



ISSN: 0975-833X

Available online at <http://www.journalcra.com>

International Journal of Current Research
Vol. 15, Issue, 06, pp.25204-25207, June, 2023
DOI: <https://doi.org/10.24941/ijcr.45548.06.2023>

INTERNATIONAL JOURNAL
OF CURRENT RESEARCH

RESEARCH ARTICLE

EXPLORING THE RELATIONSHIP BETWEEN DAYLIGHTING AND SUSTAINABLE URBAN PLANNING: A COMPREHENSIVE STUDY

^{1,*}Alpana Kamble and ²Dr. Ila Gupta

¹Research Scholar Amity School of Architecture and Planning

²Professor and Amity School of Architecture and Planning

ARTICLE INFO

Article History:

Received 24th March, 2023
Received in revised form
14th April, 2023
Accepted 20th May, 2023
Published online 30th June, 2023

Key words:

Urban Panning, Day lighting, Energy, Productivity.

*Corresponding Author:
Alpana Kamble

Copyright©2023, Alpana Kamble and Ila Gupta. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Alpana Kamble and Dr. Ila Gupta. 2023. "Exploring the Relationship between Daylighting and Sustainable Urban Planning: A Comprehensive Study". *International Journal of Current Research*, 15, (06), 25204-25207.

ABSTRACT

The relationship between daylighting and urban planning has been extensively researched, highlighting the positive impact of natural illumination on energy consumption, health, productivity, and well-being. Effective daylighting strategies can lead to reduced energy costs, improved indoor air quality, increased visual comfort, and enhanced work and learning performance. As a key aspect of sustainable design, the importance of integrating daylighting into the early stages of urban planning and design has been recognized, with studies considering factors such as building height, street width, and green spaces. The research supports the notion that prioritizing daylighting in urban planning is crucial for creating healthy, efficient, and sustainable cities.

INTRODUCTION

Daylighting, the use of natural light in indoor spaces through windows and skylights, has become a topic of great interest in recent years due to its numerous benefits. The relationship between daylighting and urban planning has been extensively researched, with studies revealing the positive impact of natural illumination on energy consumption, health, productivity, and well-being. Researchers have found that effective daylighting strategies can reduce energy costs, improve indoor air quality, increase visual comfort, and enhance work and learning performance. In the realm of sustainable design, daylighting has been recognized as a key aspect of urban planning and many studies have explored its impact on building design, orientation, and urban form. These studies emphasize the importance of considering daylighting from the early stages of design and taking into account factors such as building height, street width, and green spaces to create livable and energy-efficient urban environments. The research supports the idea that prioritizing daylighting in urban planning is crucial for creating healthy, efficient, and sustainable cities.

Objective: The objective of this research is to examine the relationship between daylighting and urban planning, with a focus on the positive impact of natural illumination on energy consumption, health, productivity, and well-being.

The study aims to identify effective daylighting strategies that can lead to reduced energy costs, improved indoor air quality, increased visual comfort, and enhanced work and learning performance. Additionally, the research seeks to recognize the importance of integrating daylighting into the early stages of urban planning and design, considering factors such as building height, street width, and green spaces. The ultimate goal is to provide evidence that prioritizing daylighting in urban planning is crucial for creating healthy, efficient, and sustainable cities.

LITERATURE REVIEW

Literature review was done on a number of researches and the research papers which included the day lighting and the effect on the urban planning around the world .The research by Glicksman (2017) focuses on the role of natural light in architecture and urban design, and its impact on health and well-being. Mardaljevic, J. (2013) in his book "Natural Light in Architecture: Design Principles and Case Studies" presents a comprehensive overview of the design principles and case studies related to the use of natural light in architecture. Lee and Kim (2015) examined the impact of natural light on energy consumption in buildings. Jeong, S., & Lee, J. (2013) conducted research on the impact of natural light on energy consumption and indoor environmental quality in office buildings.

Chan and Ma in 2018 examined the impact of daylighting (the use of natural light in a building) on indoor environmental quality and energy consumption in office buildings. X. Li and Y. Li (2015) researched titled as "Daylighting in public buildings: A review of design strategies and their impact on visual and environmental comfort". M. Baier and M. Amann (2018) did a research study that examined the effects of daylight on human health and well-being in indoor spaces "The Impact of Daylight on Human Health and Well-being in the Built Environment". Research study conducted by S. Mardaljevic and J.S. Currie in 2006 on "Daylighting in Schools: A Review of the Impact on Student Learning and Performance". The research paper by A. E. Kontakos and V. K. Palyvos, published in 2016, "Daylighting and its effects on energy consumption in commercial buildings: A review" aimed to review the literature on the relationship between daylighting and energy consumption in commercial buildings. A research study that investigated the relationship between urban form, daylight, and energy consumption in buildings "Urban Form, Daylight and Energy in Buildings: An interdisciplinary approach" by R. L. de Oliveira, published in the *Building and Environment* in 2017.

RESULTS AND DISCUSSION

The research by Glicksman (2017) focuses on the role of natural light in architecture and urban design, and its impact on health and well-being. The article discusses the importance of natural light for psychological and physiological well-being, and how it can be incorporated into architectural design to improve the quality of indoor environments. The author also explores the effects of light on circadian rhythms and how natural light can be used to improve sleep and overall health. The article concludes by emphasizing the importance of incorporating natural light into architectural design to promote health and well-being, and highlights the need for further research in this area. Mardaljevic, J. (2013) in his book "Natural Light in Architecture: Design Principles and Case Studies" presents a comprehensive overview of the design principles and case studies related to the use of natural light in architecture. The author starts by discussing the importance of natural light in architecture and its impact on human health, well-being and energy efficiency. He then goes on to discuss various design principles and strategies that architects can use to harness natural light effectively in their designs. The book also includes a number of case studies that showcase the practical application of these design principles in real-world projects. These case studies range from small-scale residential projects to large-scale commercial and institutional buildings. The author examines the design solutions used in each project and the impact of natural light on the overall design.

The book concludes by discussing the future of natural light in architecture and its potential to contribute to sustainable design. Overall, the book provides a valuable resource for architects, students of architecture and anyone interested in the role of natural light in the built environment. It is a useful guide for architects and students of architecture to understand the importance of natural light in design and how to design with natural light in mind. It also includes real-life examples of how it has been used in the past and the impact it had on the overall design. The research by Lee and Kim (2015) examines the impact of natural light on energy consumption in buildings. The study found that buildings with ample natural light had lower energy consumption for lighting compared to buildings with limited natural light. Additionally, the study found that buildings with proper daylighting design had overall lower energy consumption and improved indoor environmental quality. The authors concluded that incorporating natural light in building design can lead to significant energy savings and improved indoor environmental quality. Jeong, S., & Lee, J. (2013) conducted research on the impact of natural light on energy consumption and indoor environmental quality in office buildings. They found that the use of natural light can significantly reduce energy consumption in office buildings while improving indoor environmental quality, including increased visual comfort, improved air quality, and better thermal comfort.

Additionally, they found that the use of natural light can also lead to cost savings, as well as improved employee productivity and well-being. Overall, the study suggests that incorporating natural light into the design of office buildings can have a positive impact on both energy consumption and indoor environmental quality. The research conducted by Chan and Ma in 2018 examines the impact of daylighting (the use of natural light in a building) on indoor environmental quality and energy consumption in office buildings. The study looks at how different design strategies, such as the use of skylights, clerestory windows, and light shelves, can affect the amount of natural light in a building and how this in turn affects factors such as lighting energy consumption, thermal comfort, and visual comfort. The study found that the use of daylighting can lead to significant reductions in lighting energy consumption and improvements in thermal comfort and visual comfort in office buildings. The authors conclude that daylighting is an effective strategy for improving indoor environmental quality and reducing energy consumption in office buildings. One study conducted in the United States found that buildings that incorporated daylighting strategies, such as skylights and windows, had a significant reduction in energy consumption compared to buildings without natural light. Another study conducted in the United Kingdom found that buildings that incorporated daylighting strategies had a decrease in absenteeism, increased productivity, and an overall improvement in employee satisfaction. There were also studies that looked at the impact of daylighting on the urban environment. One study conducted in Europe found that cities with a high proportion of daylight in their public spaces had a higher sense of community, more social interaction, and more active use of public spaces.

The research by X. Li and Y. Li (2015) titled "Daylighting in public buildings: A review of design strategies and their impact on visual and environmental comfort" is a study that reviews the various design strategies used for incorporating daylighting in public buildings and the impact of these strategies on both visual and environmental comfort. The study looks at the different types of daylighting systems, such as skylights, light wells, and atria, and evaluates their effectiveness in providing natural light while minimizing glare and overheating. The study also examines the use of daylighting simulation software in the design process and the importance of considering the building's orientation and surrounding environment. Overall, the study concludes that proper design strategies for daylighting in public buildings can have a positive impact on visual comfort, energy efficiency, and overall sustainability. M. Baier and M. Amann (2018) did a research study that examined the effects of daylight on human health and well-being in indoor spaces "The Impact of Daylight on Human Health and Well-being in the Built Environment". The study specifically looks at how different levels of daylight exposure can impact physiological and psychological processes, such as circadian rhythm regulation and mood. The study also discusses the potential benefits of incorporating natural light into the design of buildings, such as improved sleep, reduced depression and anxiety, and improved cognitive function. Overall, the study suggests that proper daylighting in the built environment can have a positive impact on human health and well-being.

Research study conducted by S. Mardaljevic and J.S. Currie in 2006 on "Daylighting in Schools: A Review of the Impact on Student Learning and Performance". The study reviewed previous research on the impact of daylighting in schools on student learning and performance. The authors found that natural light in classrooms can have a positive impact on student learning and performance, as well as on student behavior and well-being. The study concluded that incorporating daylighting in the design of schools is an important consideration for creating optimal learning environments. The research paper "Daylighting and its effects on energy consumption in commercial buildings: A review" by A. E. Kontakos and V. K. Palyvos, published in 2016, aims to review the literature on the relationship between daylighting and energy consumption in commercial buildings. The authors examine the impact of natural light on energy consumption, including lighting, heating, and cooling.

They also discuss the design strategies that can be used to optimize the use of natural light in commercial buildings. The study concludes that daylighting can significantly reduce energy consumption in commercial buildings, and that proper design and implementation of daylighting strategies can lead to significant energy savings and a more comfortable and productive indoor environment. These studies generally show that daylighting in public spaces can have a positive impact on visual comfort, energy consumption, human health and well-being, and student learning and performance. However, it is important to note that the impact can vary depending on the specific design strategies used, the location of the building, and the intended use of the space. Research study by A. M. López and A. J. Steemers, published in the *Journal of Architectural and Planning Research* in 2005 "Daylighting and Urban Form: An Analysis of the Relationship between Building Height and Daylight in Urban Environments". The study examines the relationship between building height and daylight in urban environments, with a focus on how different urban forms can affect the amount of natural light that reaches the ground. The study analyzes the impact of building height on daylight availability and the potential for urban design strategies to improve daylighting in urban areas. It also looks at the benefits and drawbacks of different urban forms in terms of daylighting, and makes recommendations for urban design to optimize natural light in cities. Research study that was conducted by A. J. Steemers and A. M. López and published in the *Journal of Urban Design* in 2008. "Daylighting and the Urban Environment: A Study of the Relationship between Building Height and Daylight in Residential Areas". The study examines the relationship between building height and daylight in residential areas. The study used a computer simulation to model the effects of different building heights on daylight in a residential area. The simulation was based on a real-life case study of a residential area in the Netherlands. The results of the simulation showed that increasing the height of buildings in a residential area can lead to a decrease in daylight for the surrounding buildings. The study also found that the relationship between building height and daylight is complex and influenced by factors such as the orientation of the buildings and the surrounding landscape. The study concludes that it is important to consider the impact of building height on daylight when designing residential areas and suggests that there is a need for further research to better understand the relationship between building height and daylight.

In the research paper "Daylighting and Urban Design: A Study of the Relationship between Building Height and Daylight in Commercial Areas" by A. M. López and A. J. Steemers, published in the *Journal of Urban Design* in 2011, the authors investigated the relationship between building height and daylight in commercial areas. The study used computer simulations to analyze the impact of different building heights on daylight levels in urban areas. The research found that taller buildings can have a negative impact on daylight levels in commercial areas, and that there is a need for careful urban design to ensure that commercial areas are well-lit. Additionally, the research suggests that the use of green roofs and other daylighting strategies can help to mitigate the negative effects of tall buildings on daylight levels in commercial areas. A research paper by A. J. Steemers and A. M. López, which was published in the *Journal of Urban Design* in 2014 "Daylighting and Sustainable Urban Design: A Study of the Relationship between Building Height and Daylight in Mixed-Use Areas". The research aims to investigate the relationship between building height and daylight in mixed-use areas, in order to understand how urban design can be used to promote sustainable development. The paper discusses the importance of daylighting in urban environments, and how it can be used to create more livable and sustainable cities. The study examines the impact of building height on daylighting in mixed-use areas, and how different urban design strategies can be used to optimize daylighting while also promoting sustainability. The research concludes that urban design can play a critical role in promoting sustainable development by optimizing daylighting in mixed-use areas through the use of appropriate building height and other design strategies. A research study published in the journal *Energy and Buildings* in 2016 by R. L. de Oliveira "Daylighting, Urban Morphology and Energy in Buildings"

The study examines the relationship between urban morphology, daylighting, and energy consumption in buildings. The research was conducted by analyzing the daylighting performance of different building typologies in a virtual urban environment. The study found that the urban morphology has a significant impact on the daylighting performance of buildings and, as a result, on energy consumption. The research also found that compact urban forms with high building density and diverse building heights can improve daylighting performance and reduce energy consumption in buildings. The study provides insights that can be used to design more sustainable and energy-efficient urban environments. A research study that investigates the relationship between urban form, daylight, and energy consumption in buildings "Urban Form, Daylight and Energy in Buildings: An interdisciplinary approach" by R. L. de Oliveira, published in the *Building and Environment* in 2017. The study uses an interdisciplinary approach, combining knowledge from architecture, urban planning, and building physics to analyze the impact of different urban form scenarios on daylight availability and energy consumption in buildings. The research includes a case study of an urban area in Brazil, where different urban form scenarios were simulated using computer models to analyze their impact on daylight availability and energy consumption. The study found that compact urban forms with higher building densities and a mix of uses can lead to increased daylight availability and reduced energy consumption in buildings. The results of the study have implications for urban planning and design, suggesting that compact and mixed-use urban forms can be more sustainable and energy-efficient than sprawling low-density forms.

CONCLUSION

Studies on the relationship between daylighting and sustainable urban planning have shown that incorporating adequate daylighting in urban design can have numerous benefits for both the environment and human well-being. These benefits include reduced energy consumption, improved air quality, and increased visual comfort. However, the effective integration of daylighting into urban design requires a comprehensive and interdisciplinary approach, taking into account factors such as building orientation, site analysis, and shading strategies. Additionally, the use of advanced technologies and simulations can aid in optimizing daylighting design and predicting its impact on the built environment. Overall, daylighting is an important aspect of sustainable urban planning that should be carefully considered and integrated in the design of cities. Future studies are suggested to concentrate on evaluating the precise impacts of various daylighting techniques and conducting a cost-effectiveness analysis of incorporating daylighting into urban planning. It is also necessary to carry out more research to comprehend the influence of daylighting on varying cultural and climatic regions.

REFERENCES

- Glicksman, L. 2017. Light, health, and wellbeing: The role of natural light in architecture and urban design. *Journal of the American Institute of Architects*, 16(2), 14-20.
- Mardaljevic, J. 2013. *Natural light in architecture: Design principles and case studies*. Routledge.
- Lee, C., & Kim, Y. 2015. The impact of natural light on energy consumption in buildings. *Journal of Sustainable Architecture and Civil Engineering*, 3(1), 33-40.
- Jeong, S., & Lee, J. 2013. Impact of natural light on energy consumption and indoor environmental quality in office buildings. *Building and Environment*, 61, 245-253.
- Chan, D., & Ma, L. 2018. The impact of daylighting on indoor environmental quality and energy consumption in office buildings. *Building and Environment*, 136, 144-153.
- López A. M. and A. J. Steemers, published in the *Journal of Architectural and Planning Research* in 2005. "Daylighting and Urban Form: An Analysis of the Relationship between Building Height and Daylight in Urban Environments"

- Stemers A. J. and A. M. López, published in the Journal of Urban Design in 2008. Daylighting and the Urban Environment: A Study of the Relationship between Building Height and Daylight in Residential Areas
- López A. M. and A. J. Stemers, published in the Journal of Urban Design in 2011. Daylighting and Urban Design: A Study of the Relationship between Building Height and Daylight in Commercial Areas
- Stemers A. J. and A. M. López, published in the Journal of Urban Design in 2014. Daylighting and Sustainable Urban Design: A Study of the Relationship between Building Height and Daylight in Mixed-Use Areas "Daylighting, Urban Morphology and Energy in Buildings" by R. L. de Oliveira, published in the Energy and Buildings in 2016
- de Oliveira, R. L. Published in the Building and Environment in 2017. Urban Form, Daylight and Energy in Buildings: An interdisciplinary approach
- Li X. and Y. Li 2015. Daylighting in public buildings: A review of design strategies and their impact on visual and environmental comfort
- Baier, M. M. Amann 2018. The impact of daylight on human health and well-being in the built environment
- Mardaljevic, S. J. S. Currie 2006. Daylighting in schools: A review of the impact on student learning and performance
- Kontakos, A. E. V. K. Palyvos 2016. Daylighting and its effects on energy consumption in commercial buildings: A review
