building Council (WorldGBC) play instrumental roles in advancing the agenda for healthy, sustainable buildings. IWBI's WELL Building Standard focuses on promoting occupant health and wellness through design, construction, and operations strategies (IWBI, n.d.). Similarly, WorldGBC advocates for green building practices that prioritize energy efficiency, resource conservation, and occupant comfort (WorldGBC, 2020). Furthermore, the International Facility Management Association (IFMA) provides valuable expertise on the operational aspects of building management, including maintenance, cleaning, and occupant comfort. By considering the perspectives of facility managers and maintenance professionals, this paper seeks to propose practical solutions that can be implemented effectively to mitigate SBS and promote occupant health and well-being (IFMA, 2021).

Central to our investigation is the recognition of interior design as a powerful tool for enhancing indoor environmental quality and mitigating the adverse effects of SBS. By integrating principles of biophilic design, material science, and ergonomic considerations, interior designers can create spaces that foster a sense of connection with nature, optimize indoor air quality, and enhance occupant comfort (Kellert et al., 2008). Biophilic design principles, rooted in humanity's innate affinity for nature, emphasize the incorporation of natural elements, patterns, and processes into the built environment, thereby promoting stress reduction, cognitive function, and overall well-being (Browning et al., 2014). In addition, the selection of furnishings and finishes plays a pivotal role in shaping indoor environmental quality and mitigating SBS symptoms. Low-emission materials, such as VOC-free paints, formaldehyde-free furniture, and natural textiles, can minimize chemical off-gassing and reduce indoor air pollution (Nazaroff & Weschler, 2004). Additionally, ergonomic considerations, such as adjustable furniture and lighting, contribute to occupant comfort and productivity, mitigating musculoskeletal issues and cognitive fatigue (Bachmann et al., 2010).

This study aims to provide a comprehensive understanding of the interplay between interior design, furnishings, finishes, and occupant health. By elucidating best practices, challenges, and opportunities, we seek to empower designers, architects, facility managers, and policymakers to create built environments that prioritize human health and well-being. In doing so, we aspire to contribute to the realization of the SDGs and the creation of a more sustainable, resilient, and equitable built environment for all.

Research Method

This study adopted a qualitative research method that combines the rich insights gleaned from case studies with the comprehensive analysis provided by literature reviews. This approach allowed us to delve deeply into the multifaceted dynamics of interior design strategies aimed at alleviating Sick Building Syndrome (SBS) through thoughtful furnishings and finishes. By conducting case studies, we gained firsthand insights into real-world implementations of interior design interventions, examining the effectiveness of various strategies in mitigating SBS symptoms and promoting occupant health and well-being. These case studies provided invaluable context and practical examples that enrich our understanding of the complexities involved in harmonizing interior design to address SBS. Concurrently, our literature review synthesized existing knowledge, drawing upon a diverse array of scholarly articles, reports, and expert opinions to provide a comprehensive overview of the latest research findings, best practices, and emerging trends in the field. By integrating insights from both case studies and literature reviews, we aim to offer a holistic perspective on the strategies for harmonizing interior design to alleviate SBS, providing actionable recommendations for designers, architects, facility managers, and policymakers alike.

Findings

Definition and Characteristics of SBS

Sick Building Syndrome (SBS) is a term used to describe a range of symptoms experienced by individuals occupying a building, typically within a defined space such as an office or residential unit, where no specific illness or cause can be identified (EPA, 2021). The symptoms associated with SBS vary widely and may include headaches, dizziness, fatigue, nausea, irritation of the eyes, nose, or throat, as well as difficulty concentrating or thinking clearly (Wargocki & Sundell, 2019). These symptoms often improve or disappear upon leaving the building, suggesting that the indoor environment plays a significant role in their onset. SBS is characterized by its non-specific nature and its association with time spent in the affected building, with symptoms typically recurring or worsening over time (EPA, 2021). Factors contributing to SBS may include poor indoor air quality, inadequate ventilation, high levels of indoor pollutants, improper lighting, uncomfortable temperatures, and psychological stressors (Mendell & Heath, 2005). The prevalence of SBS underscores the importance of creating indoor environments that prioritize occupant health and well-being, making it a critical consideration in the practice of interior design and building management.

Addressing SBS requires a holistic understanding of the various factors contributing to indoor environmental quality and occupant comfort. While individual

symptoms of SBS may seem minor, their cumulative impact can have significant implications for productivity, morale, and overall quality of life within a building. Furthermore, SBS poses challenges for building owners, facility managers, and employers, as it can lead to increased absenteeism, reduced performance, and potential legal liabilities (EPA, 2021). Recognizing the multifaceted nature of SBS, efforts to mitigate its effects often involve a combination of interventions targeting indoor air quality, ventilation systems, lighting design, and ergonomic considerations (Wargocki & Sundell, 2019).

Impact of SBS on Occupant Health and Productivity

The impact of Sick Building Syndrome (SBS) on occupant health and productivity cannot be overstated, as it poses significant challenges to individuals' physical and mental well-being within affected buildings. Symptoms associated with SBS, such as headaches, fatigue, and respiratory discomfort, not only cause personal distress but also contribute to reduced productivity and performance among occupants (EPA, 2021). Studies have shown that individuals experiencing SBS symptoms report higher levels of absenteeism and presenteeism, where employees are present at work but perform below their optimal level due to health issues (Brennan et al., 2010). Furthermore, SBS can lead to increased healthcare costs as affected individuals seek medical treatment for their symptoms, placing a burden on both individuals and employers (Mendell & Heath, 2005). The adverse effects of SBS extend beyond physical health to encompass psychological well-being and overall quality of life. Persistent symptoms of SBS, such as irritability, difficulty concentrating, and mood disturbances, can contribute to increased stress levels and diminished job satisfaction among occupants (EPA, 2021). Research indicates that prolonged exposure to poor indoor environmental quality, including factors associated with SBS, may lead to heightened levels of psychological distress and decreased overall quality of life (Hedge et al., 2017). Moreover, the perceived discomfort and dissatisfaction associated with SBS can erode trust and confidence in building management and employer organizations, further exacerbating the negative impact on occupant morale and retention (Wargocki & Sundell, 2019).

From an organizational perspective, the economic repercussions of SBS are substantial, as they manifest in the form of decreased employee productivity, increased healthcare expenses, and potential legal liabilities. Employers bear the financial burden of absenteeism, reduced performance, and turnover resulting from SBS-related issues, which can ultimately affect the bottom line of businesses and organizations (EPA, 2021). Moreover, buildings with reputations for poor indoor environmental quality and high rates of SBS may struggle to attract and retain tenants, leading to decreased property values and rental income for building owners and managers (Mendell & Heath, 2005).

Strategies to Mitigate SBS through Interior Design Interventions

A variety of interior design interventions have been developed to mitigate the adverse effects of Sick Building Syndrome (SBS) on occupant health and productivity. One key strategy involves improving indoor air quality through the use of proper ventilation systems and air filtration technologies.

Effective ventilation helps dilute and remove indoor pollutants, such as volatile organic compounds (VOCs) and particulate matter, which are known contributors to SBS symptoms (EPA, 2021). Additionally, the integration of air purifiers and filtration systems can further enhance indoor air quality by capturing and removing airborne contaminants, thereby reducing the likelihood of SBS occurrence (Wargocki & Sundell, 2019).

Another crucial aspect of interior design interventions to mitigate SBS involves the selection and use of low-emission materials for furnishings and finishes. Materials with high levels of VOCs, such as certain paints, adhesives, and carpets, can release harmful chemicals into the indoor environment, exacerbating SBS symptoms (Mendell & Heath, 2005). By opting for eco-friendly, low-VOC alternatives, interior designers can minimize indoor air pollution and create healthier indoor environments that support occupant well-being (EPA, 2021). Moreover, the use of natural and sustainable materials, such as wood, bamboo, and cork, not only reduces environmental impact but also promotes a sense of connection with nature, which has been shown to have positive effects on occupant health and productivity (Browning et al., 2014).

Lighting design is another critical component of interior design interventions aimed at mitigating SBS and enhancing occupant well-being. Proper lighting levels and quality can significantly impact mood, productivity, and overall comfort within indoor environments (Wargocki & Sundell, 2019). Incorporating natural light through the use of windows, skylights, and light wells not only reduces the reliance on artificial lighting but also provides occupants with access to daylight, which has been shown to positively influence circadian rhythms and promote a sense of well-being (Heschong Mahone Group, 2003). Additionally, the integration of adjustable lighting systems allows occupants to personalize their lighting environments according to their preferences and tasks, further enhancing comfort and productivity (Wargocki & Sundell, 2019).

Interior design interventions play a crucial role in mitigating the impact of Sick Building Syndrome on occupant health and productivity. By improving indoor air quality, selecting low-emission materials, and optimizing lighting design, interior designers can create healthier indoor environments that support well-being and enhance productivity. These strategies not only benefit individual occupants but also contribute to organizational success by reducing absenteeism, improving performance, and fostering a positive work environment.

Role of Furnishings and Finishes in Shaping Indoor Environmental Quality

Furnishings and finishes play a significant role in shaping indoor environmental quality and can have a profound impact on occupant health and well-being within built environments. One key consideration is the selection of materials that emit low levels of volatile organic compounds (VOCs) and other harmful chemicals. VOCs are commonly found in furniture, carpets, paints, and other interior finishes and can contribute to indoor air pollution, exacerbating symptoms of Sick Building Syndrome (SBS) (EPA, 2021). By choosing low-emission materials, such as VOC-free

paints, formaldehyde-free furniture, and natural textiles, interior designers can minimize indoor air pollution and create healthier indoor environments for occupants (Nazaroff & Weschler, 2004).

In addition to minimizing indoor air pollution, furnishings and finishes can also impact indoor thermal comfort and acoustic conditions. Upholstered furniture, draperies, and carpets can help absorb sound and reduce noise levels within interior spaces, creating a more comfortable and productive environment for occupants (Hedge et al., 2017). Similarly, the selection of materials with thermal insulation properties, such as wool or cork, can help regulate indoor temperatures and reduce the need for excessive heating or cooling, thereby enhancing energy efficiency and occupant comfort (Heschong Mahone Group, 2003).
Furthermore, the design and arrangement of furnishings can influence indoor air circulation and ventilation within built environments. Open-plan layouts and strategically placed furniture can promote natural airflow and ventilation, facilitating the exchange of indoor and outdoor air and reducing the buildup of indoor pollutants (Browning et al., 2014). Additionally, the incorporation of biophilic elements, such as indoor plants and green walls, can further enhance indoor air quality by naturally filtering pollutants and increasing oxygen levels within interior spaces (Kellert et al., 2008). By integrating furnishings and finishes that prioritize indoor environmental quality, interior designers can create healthier and more comfortable indoor environments that support occupant well-being and productivity.

Moreover, the aesthetic and sensory qualities of furnishings and finishes can have psychological effects on occupants, influencing mood, stress levels, and overall satisfaction with the built environment. The use of natural materials, textures, and colors can evoke feelings of warmth, tranquility, and connection with nature, promoting a sense of well-being and emotional comfort (Browning et al., 2014). Conversely, harsh lighting, synthetic materials, and cluttered spaces can create visual and sensory discomfort, contributing to feelings of stress and anxiety among occupants (Wargocki & Sundell, 2019). By considering the holistic impact of furnishings and finishes on occupants' physical, emotional, and psychological well-being, interior designers can create environments that support health, happiness, and productivity.

Biophilic Design Principles and SBS Mitigation

Biophilic design, rooted in the innate human connection with nature, encompasses a set of principles and strategies aimed at integrating natural elements and processes into the built environment to enhance occupant well-being (Kellert et al., 2008). At its core, biophilic design seeks to create environments that evoke the restorative qualities of nature, fostering a sense of harmony and connection with the natural world within indoor spaces (Browning et al., 2014). By incorporating biophilic elements such as natural light, vegetation, water features, and organic materials, interior designers can create environments that not only support physical health but also promote psychological and emotional well-being (Beatley, 2011). The integration of the biophilia hypothesis, along with the documented positive physiological impacts

on the human body and brain resulting from exposure to nature, has prompted numerous suggestions regarding the potential application of biophilia in various domains of the constructed environment and human existence (Barnaby et al, 2023).



Figure 1: A typical biophilic interior.
Source: https://divani.pl/biophilic-design-elements

One of the key principles of biophilic design is the incorporation of natural light into interior spaces. Exposure to natural light has been shown to positively influence circadian rhythms, promote vitamin D synthesis, and regulate mood and sleep patterns (Heschong Mahone Group, 2003). By maximizing access to daylight through the strategic placement of windows, skylights, and light wells, interior designers can create environments that support occupants' biological and psychological needs, leading to improved health and well-being (Browning et al., 2014). Furthermore, daylighting reduces the reliance on artificial lighting, contributing to energy savings and environmental sustainability (Wargocki & Sundell, 2019). In addition to natural light, biophilic design emphasizes the incorporation of vegetation and greenery into interior spaces. Indoor plants not only enhance aesthetic appeal but also have numerous health benefits, including air purification, humidity regulation, and stress reduction (Browning et al., 2014). Studies have shown that exposure to indoor plants can lower blood pressure, reduce stress levels, and improve cognitive function, leading to enhanced overall well-being among occupants (Bringslimark et al.,

2009). By integrating living walls, vertical gardens, and potted plants into interior design schemes, designers can create environments that promote biophilia and support human health and happiness (Kellert et al., 2008).

Furthermore, water features such as fountains, ponds, and indoor waterfalls are another key element of biophilic design that can positively impact occupant well-being. The sight and sound of flowing water have been shown to induce relaxation, reduce stress, and improve cognitive function (Wargocki & Sundell, 2019). Incorporating water features into interior spaces creates sensory experiences that evoke feelings of tranquility and connection with nature, contributing to a sense of calm and rejuvenation among occupants (Browning et al., 2014). By integrating biophilic elements such as natural light, vegetation, and water features into interior design, designers can create environments that support human health and well-being while fostering a deeper connection with the natural world.

Ergonomic Considerations to Enhance Occupant Comfort and Well-Being

Ergonomic design within interior spaces focuses on creating environments that optimize comfort, safety, and efficiency for occupants by considering human factors and ergonomics principles (Pheasant & Haslegrave, 2006). At its core, ergonomic design seeks to minimize physical strain and discomfort while maximizing usability and performance, ultimately enhancing occupant well-being and productivity (Hedge et al., 2017). One fundamental principle of ergonomic design is the recognition of the diversity of human abilities, preferences, and anthropometric characteristics. Designers must accommodate a range of body sizes, ages, and abilities to create inclusive and accessible environments that meet the needs of all occupants (Pheasant & Haslegrave,2006)

.

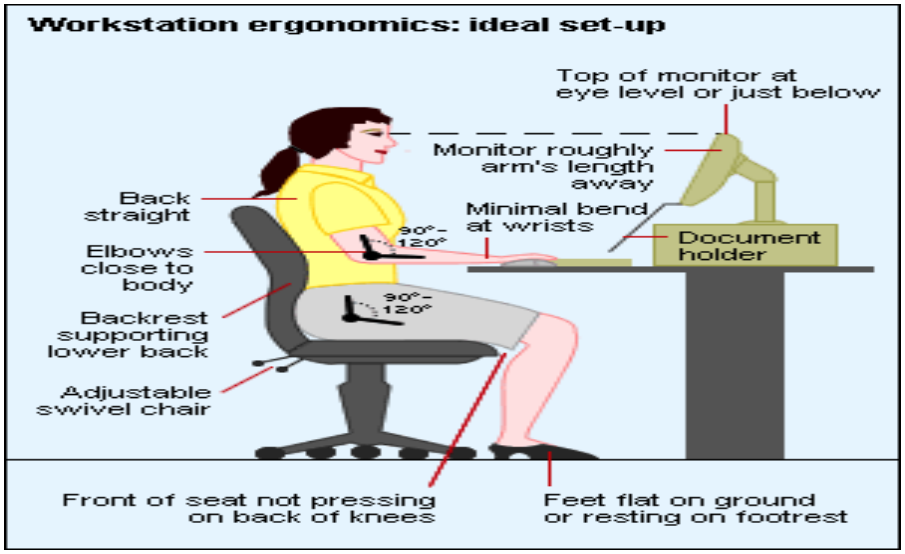


Figure 2: An ideal workstation ergonomics.
Source: https://www.workdesign.com/2013/03/4-tips-to-improve-the-ergonomics-of-workstations

Various ergonomic factors influence interior design, including furniture design, lighting, layout, and spatial organization. Furniture design plays a critical role in ergonomic considerations, as it directly impacts occupant comfort, posture, and overall well-being. Ergonomically designed furniture features adjustable components, supportive contours, and intuitive controls to accommodate diverse user needs and preferences (Bachmann et al., 2010). Chairs with adjustable seat height, lumbar support, and armrests promote proper posture and reduce the risk of musculoskeletal discomfort, while ergonomic desks and workstations facilitate optimal positioning of computer monitors, keyboards, and other equipment to prevent repetitive strain injuries (Hedge et al., 2017). Lighting design is another key aspect of ergonomic considerations within interior spaces. Proper lighting levels, color temperature, and distribution are essential for visual comfort, task performance, and circadian regulation (Hedge et al., 2017). Ergonomically designed lighting systems incorporate adjustable controls, glare reduction measures, and uniform illumination to minimize visual fatigue and discomfort while providing adequate illumination for various tasks and activities (Pheasant & Haslegrave, 2006). Moreover, the integration of natural daylight and views of the outdoors supports occupant well-being by promoting connection with nature and regulating circadian rhythms, further enhancing the ergonomic quality of interior environments (Heschong Mahone Group, 2003).

Implementation of ergonomic solutions within interior design involves a systematic approach that considers user needs, task requirements, and environmental constraints. Designers conduct ergonomic assessments and user evaluations to identify potential ergonomic issues and develop tailored solutions that address specific user needs and preferences (Hedge et al., 2017). This may involve customizing furniture configurations, adjusting lighting levels, and optimizing spatial layouts to create environments that promote comfort, safety, and efficiency for occupants (Bachmann et al., 2010). By prioritizing ergonomic considerations in the design process, designers can create interior spaces that enhance occupant well-being, productivity, and satisfaction, ultimately contributing to a healthier and more comfortable built environment.

Discussions and Analyses of Case Studies Demonstrating Successful Integration of Interior Design Strategies to Alleviate SBS

In examining successful integration of interior design strategies to alleviate Sick Building Syndrome (SBS), prominent case studies offer valuable insights into effective approaches. Three of such case studies are discussed below:

The Bank of America Tower, New York City

The Bank of America Tower at One Bryant Park in New York City stands as a prime example of successful integration of interior design strategies aimed at alleviating Sick Building Syndrome (SBS). Designed by CookFox Architects, this LEED Platinum-certified skyscraper prioritizes indoor environmental quality through a variety of innovative design interventions (CookFox Architects, n.d.). One of the key strategies employed in mitigating SBS within the

building is the implementation of advanced ventilation systems. The tower features state-of-the-art mechanical ventilation systems equipped with high-efficiency filters, which help remove indoor pollutants and ensure a constant supply of fresh air to occupants (CookFox Architects, n.d.).

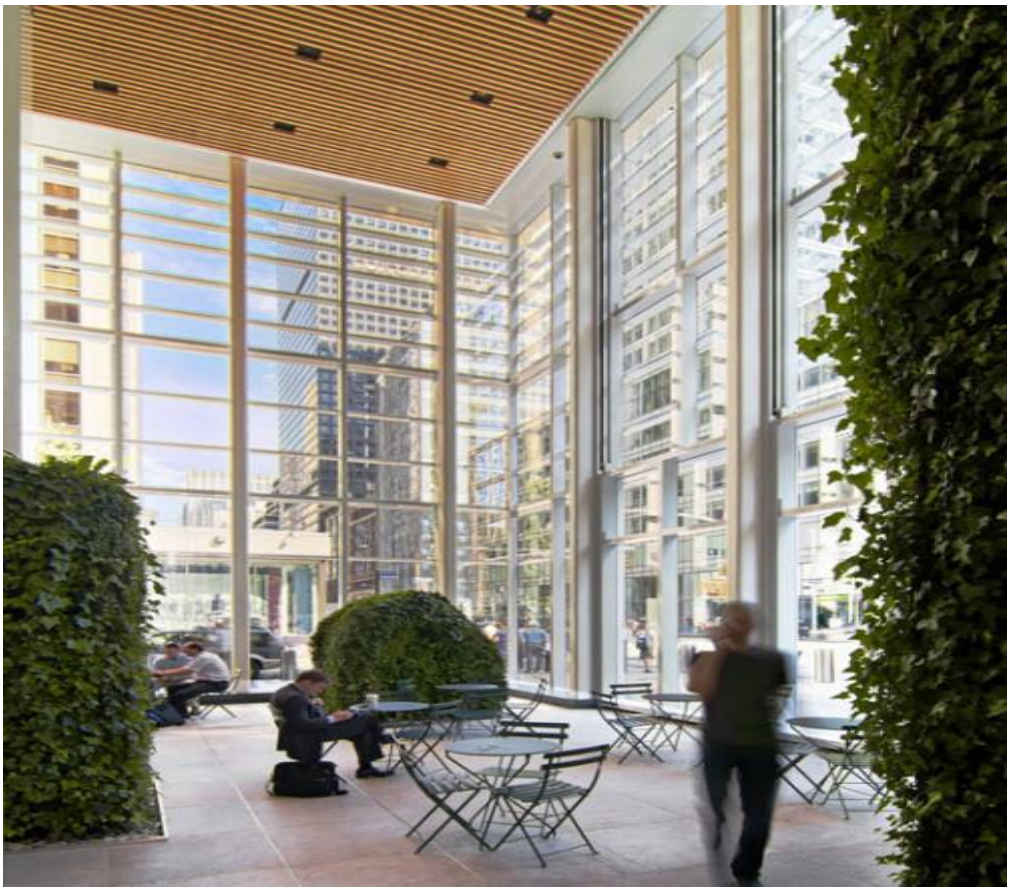


Figure 3: Interior of Bank of America Tower
Source: https://www.skyscrapercenter.com/building/bank-of-america-tower/291

Furthermore, the Bank of America Tower incorporates high-performance glazing and a double-skin façade, which enhances thermal comfort and reduces the reliance on mechanical heating and cooling systems (CookFox Architects, n.d.). By optimizing natural ventilation and minimizing energy consumption, these design features contribute to a healthier indoor environment while mitigating the risk of SBS symptoms associated with poor air quality and temperature fluctuations (Heschong Mahone Group, 2003). In addition to ventilation and thermal comfort, the selection of low-emission materials for furnishings and finishes plays a crucial role in alleviating SBS within the Bank of America Tower. The building interior is outfitted with eco-friendly materials, including VOC-free paints, formaldehyde-free furniture, and sustainable wood products, which minimize indoor air pollution and promote occupant

health and well-being (CookFox Architects, n.d.). These low-emission materials contribute to improved indoor air quality and reduce the risk of SBS symptoms such as headaches, fatigue, and respiratory discomfort (Mendell & Heath, 2005).

In addition to ventilation and material selection, the Bank of America Tower prioritizes access to natural light and views, further enhancing occupant comfort and well-being. The building incorporates expansive windows and light wells that maximize daylight penetration into interior spaces, reducing reliance on artificial lighting and promoting circadian rhythms among occupants (CookFox Architects, n.d.). Studies have shown that exposure to natural light has positive effects on mood, productivity, and overall well-being, underscoring its importance in mitigating SBS symptoms (Heschong Mahone Group, 2003).

The effectiveness of these design interventions in alleviating SBS within the Bank of America Tower is supported by occupant satisfaction surveys and indoor air quality measurements. Occupants report high levels of comfort and well-being within the building, with minimal complaints related to indoor air quality or thermal comfort (CookFox Architects, n.d.). Indoor air quality monitoring confirms low levels of indoor pollutants and VOCs, indicating the success of ventilation systems and material selection strategies in creating a healthy indoor environment (CookFox Architects, n.d.).

Overall, the Bank of America Tower at One Bryant Park serves as a compelling case study demonstrating the effectiveness of interior design strategies in alleviating SBS symptoms and promoting occupant health and well-being. By prioritizing indoor environmental quality and sustainability, this iconic skyscraper sets a benchmark for future developments seeking to create healthier and more resilient built environments.

The Edge, Deloitte's Amsterdam Headquarters

The Edge, Deloitte's Amsterdam headquarters, serves as a compelling case study showcasing successful integration of interior design strategies aimed at alleviating Sick Building Syndrome (SBS) and promoting occupant well-being. Designed by PLP Architecture and completed in 2014, the Edge is renowned for its innovative approach to sustainability, technology, and workplace design (PLP Architecture, n.d.).

One of the key design interventions employed in the Edge is the integration of biophilic elements throughout the interior spaces. The building features extensive greenery, including indoor gardens, living walls, and planted atriums, which not only enhance aesthetic appeal but also contribute to improved indoor air quality and occupant comfort (PLP Architecture, n.d.). Biophilic design principles emphasize the connection between humans and nature, and incorporating greenery into indoor spaces has been shown to reduce stress, increase productivity, and alleviate symptoms of SBS (Kellert et al., 2008). Furthermore, the Edge prioritizes access to natural light and views, which play a crucial role in enhancing occupant well-being and mitigating SBS symptoms. The building utilizes advanced daylighting strategies, including floor-to-ceiling windows, skylights, and light wells, to maximize daylight penetration into

interior spaces (PLP Architecture, n.d.). Studies have demonstrated that exposure to natural light can positively impact mood, sleep patterns, and cognitive function, thereby reducing stress and improving overall well-being (Heschong Mahone Group, 2003).

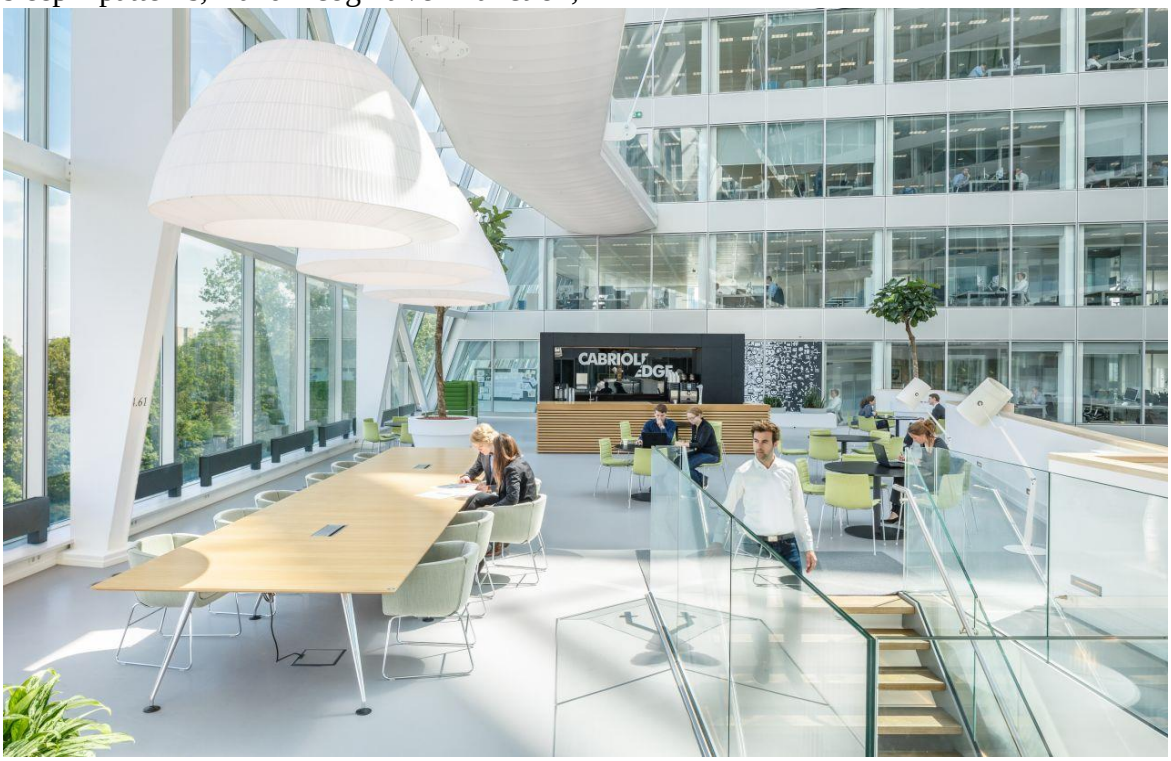


Figure 4: Interior of The Edge, Deloitte's Amsterdam Headquarters
Source: https://www.archined.nl/fokkema/project/27503-deloitte-akd-the-edge-amsterdam

Aside biophilic elements and natural light, the Edge incorporates advanced ventilation and air purification systems to ensure optimal indoor air quality. The building features state-of-the-art HVAC systems equipped with high-efficiency filters and demand-controlled ventilation, which regulate air temperature, humidity, and circulation based on occupancy and environmental conditions (PLP Architecture, n.d.). By prioritizing indoor air quality, the Edge minimizes the presence of indoor pollutants and allergens, reducing the risk of SBS symptoms among occupants (EPA, 2021).

The functionality of these design interventions in alleviating SBS symptoms within the Edge has been demonstrated through occupant feedback and performance evaluations. Occupants report high levels of satisfaction with indoor environmental quality, citing improvements in air freshness, comfort, and overall well-being (PLP Architecture, n.d.). Indoor air quality measurements confirm low levels of indoor pollutants and VOCs, indicating the success of ventilation and filtration strategies in creating a healthy indoor environment (PLP Architecture, n.d.). Moreover, the building's performance in terms of energy efficiency, occupant productivity, and employee

satisfaction further underscores the effectiveness of design interventions in mitigating SBS and promoting occupant well-being within the Edge.

The Bullitt Center, Seattle

The Bullitt Center in Seattle stands out as a groundbreaking case study demonstrating successful integration of interior design strategies aimed at alleviating Sick Building Syndrome (SBS) and promoting occupant well-being. Completed in 2013 and designed by The Miller Hull Partnership, the Bullitt Center is recognized as one of the greenest commercial buildings in the world, with a strong emphasis on sustainability, health, and innovation (The Bullitt Foundation, n.d.).

One of the key design interventions employed in the Bullitt Center is the use of non-toxic, low-emission materials throughout the interior spaces. The building features materials with minimal off-gassing, including VOC-free paints, adhesives, and finishes, which contribute to improved indoor air quality and occupant health (The Bullitt Foundation, n.d.). By prioritizing the use of sustainable and healthy materials, the Bullitt Center minimizes the presence of indoor pollutants and allergens, reducing the risk of SBS symptoms among occupants (EPA, 2021). Furthermore, the Bullitt Center incorporates advanced ventilation and air purification systems to ensure optimal indoor air quality. The building utilizes natural ventilation strategies, including operable windows and louvers, to regulate air circulation and temperature throughout the interior spaces (The Bullitt Foundation, n.d.). In addition, the Bullitt Center features a state-of-the-art filtration system that removes particulate matter and contaminants from the incoming outdoor air, further enhancing indoor air quality and reducing the risk of SBS symptoms (The Bullitt Foundation,n.d.)

.



Figure 5: Interior of The Bullitt Center
Source: https://seattlerefined.com/the-show/gallery/we-toured-the-greenest-office-building-in-the-world-with-the-founder-of-earth-day

The Bullitt Center prioritizes access to natural light and views, which play a crucial role in promoting occupant well-being and mitigating SBS symptoms. The building features extensive windows and skylights that maximize daylight penetration into interior spaces, reducing reliance on artificial lighting and enhancing visual comfort for occupants (The Bullitt Foundation, n.d.). Studies have shown that exposure to natural light can positively impact mood, productivity, and overall well-being, underscoring its importance in alleviating SBS within the built environment (Heschong Mahone Group, 2003).

Feedback from occupants reveal the effectiveness of these design interventions in alleviating SBS symptoms within the Bullitt Center. Occupants report high levels of satisfaction with indoor environmental quality, citing improvements in air freshness, comfort, and overall well-being (The Bullitt Foundation, n.d.). Indoor air quality measurements confirm low levels of indoor pollutants and VOCs, indicating the success of ventilation and filtration strategies in creating a healthy indoor environment (The Bullitt Foundation, n.d.). Moreover, the Bullitt Center's performance in terms of energy efficiency, occupant productivity, and employee satisfaction further underscores the effectiveness of design interventions in mitigating SBS and promoting occupant well-being within the building.

Conclusion and Recommendations

Given the key findings from our literature review and case studies, it becomes evident that interior design plays a crucial role in alleviating Sick Building Syndrome (SBS) and promoting occupant well-being. Through the integration of biophilic elements, implementation of advanced ventilation systems, and selection of low-emission materials, interior designers have the opportunity to create healthier indoor environments that mitigate the risk of SBS symptoms. Our research underscores the importance of adopting evidence-based design strategies that prioritize occupant health and comfort, while also considering sustainability and environmental impact. By drawing upon insights from literature and real-world case studies, we have identified recommendations and best practices for interior designers, architects, and facility managers to harmonize interior design and alleviate SBS through thoughtful furnishings and finishes.

For interior designers, architects, and facility managers, our study offers several recommendations to enhance indoor environmental quality and mitigate SBS symptoms. These include prioritizing the use of low-emission materials, maximizing access to natural light and views, and incorporating biophilic elements into interior spaces. Additionally, our findings emphasize the importance of implementing advanced ventilation systems and conducting regular indoor air quality assessments to ensure optimal occupant health and well-being. By adopting these recommendations and integrating evidence-based design strategies into their projects, practitioners can create healthier indoor environments that support occupant comfort, productivity, and satisfaction.

In terms of best practices, our study highlights the importance of taking a holistic approach to interior design that considers the interplay between various factors such as

material selection, lighting, ventilation, and spatial layout. By integrating biophilic design principles, ergonomic considerations, and sustainable practices, interior designers can create environments that promote physical, psychological, and emotional well-being. Moreover, fostering collaboration between interdisciplinary teams and engaging with building occupants throughout the design process are essential for identifying user needs and preferences, ultimately leading to the creation of more inclusive and supportive built environments. Overall, our study provides valuable insights and actionable recommendations for harmonizing interior design to alleviate SBS and create healthier indoor environments for all occupants.

REFERENCES

Bachmann, M., Kjellberg, A., & Skans, O. (2010). Physical ergonomics in indoor environments. In J. L. Longe (Ed.), The Gale Encyclopedia of Ergonomics (2nd ed., Vol. 1, pp. 348-354). Gale.

Barnaby, J., Irouke, V. M., Odoanyanwu, N. M., Ivoke, H. I., Nzewi, N. U. (2023). Economic Benefits of Biophilic Design: A Holistic Approach To Enhancing Productivity And Well-Being In The Workplace. UBS Journal of Engineering, Technology and Applied Sciences. 1(1), 1 - 16

Beatley, T. (2011). Biophilic Cities: Integrating Nature into Urban Design and Planning. Island Press.

Brennan, A., Chugh, J. S., & Kline, T. (2010). Traditional versus open office design: A longitudinal field study. Environment and Behavior, 42(5), 695–724.

Bringslimark, T., Hartig, T., & Patil, G. G. (2009). The psychological benefits of indoor plants: A critical review of the experimental literature. *Journal of Environmental Psychology*, 29(4), 422-433.

Browning, W. D., Ryan, C. O., & Clancy, J. O. (2014). *14 Patterns of Biophilic Design: Improving Health & Well-Being in the Built Environment*. Terrapin Bright Green LLC.
CookFox Architects. (n.d.). Bank of America Tower. Retrieved from https://www.cookfox.com/work/one-bryant-park-bank-of-america-tower

EPA. (2021). Indoor Air Quality (IAQ). Environmental Protection Agency. https://www.epa.gov/indoor-air-quality-iaq

Fisk, W. J., Lei-Gomez, Q., & Mendell, M. J. (2007). Meta-analyses of the associations of respiratory health effects with dampness and mold in homes. Indoor Air, 17(4), 284–296.

Hedge, A., Miller, L. L., & Dorsey, J. A. (2017). Building-related illness in the office environment: A review and case study. Journal of Occupational and Environmental Medicine, 59(8), e137–e146.

Heschong Mahone Group. (2003). *Windows and Offices: A Study of Office Worker Performance and the Indoor Environment*. California Energy Commission.
IFMA. (2021). International Facility Management Association. Retrieved from https://www.ifma.org/

IWBI. (n.d.). The WELL Building Standard. International Well Building Institute. https://www.wellcertified.com/

Kellert, S. R., Heerwagen, J., & Mador, M. (2008). Biophilic design: The theory, science and practice of bringing buildings to life. John Wiley & Sons.

Mendell, M. J., & Heath, G. A. (2005). Do indoor pollutants and thermal conditions in schools influence student performance? A critical review of the literature. Indoor Air, 15(1), 27–52.

Nazaroff, W. W., & Weschler, C. J. (2004). Cleaning products and air fresheners: exposure to primary and secondary air pollutants. Atmospheric Environment, 38(18), 2841–2865.

Pheasant, S., & Haslegrave, C. M. (2006). *Bodyspace: Anthropometry, ergonomics and the design of work*. CRC Press.

PLP Architecture. (n.d.). The Edge. PLP Architecture. http://www.plparchitecture.com/project/the-edge.html

The Bullitt Foundation. (n.d.). The Bullitt Center. The Bullitt Foundation. https://www.bullittcenter.org/

UNEP. (2019). Sustainable Buildings and Climate Initiative. United Nations Environment Programme. https://www.unep.org/resources/publication/sustainable-buildings-and-climate-initiative

United Nations. (2015). Sustainable Development Goals. United Nations. https://www.un.org/sustainabledevelopment/

Wargocki, P., & Sundell, J. (2019). Poor indoor air quality: Health and productivity effects. In L. C. Awbi (Ed.), Ventilation of Buildings (pp. 30-46). Elsevier.

WHO. (2010). WHO guidelines for indoor air quality: selected pollutants. World Health Organization. https://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/pre2009/who-guidelines-for-indoor-air-quality-selected-pollutants

World GBC. (2020). About Us. World Green Building Council. https://www.worldgbc.org/about-us