Educational Administration: Theory and Practice
2024, 30(1), 7624-7628
ISSN: 2148-2403
https://kuey.net/

Research Article

Visibility Evaluation Of Open Space Vs. Building Arrangement Using Simplified Area Evaluation Technique

Sagar T S[1*], Vivek Appu[2]

[1*]Associate professor, school of architecture, Siddaganga institute of technology, Tumkauru. Email: sagarts@sit.ac.in
[2]Undergraduate student, school of architecture, Siddaganga institute of technology, Tumkauru

Citation: Sagar T S, et.al (2024). Visibility Evaluation Of Open Space Vs. Building Arrangement Using Simplified Area Evaluation Technique, *Educational Administration: Theory and Practice*, 30(1) 7624-7628
Doi: 10.53555/kuey.v30i1.10794

ARTICLE INFO

ABSTRACT

This study investigates the relationship between building arrangements and the visibility of open spaces using a simplified area evaluation technique. Visibility in urban environments is a crucial factor that influences natural surveillance, privacy, social interaction, and overall quality of life. Traditional visibility analyses often focus on qualitative observations; however, this research adopts a quantitative approach to measure visual accessibility. A hypothetical urban site was modeled with multiple building configurations, including linear, L-shaped, U-shaped, S-type, and rectangular forms. Using digital tools such as DepthmapX, AutoCAD, and SketchUp, simulations were conducted to calculate the percentage of visible open space from various building facades. Results revealed that the L-shaped arrangement provided the highest visibility (63%), while more enclosed or parallel rectangular configurations resulted in reduced openness (34–46%). The findings highlight that spatial morphology strongly influences visual connectivity, shaping residents' experience of openness and privacy. The proposed simplified area evaluation method proves to be efficient, accessible, and adaptable for preliminary urban design processes, particularly for students and practitioners seeking to optimize spatial layouts without relying on highly complex computational tools. By linking visibility with perceptual conviviality and well-being, this study contributes to the broader discourse on sustainable and livable urban environments. Future phases of this research will integrate shading and microclimatic factors to complement visibility analysis, offering a more comprehensive framework for design decisions that balance environmental performance, social needs, and architectural form.

Keywords: Visibility analysis, Open space design, Building arrangement, Urban morphology, Simplified area evaluation

Introduction

The intricate relationship between the arrangement of built structures and the resulting visibility within open spaces significantly influences urban planning, architectural design, and human perception of the environment (Fenghour et al., 2022). This study introduces a simplified area evaluation technique to quantitatively assess the visibility dynamics in various urban configurations, offering a novel approach to understanding how architectural massing impacts visual permeability and openness. This technique extends traditional viewshed analyses by incorporating nuanced factors such as atmospheric attenuation and contextual visual cues, which are critical for a comprehensive understanding of visibility in complex urban settings (Schwartz et al., 2021) (Garnero & Fabrizio, 2015). Such an evaluation is crucial for enhancing the quality of urban life, as visibility directly affects aspects like natural surveillance for crime prevention, access to natural light, and the psychological comfort of inhabitants within a given space (Fenghour et al., 2022). Furthermore, the presented methodology aims to provide designers and planners with an accessible tool for optimizing visual connections to outdoor elements, thereby fostering biophilic environments and enhancing occupant well-being (Parsaee et al., 2021). The study encompasses the visibility and accessibility of various facilities and open spaces, alongside their integration with built structures. Through the application of digitalized tools, including Depthmap, AutoCAD and SketchUp, simulations were conducted to investigate the interplay between building

arrangements and both interior and exterior spaces. Various scenarios were tested to determine optimal building configurations. This research addresses the need for robust analytical methods to quantify and interpret visibility, moving beyond qualitative assessments to provide actionable data for urban design (Zhu et al., 2019). Specifically, this technique allows for a systematic analysis of how alterations in building height, massing, and spatial distribution affect the visual corridors and the extent of observable open areas, contributing to a more informed design process (Sarihan, 2021). This simplified technique offers a powerful means to evaluate the efficacy of different urban layouts in terms of visual accessibility and spatial legibility, thereby directly impacting the perceptual conviviality and overall quality of residential and public environments (Thombre & Kapshe, 2020) (GUJAR et al., 2022).

Literature Review

2.1 Significance of Open Spaces

The academic discourse surrounding "open space" reveals a spectrum of definitions. Primarily, it denotes undeveloped land such as parks, greenbelts, and natural reserves utilized for recreation, conservation, and habitat preservation(Berg et al., 2015). Concurrently, it extends to abstract notions like open-plan office layouts, open-source software, and open access to information. Open spaces also function as vital socio-cultural arenas, fostering community engagement and cultural events(Fejza, 2022; Muliasari et al., 2021). Research consistently indicates that accessibility to open spaces positively influences individual and community health and well-being. Proximity to green spaces, for instance, has been correlated with enhanced physical health through increased physical activity and improved air quality(Muqueeth, 2021). Furthermore, engagement with open spaces demonstrates a beneficial impact on mental health, with natural environments providing a calming effect and mitigating stress(Nguyen & Cicea, 2021).

Within urban planning and design, open space plays a pivotal role. In densely populated urban settings, these areas serve to counteract the detrimental effects of urbanization, including air and noise pollution, urban heat island phenomena, and biodiversity loss(Pal et al., 2023). Thoughtfully designed open spaces act as desirable and functional amenities, potentially increasing property values and bolstering local economies. In summary, open spaces offer multifaceted benefits to urban environments, encompassing improvements in health, well-being, environmental sustainability, and community development. Nevertheless, the preservation and creation of urban open spaces present considerable challenges, necessitating innovative strategies from urban planners and designers.

2.2 Importance of Visual Exposure

A relationship between visual exposure and the visual openness of spaces, defining these metrics based on viewing distances and facade openings, has been established (Schwartz et al., 2021). Visual exposure is distinguished as pertaining to shorter viewing distances, whereas visual openness is associated with longer viewing distances. It is pertinent to note that while prior research often examined visibility from street level, this study's focus is on visibility from within buildings overlooking open spaces.

An analysis of visual exposure in two dimensions across building levels and in three dimensions between them is conducted, performing a comprehensive review of both visual exposure and openness (Rizi et al., 2023). This reference proposes a quantitative approach to visual exposure, identifying influential factors such as window placement, the height of facade openings relative to adjacent structures, building orientation, site layout, entrance door positioning, and functional distribution.

Notwithstanding the literature that identifies the distance between buildings as a primary determinant of visual exposure, a comprehensive methodological framework elucidating the connection between building separation and viewing distances was not identified. Newell posits that visual exposure is intrinsically linked to visual privacy, a concept whose inherent complexity has precluded a universally agreed-upon definition, noting that privacy is strongly influenced by the proximity of facing windows and buildings.

2.3 Visual Openness

Visual openness is conceptualized as the degree to which an environment permits the unimpeded flow of visual information and perceptual experiences(Parsaee et al., 2021). This architectural and urban design principle pertains to the visibility and transparency of building facades and interior spaces, significantly shaping the perceived quality of built environments and influencing social interaction, urban vitality, and environmental sustainability(Sadeghi et al., 2015). Empirical evidence suggests that visually open environments positively affect well-being, health, and happiness by promoting social interaction and offering visual stimulation(Rossetti et al., 2018). Studies have indicated that visually open spaces incorporating green elements can enhance mental health, reduce stress, and improve mood.

Conversely, visually enclosed environments can engender feelings of confinement, isolation, and heightened stress. A deficit in visual openness can also impair situational awareness, potentially increasing crime rates and diminishing safety(Hooper et al., 2023).

From a sustainability perspective, visually open environments contribute to reduced energy consumption by maximizing natural light and ventilation, thereby lessening reliance on artificial lighting and climate control systems. Furthermore, these environments can elevate the quality of urban life by improving air quality, reducing noise pollution, and facilitating community interaction.

It is crucial to recognize that visual openness is not solely a physical attribute but is also modulated by cultural and social factors. For instance, prevailing attitudes toward privacy and personal space influence the extent of visual openness within a given context. Moreover, the visual openness of an environment can evolve dynamically with changes in its surrounding context.

In conclusion, visual openness is a multifaceted concept with significant implications for the quality of the built environment and the well-being of its occupants. Further research is warranted to comprehensively understand the effects of visual openness and its effective integration into urban design and architecture to foster more dynamic, sustainable, and livable communities.

Methodology

3.1 Simplified Area Evaluation

Simplified area evaluation refers to a method of estimating the area of a polygon by dividing it into simpler geometric shapes, such as rectangles or triangles, and summing their areas. This technique is particularly valuable in urban planning, where rapid assessment of spatial configurations is essential for preliminary design iterations and impact analyses (Pawestri et al., 2019). This approach offers a pragmatic solution for quantifying visual fields and assessing the effective visible area from various viewpoints within a built environment, providing a foundation for evaluating visibility in relation to building arrangements and open spaces

3.2 Application of Simplified Area Evaluation

The simplified area evaluation can be applied in various research studies, such as urban planning, architects, students, public health, and social sciences. This evaluation technique can quantify visual penetration, thereby assessing the quality of a building opening's visual privacy by measuring the potential visual exposure index (Zheng et al., 2021).

3.3 Selection of Site and Arrangement of Building

The study site is a hypothetical urban location. The researcher selected an undeveloped plot to propose a building arrangement, which was then simulated using DepthmapX to aid in the development or refinement of design guidelines for the specific area. Any proposed building configuration will undergo testing against multiple criteria in each simulation due to the site's importance.

The site is rectangular and surrounded by open spaces on all sides. To enable a comparison of results from various site options, the researcher previously conducted a study on the same site. Several building configurations were proposed, and simulations were run to determine the optimal arrangement for maximizing the visible open space from within the buildings.

In this investigation, the following building arrangements were assessed: a linear configuration, an L-shaped arrangement, a U-shaped arrangement, an S-Type arrangement, and two rectangular configurations (one separated and one contiguous). The researcher employed the same site with different building layouts to ascertain the proportion of visible open space.

By comparing the simulation outcomes, the aim is to identify the building arrangement that simultaneously optimizes open space visibility. The overarching goal is to improve the quality of life for residents, visitors, and pedestrians who collectively use the area, rather than focusing on a single factor. This comprehensive approach aligns with the principles of space syntax, which emphasizes how spatial configurations influence human behavior and perceptions, including visual privacy and exposure (Suryadi et al., 2022) (Şalgamcıoğlu, 2021).

3.4 Methodology

The research adopts a straightforward yet effective methodology for evaluating visibility, which does not necessitate sophisticated software or advanced computational programs. This approach is also advantageous for students engaged in architectural design, particularly concerning window placement and spatial distribution, and in urban design when proposing building configurations and forms. This paper's central aim is not to examine building openness but rather to investigate the visibility of open space as perceived from the facades of adjacent structures.

Visibility simulations are conducted for each plan, analyzing the visual access from the front, back, right, and left sides of every building enclosing the open space. Following the simulation of each building facade that faces the open space within the scenario, a calculated percentage quantifies the proportion of visible open space from these facades. This approach enables a comparative analysis of different building arrangements to determine their impact on visual connectivity and the perceived openness of the urban environment (Fenghour et al., 2022). This technique quantifies visual exposure related to spatial configuration and can be used to evaluate and implement urban privacy issues in development (Zheng et al., 2021). This methodology provides a robust framework for assessing how different building arrangements influence the perception and actual availability of open space, thereby contributing to more informed urban planning and design decisions (Noblejas et al., 2021).

Results and Discussion

The findings from the simplified area evaluation technique reveal distinct differences in the visibility of open space across various building arrangements, confirming the influence of spatial morphology on perceived openness and privacy.

The simulation results for different building prototypes show varied percentages of visible open space depending on their layout and orientation. The L-shaped building arrangement allowed for 63% visible open space, while the U-shaped building achieved 46%. Rectangular configurations showed 40% and 43% respectively, with a parallel arrangement to the longer side yielding 34%. The S-shaped building resulted in 45% visible open space. The L-shaped configuration provides the best visibility of open spaces, likely because its design creates more open areas and voids suitable for social or physical activities. This layout seems more appropriate for residential use, aiming to improve the quality of life for all users by maximizing the perception and access to open spaces on all floors. Conversely, layouts that feature more enclosed or constrained arrangements, such as certain rectangular or parallel configurations, demonstrated reduced visual exposure to open spaces, potentially impacting user experience and limiting opportunities for engagement (Mei & Schroth, 2019). These findings underscore the critical role of urban morphology in shaping the visual experience within built environments, directly impacting factors such as privacy and social interaction (Zerouati & Bellal, 2019) (Zheng et al., 2021).

Conclusion

This research demonstrates that the simplified area evaluation technique effectively quantifies the impact of urban morphology on the visibility of open spaces, providing valuable insights for urban planners and designers. This paper constitutes the second phase of a research initiative focused on assessing various building configurations against the metric of open space visibility, quantified by the visible area from surrounding structures. The study aimed to identify the optimal building arrangement by comparing and integrating simulation results, seeking a design that simultaneously maximizes both outdoor shading and open space visibility. The current phase exclusively focuses on the visibility aspect, with future work planned to integrate shading analysis for a comprehensive understanding of urban microclimates. This ongoing investigation contributes significantly to the body of knowledge concerning urban morphology, particularly in understanding how building arrangements influence microclimatic conditions and the psychological well-being of inhabitants through visual connectivity to open areas . Simulation outcomes indicate that the L-shaped building configuration offers superior visibility of open spaces, potentially enhancing its economic viability. This arrangement is particularly well-suited for residential developments, offering additional outdoor areas conducive to social interaction, physical activities, and recreation.(Hui-min et al., 2019).

References

1. Berg, M. van den, Wendel-Vos, W., Poppel, M. N. M. van, Kemper, H. C. G., Mechelen, W. van, & Maas, J. (2015). Health benefits of green spaces in the living environment: A systematic review of epidemiological studies [Review of *Health benefits of green spaces in the living environment: A systematic review of epidemiological studies*]. *Urban Forestry & Urban Greening*, *14*(4), 806. Elsevier BV. https://doi.org/10.1016/j.ufug.2015.07.008
2. Fejza, A. (2022). Spatial Elements that Create the Quality Public Space. *Igra Ustvarjalnosti - Creativity Game*, 14. https://doi.org/10.15292/iu-cg.2022.10.014-021
3. Fenghour, A., Hamouda, A., & Benyahia, L. (2022). ENCLOSURE OF OUTDOOR SPACES IN A RESIDENTIAL ENVIRONMENT BETWEEN VISIBILITY AND ACCESSIBILITY. *Arquitetura Revista*, *18*(1), 99. https://doi.org/10.4013/arq.2022.181.06
4. Garnero, G., & Fabrizio, E. (2015). Visibility analysis in urban spaces: a raster-based approach and case studies. *Environment and Planning B Planning and Design*, *42*(4), 688. https://doi.org/10.1068/b130119p

5. GUJAR, S., Deshmukh, A. M., & CHIVATE, A. (2022). THE ROLE OF OPEN-BUILT SPACE MORPHOLOGY IN RESIDENTIAL ENVIRONMENT QUALITY ASSESSMENT OF CLUSTER HOUSING. *METU Journal of the Faculty of Architecture*, *39*(2). https://doi.org/10.4305/metu.jfa.2022.2.5
6. Hooper, P., Kleeman, A., Edwards, N., Bolleter, J., & Foster, S. (2023). The architecture of mental health: identifying the combination of apartment building design requirements for positive mental health outcomes. *The Lancet Regional Health - Western Pacific*, *37*, 100807. https://doi.org/10.1016/j.lanwpc.2023.100807
7. Mei, L., & Schroth, O. (2019). Assessment of Aesthetic Preferences in Relation to Vegetation-Created Enclosure in Chinese Urban Parks: A Case Study of Shenzhen Litchi Park. *Sustainability*, *11*(6), 1809. https://doi.org/10.3390/su11061809
8. Muliasari, I. G. A. D., Suartika, G. A. M., & Saputra, K. E. (2021). Conversion of Public Green Open Spaces to Facilitate the Tourist Industry. *IOP Conference Series Earth and Environmental Science*, *903*(1), 12011. https://doi.org/10.1088/1755-1315/903/1/012011
9. Muqueeth, S. (2021). Parks: A vital community condition. *Parks Stewardship Forum*, *37*(1). https://doi.org/10.5070/p537151742
10. Nguyen, T. H. T., & Cicea, C. (2021). Green Space and Its Role to Improve Social and Economic Development for a Better Quality of Life. *MANAGEMENT AND ECONOMICS REVIEW*, *6*(1), 49. https://doi.org/10.24818/mer/2021.06-04
11. Noblejas, H. C., Barrionuevo, J. F. S., Muñoz, D. G., & Rodríguez, M. F. M. (2021). A Methodological Proposal for the Analysis of Lighting the House Building Façades. *ISPRS International Journal of Geo-Information*, *10*(8), 536. https://doi.org/10.3390/ijgi10080536
12. Pal, T., Paul, A., & Maiti, C. (2023). Analysis of Urban Green Spaces using Geospatial Techniques: A case study of Chandannagar Municipal Corporation, Hugli, West Bengal, India. *World Journal of Advanced Research and Reviews*, *19*(3), 370. https://doi.org/10.30574/wjarr.2023.19.3.1750
13. Parsaee, M., Demers, C. M. H., Potvin, A., Hébert, M., & Lalonde, J. (2021). Window View Access in Architecture: Spatial Visualization and Probability Evaluations Based on Human Vision Fields and Biophilia. *Buildings*, *11*(12), 627. https://doi.org/10.3390/buildings11120627
14. Pawestri, S., Soemardiono, B., & Defiana, I. (2019). Rearrangement Public Corridor within Green Concept and Sustainability Case Study of Mayjen Yono Suwoyo Street, Surabaya, Indonesia. *International Journal of Engineering Research and Advanced Technology*, *5*(7), 85. https://doi.org/10.31695/ijerat.2019.3528
15. Rizi, R. A., Sangin, H., chobari, K. H., Eltaweel, A., & Phipps, R. (2023). Optimising Daylight and Ventilation Performance: A Building Envelope Design Methodology. *Buildings*, *13*(11), 2840. https://doi.org/10.3390/buildings13112840
16. Rossetti, T., Löbel, H., Rocco, V., & Hurtubia, R. (2018). Explaining subjective perceptions of public spaces as a function of the built environment: A massive data approach. *Landscape and Urban Planning*, *181*, 169. https://doi.org/10.1016/j.landurbplan.2018.09.020
17. Sadeghi, G., Sani, R. M., & Wang, Y. (2015). Symbolic Meaning of Transparency in Contemporary Architecture: An Evaluation of Recent Public Buildings in Famagusta. *Current Urban Studies*, *3*(4), 385. https://doi.org/10.4236/cus.2015.34030
18. Şalgamcıoğlu, M. E. (2021). A Methodology approach for the comparison of cases in space syntax and morphology studies. *Journal of Design for Resilience in Architecture and Planning*, *2*(1), 86. https://doi.org/10.47818/drarch.2021.v2i1013
19. Sarihan, E. I. (2021). Visibility Model of Tangible Heritage. Visualization of the Urban Heritage Environment with Spatial Analysis Methods. *Heritage*, *4*(3), 2163. https://doi.org/10.3390/heritage4030122
20. Schwartz, M., Vinnikov, M., & Federici, J. F. (2021). Adding Visibility to Visibility Graphs: Weighting Visibility Analysis with Attenuation Coefficients. *arXiv (Cornell University)*. https://doi.org/10.48550/arxiv.2108.04231
21. Suryadi, A. S. A., Mohidin, H. H. B., Aminuddin, A. M. R., & Sediadi, E. (2022). The Spatial Visibility within the Low-income Housing Living Unit. *Environment-Behaviour Proceedings Journal*, *7*(19), 299. https://doi.org/10.21834/ebpj.v7i19.3269
22. Thombre, L., & Kapshe, C. (2020). Understanding Contribution of Physical Accessibility in Perceptual Conviviality of Public Open Spaces using Analytical Hierarchy Process. *International Journal of Innovative Technology and Exploring Engineering*, *9*(4), 2798. https://doi.org/10.35940/ijitee.d1671.029420
23. Zerouati, W., & Bellal, T. (2019). Evaluating the impact of mass housings' in-between spaces' spatial configuration on users' social interaction. *Frontiers of Architectural Research*, *9*(1), 34. https://doi.org/10.1016/j.foar.2019.05.005
24. Zheng, H., Wu, B., Wei, H., Yan, J., & Zhu, J. (2021). A Quantitative Method for Evaluation of Visual Privacy in Residential Environments. *Buildings*, *11*(7), 272. https://doi.org/10.3390/buildings11070272