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ISOVIST POLYGON IN REGARD TO VIEWING DISTANCE AS A REFERENCE FOR SOFTBALL STADIUM MOVEMENT SPACE ACHIEVEMENT

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ABSTRACT

Stadium spatial planning should always include circulation access for all users. Circulation routes must be clearly differentiated for spectators, players, and stadium management. This separation of access is intended to prevent conflicts between different spatial functions. The circulation in question refers to entry and exit access within the softball stadium building. With the numerous access points and rooms in the facility, clear identification signs (signage) are essential to help users quickly understand their surroundings and navigate to their destinations. In terms of layout, the softball stadium includes several spaces and rooms designed to support all visitor activities. Generally, a good building must have better spatial pattern arrangement, this can be assessed by measuring the sight distance that affects the achievement of space for movement. As a primary requirement for a stadium where human movement in the building must be fast in circulation, access in and out is a crucial part. The method used to answer this problem uses isovist polygons, where the results of data analysis from previous studies are incorporated to determine sight distance through the point of achieving spatial syntax. If previous research produces connectivity, integrity, and clarity quantitatively through the study of space syntax in the softball stadium building. As a result, a computerized display pattern will be obtained for several sides of the softball stadium layout. Visibility, using recognition measurements using isovist polygons, measures the user reach within the softball stadium based on key points of user circulation.

Keywords: circulation, isovist polygon, movement space, sight distance, spatial planning

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INTRODUCTION

A stadium building must have easy accessibility, especially for the user's circulation that need to be fast and easy to find. The stadium must have a concept that is free of view to support the audience in watching the match with good circulation from outside to inside the stadium (H. A. Putra, 2013). The stadium building must implement comfort and safety to satisfy the audience in the form of space facilities inside. (H. A. Putra, 2013). Through the isovist polygon by looking at the visibility, it is expected that users, especially spectators who are in the building, can easily figure out the distance between spaces. The scale for a stadium with a capacity of that size is quite large so that it requires special handling and assessment related to the spatial pattern of people's visibility, in this case, especially spectators, related to ease of access inside the stadium building. In general, stadium planning must consider the effectiveness of audience viewpoints, which can be evaluated using previous research data that includes connectivity, integration, and intelligibility values obtained through spatial syntax. Therefore, this study conducts a re-evaluation to determine the accuracy and effectiveness of isovist polygons in representing the viewpoints of spaces within the stadium building.

Buildings are inseparable from the spaces within them, which are organized in the form of a floor plan layout. The core and territory can be determinants for the placement of spatial configuration patterns (Irwanuddin, 2018). Space in a building must be able to accommodate the right number of people who will use the space, space limitations and capacity are references in understanding spatial studies. Achieving efficiency and effectiveness in a space can also be used with the concept of a mix-use approach. (Alkhodri, 2004). The space presented must implement an understanding of effectiveness and efficiency so that dead space does not occur and can maximize the scope according to its function. The design of activities in a building space is influenced by image, security, location, comfort, courage, flexibility, intimacy, clarity, and socio-cultural conditions. (Saputri et al., 2022). Interior space must adjust the sequence or axis clearly to enter a building, in addition, the maximum space organization must be arranged linearly (Prastowo et al., 2019). In theory, interior space has a story/context that is tailored to its flow and function. The experience and quality of space have several aspects, namely spatial intelligence and temporality/memory & sequence. (Clarke, 2012). Circulation can be a connection between spaces in several ways, including passing through spaces and through spaces that penetrate (Ching, 2007). Behavior mapping is used to determine the configuration of space based on existing movements with known points or nodes (Siregar, 2014). Territoriality is a data processing technique by means of documentation and content analysis (Purwanto & Santosa, 2021). The use of isovist analysis can be used to identify

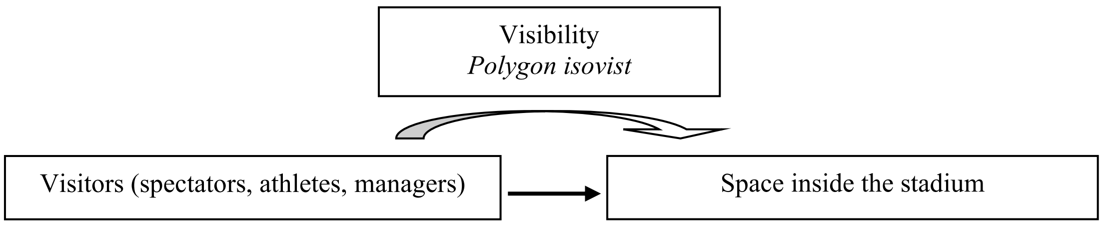

Figure 1. Problem solving achievement patterns
(Source: Reseacher, 2023).

the potential and configuration of space in order to obtain output data in the form of a description of the movement of community accessibility (Kustiani & Khidmat, 2022).

Isovist polygon is a state of the observer's ability to see which is depicted from one point of convex space with its surroundings because there is a main movement in that space (H[1] & Kusliansjah, n.d.). *Isovist polygons are related to the syntax of space, which is used to measure spatial quality in relation to the configuration of space. The utilization of space can run optimally with spatial logic which is useful for seeing the direction of development of a space* (Romdhoni, 2018). Graphic methods can be used as a basis for building sustainable designs (Arinto, 2018). Through the syntax of space, the value of the starting point and the meeting point between several space functions for the users within it can be known (Husni, 2019). Isovist is efficient in predicting individual behavior with certain geometric and scale limitations (DONG et al., 2017). MAS (Multi-Agent Simulation) and VGA (Visual Graphic Analysis) are parameters in development to determine the layout in the implementation of DepthMap (Turner, 2001). Isovist itself in the field of architecture can control views, privacy, limitations, and assessments of complexity and dynamic areas (Benedikt, 1979). Connectivity analysis shows how well an area or room can be connected and integrated with others, while visual control analysis selects visually dominant areas and those areas should see many spaces but each room should see relatively few. Accessibility between spaces to support user activities in the building must be easily achieved with a good level of spatial configuration based on zoning and distribution quality. (H. A. Putra & Hastorahmanto, 2023).

METHODS

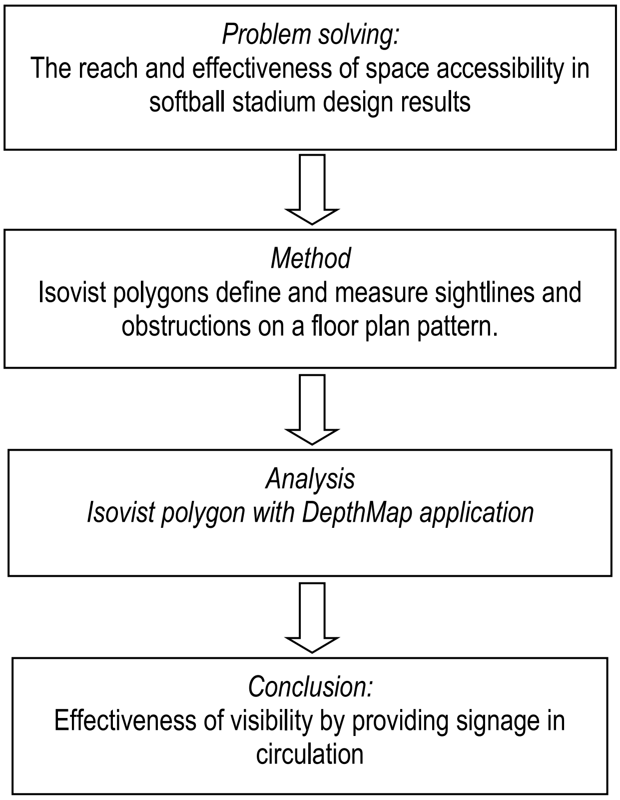

Figure 2. Research flow chart
(Source: Reseacher, 2023).

The test was carried out using the DepthMap application to determine the direction and distance of the audience's view of the existing spaces. Analysis of this view is to determine the suitability of the spatial configuration pattern with the viewer regarding its layout to make it easier to reach the spaces within it. Orientation and mobility are very necessary, especially in public buildings to facilitate user accessibility within them (Setiawan et al., 2019). Sight distance can emphasize overall visibility in the area inside the building by providing direction signs and architectural features (Natapov et al., 2022). Isovist polygons in the DepthMap application are used to draw lines to determine the viewing distance of spectators to the spaces inside. The point of crowd that is the center of the connectivity data in the building's space syntax is taken as a reference in placing points/nodes for further data processing using isovist polygons (H. A. Putra & Hastorahmanto, 2023). Through connectivity analysis, effective viewing points for visitors inside the softball stadium building can be identified. The purpose of the data obtained is to determine how easily spectators can visually access and understand the different spaces within the stadium. All stages are carried out by referring to the research flow diagram as shown in Figure 6. Open spaces in buildings have good visual stimuli (such as color, furniture and decoration) to increase the level of visibility in reaching (Exora et al., 2022). Accelerating the movement of accessibility of space while inside the softball stadium building can be done by providing names and signs based on zoning divisions (H. Putra & Hastorahmanto, 2024).

RESULT AND DISCUSSION

The large number of visitors that can be accommodated in a softball stadium building requires easy accessibility and control of views from one point to another. In addition to the large number of stadium capacities, softball stadium buildings also have quite large shapes. So that connectivity between spaces must be maintained with visuals related to good visibility so that they are easily accessible by visitors. By using DepthMap connectivity data obtained from previous studies, it is reviewed again regarding display control, privacy, limitations and complexity of an accessibility flow in the stadium space (H. A. Putra & Hastorahmanto, 2023). The main data collection from connectivity to study user visibility in the building so that a visual isovist polygon graph is obtained.

The highest connectivity value indicates the potential to be a direct connection center in a building (Wijaya et al., 2024). Areas with low connectivity experience more spatial isolation than areas with high levels of accessibility (Pratama & Asikin, 2025). The user's movement flow is greatly influenced by the presence of clear wayfinding in the form

Table 1. Visibility Area Of Each Floor Based On Connectivity

Floor Name	Building Floor Area	Wide Viewing Area	Percentage of Visibility Coverage
Floor 1 (car park)	4903,41m2	3530,46m2	72%
Floor 2 (lobby)	3273,54m2	1342,14m2	41%
Floor 3 (tribun area)	2190,35m2	2015,12m2	92%
Floor 4 (foyer)	136,21m2	114,42m2	84%

Source: Researcher, 2023

of graphic and structural design (Sari & Bomo, 2022). Stadiums should have clear directions of sight, especially for spectators accessing the various spaces within. The floor plan should be as free as possible from partitions and should be limited only by columns as vanishing points for users' visibility. Table 1 above shows that the second floor has the lowest visibility, at 41%. This is because there are numerous partitions and other obstructions to visibility on that floor, requiring signage for wayfinding. However, the third floor offers the clearest view without any obstructions, with a coverage percentage of 92%.

With the large number and size of the softball stadium layout, it is necessary to conduct a study related to the visitor's visibility in the stadium for each floor as a form of supporting ease of accessibility for visitor activities while in the building. Based on Figure 3, the isovist polygon analysis using DepthMap with a 360° view on the first floor shows that visibility for visitors is clear and unobstructed. This is because the majority of the floor area is occupied by the parking lot, allowing for free and open lines of sight. This ease of view can provide effectiveness for visitors in finding a parking space with a very wide and far radius. In addition, visitors who bring their own cars can also see the entry and exit of the parking lot in the building easily. The viewing area that is closed or cannot be seen easily (very limited visibility) is only in the area near the foyer accessing the escalator. This location is because the escalator closes the visitor's view when viewed from the point/node of the connectivity results at the end (center of the inner curve). For the 1st floor, it is included in the category of connecting circulation between spaces through boundaries, where the space works axially and is able to accommodate large movements (vehicles) in it.

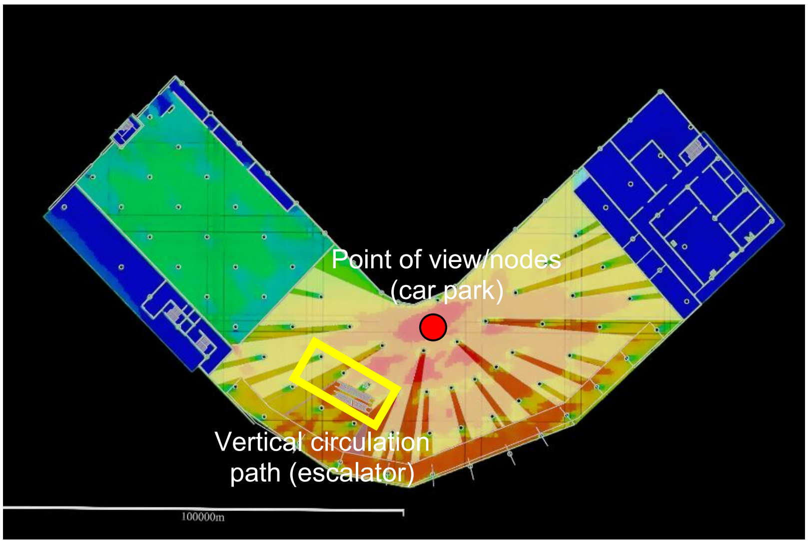

Figure 3. Generating location polygon isovist softball stadium floor plan 1 (Source: Researcher, 2023).

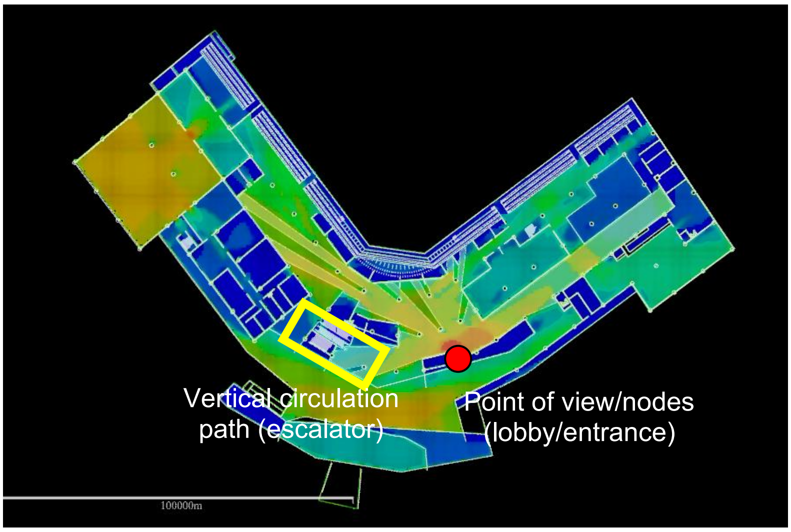

Figure 4. Generating location polygon isovist softball stadium floor plan 2
(Source: Researcher, 2023).

The 2nd floor plan of the softball stadium building consists of several rooms that have more complex functions, as seen in the figure 4. On this floor, the majority is a zone area for visitors who act as spectators of the match. However, on this floor there is also a more private zone and is intended for athletes, stadium management staffs and softball sports associations. In addition, with the point/node of view located at the entrance to the ticket sales area, visitors can see several spaces that are not limited or obstructed. By paying attention to the point/node and distance at that point, visitors' views can reach the inside of the side access entry to the spectator stands. The viewing area is very freely accessible to the audience by emphasizing the results of data connectivity, circulation to service areas such as toilets and several indoor game room areas can be easily recognized and understood by visitors as directions. This 2nd floor is included in the type of circulation category connecting between spaces through the track space, where there are permanent spaces connected by circulation paths.

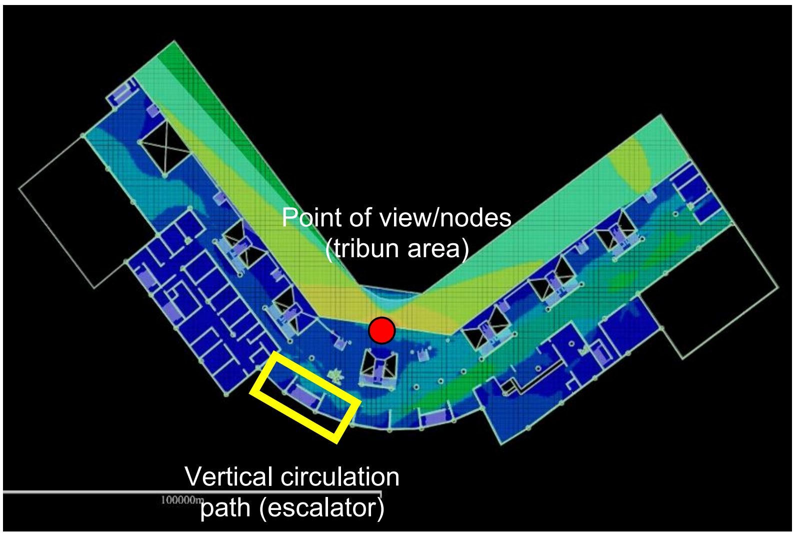

Figure 5. Generating location polygon isovist softball stadium floor plan 3
(Source: Researcher, 2023).

Based on the results of the DepthMap connectivity on the 3rd floor, where the largest visitor viewpoint/node is in the spectator stands or precisely in the inner curved area (see Figure 5). When viewed based on the results obtained from the isovist polygon related to location generation, the distance of view obtained by visitors can be free without obstacles in observing and reaching other viewpoints. In addition, spectators follow a fixed and consistent circulation pattern between spaces, passing through transitional areas and sloped seating stands. As a result, on the 3rd floor, there are no significant privacy barriers or visual limitations for the audience when watching the softball match. In general, if a spectator is positioned at a different point within the stands, they can still freely view the field and other directions without obstruction.

On the 4th floor plan, it has a smaller area compared to several other floors, this is because this floor area is indeed only intended for VVIP guests or spectators. So, the level of privacy and security is high enough to facilitate high-profile guests or their class, as seen in the figure 6. The rooms presented on the 4th floor plan are not too many like the room for watching matches with vertical accessibility using a lift that is indeed intended for VVIP guests. The visibility on this floor also includes several rooms so that VVIP guests can easily reach the room. When examined in terms of circulation, the connecting space on the 4th floor is included in the type of transparent space where there are several scale rooms ranging from large to small, that can be monitored by visitors. This is related to the configuration of the space which is indeed intended for the private zone type. The point of view taken is based on the results of the connectivity analysis on the circulation path right in front of the lift area. So that this area becomes the gathering point and the most frequently passed viewpoint by visitors.

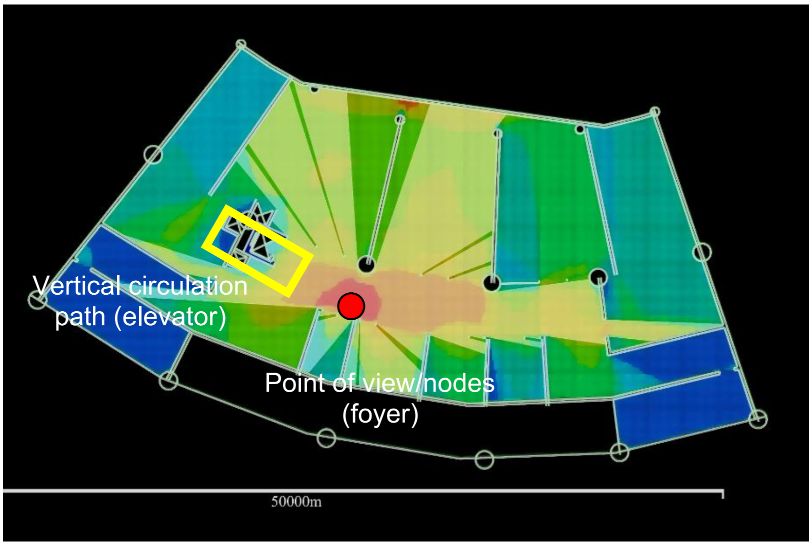

Figure 6. Generating location polygon isovist softball stadium floor plan 4 (Source: Researcher, 2023).

Table 2. Analysis Of Softball Stadium Visibility Characteristics

Building Floor	Aspects of Space Quality Experience	Circulation Aspects of Connecting Spaces	Study
Floor 1	*Spatial Intelligence*	Through Penetrating Space	The circulation path presented is almost entirely free (parking) without obstructions in the form of a combination of the use of space and the creation of movement within it and the visibility can be reached quite widely up to several zone areas.
Floor 2	*Temporality/Memory & Sequence*	Passing through space	The space presented is permanent by passing through circulation paths in the building and is interconnected with axial paths and the user's visibility is limited because there are many dividers and connections between spaces.
Floor 3	*Spatial Intelligence*	Through Penetrating Space	Appearing in the spectator stands section where the spaces formed are unobstructed and free in terms of visibility with sloping room conditions, besides that the presentation of the spatial experience on this floor is quite monotonous with the same and constant view.
Floor 4	*Temporality/Memory & Sequence*	Passing through space	With its small shape, this floor has limited visibility for users, this is because there are several room dividers consisting of various functions for their use and also the rooms are connected by connecting paths.

Source: Researcher, 2023

CONCLUSION

Stadiums are synonymous with complex buildings and have sufficient floor space to accommodate the capacity of spectators at each match. Each floor of the softball stadium building from the design work has its own function with various types of zones that have been determined. In general, the spaces presented in a softball stadium building must be interconnected from one point to another. In addition, it is also necessary to present space for visitors to feel and remember the circulation path passed. Points/nodes must accommodate each other's view distance so that they can recognize and know and feel the effectiveness of accessibility in the space for visitors. In general, a floor plan with a small allocation for movement activities with a tendency to stop at a point has a quality of spatial experience in terms of spatial intelligence with the concept of circulation of interconnectedness between spaces falling into the category of passing through space. This is reflected in the 1st and 3rd floors of the softball stadium which only have a stop and go system. Meanwhile, the 2nd and 4th floors have a quality of spatial experience in terms of temporality/memory & sequence, in addition, the interconnectedness of circulation between spaces is included in the category of passing through space. This is because the spaces on both floors have multiple functions, presented as public facilities with each zone designated for visitors. It can be concluded that in general, there is a need for spatial arrangement on each floor plan in a softball stadium building. Where on the floor there are many partitions with different room functions, a very clear circulation flow guide is needed so that users know and understand and memorize every rhythm of the movement flow. Meanwhile, on the floor of the building with minimal partitions for rooms, it can be easily memorized by visitors, because the form mostly already has circulation as a movement flow in the building. Not only is the calculation of the view distance used, but to facilitate visitors in the stadium in accessing the existing spaces, an identifier for each room is needed. Generally speaking, areas with high connectivity are areas that also have high visibility for each point on each floor, especially on the 3rd floor plan which is the open grandstand area. In the next activity, further research can be conducted related to wayfinding to obtain signage from the effectiveness of accelerating visitor accessibility in the softball stadium building. This activity can be based on research results that can be continued to facilitate recognition from the entrance to the exit of the stadium building for visitors.

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REFERENCES

Alkhodri, A. (2004). *Stadion Sepak Bola di Kabupaten Sleman Perancangan Ruang Dalam dan Ruang Luar Melalui Pendekatan Multi Fungsi yang Mampu Mengakomodasi Olah Raga Prestasi, Olah Raga Rekreasi dan Kegiatan Komersial*.

Arinto, F. X. E. (2018). Pelestarian arsitektur berdasarkan architectural architypes melalui metode grafis. *ARTEKS: Jurnal Teknik Arsitektur*, *3*(1), 29–36.

Benedikt, M. L. (1979). To take hold of space: isovists and isovist fields. *Environment and Planning B: Planning and Design*, *6*(1), 47–65.

Ching, F. D. K. (2007). *Arsitektur–Bentuk, Ruang dan Tatanan, Edisi Ketiga, Jakarta: Penerbit Erlangga*.

Clarke, A. (2012). Spatial experience narrative and Architecture. *Byera Hadley Report*.

DONG, J. I. A., LI, L. I., HUANG, J., & HAN, D. (2017). Isovist based analysis of supermarket layout. *Verification of Visibility Graph Analysis and Multi-Agent Simulation*, 1–12.

Exora, R. D., Adhitama, G. P., & Nurdini, A. (2022). The Potential Placement of Visual Stimuli for Occupant Interaction Improvement in Compact Living Space at Karawang, West Java: The Isovist of Space Syntax Approach. *IOP Conference Series: Earth and Environmental Science*, *1058*(1), 12031.

H[1], R., & Kusliansjah, Y. K. (n.d.). *PENATAAN ELEMEN SIRKULASI VERTIKAL PADA GEDUNG UNPAR JL. MERDEKA NO. 30 BANDUNG MELALUI PENDEKATAN SPACE SYNTAX DAN KRITERIA HERITAGE*.

Husni, M. F. D. (2019). *Proposal Pedestrianization of Kota Lama Semarang, Indonesia*.

Frankfurt University of Applied Sciences.

Irwanuddin, I. (2018). Identifikasi Genotype Rumah Adat Sumba Barat dengan Metode Space Syntax. *RUAS*, *16*(1), 58–70.

Kustiani, K., & Khidmat, R. P. (2022). The Analysis of Open Space Configuration as an Evacuation Assembly Point, Case Study: Universitas Bandar Lampung. *Jurnal Arsitektur*, *12*(1), 27–38.

Natapov, A., Parush, A., Laufer, L., & Fisher-Gewirtzman, D. (2022). Architectural features and indoor evacuation wayfinding: The starting point matters. *Safety Science*, *145*, 105483.

Prastowo, R. M., Hartanti, N. B., & Rahmah, N. (2019). Penerapan konsep arsitektur naratif terhadap tata ruang pameran pada museum. *Prosiding Seminar Nasional Pakar*, 1–8.

Pratama, Y. V., & Asikin, D. (2025). Spatial Configuration and Social Integration in the Residential Area of Benteng Keraton Buton. *RUAS*, *23*(1).

Purwanto, A., & Santosa, R. B. (2021). Kajian State of the Art Pola Teritorialitas Kotagede Menggunakan Metode Space Syntax. *MARKA (Media Arsitektur Dan Kota): Jurnal Ilmiah Penelitian*, *5*(1), 39–60.

Putra, H. A. (2013). Stadion dan Fasilitas Pelatihan Sofbol di Surabaya. *EDimensi Arsitektur Petra*, *1*(2), 269–275.

Putra, H. A., & Hastorahmanto, P. S. (2023). SPACE SYNTAX IN ADJUSTMENT OF SPACE PATTERNS OF SOFBOL STADIONS IN SURABAYA. *Journal of Architecture&ENVIRONMENT*, *22*(2), 153–168.

Putra, H., & Hastorahmanto, P. (2024). IMPLEMENTATION OF WAYFINDING SIGN IN THE ACCESSIBILITY OF SOFTBALL STADIUM IN SURABAYA. *Border: Jurnal Arsitektur*, *6*(2), 197–212.

Romdhoni, M. F. (2018). Analisis Pola Konfigurasi Ruang Terbuka Kota Dengan Penggunaan Metoda Space Syntax Sebagai Spatial Logic Dan Space Use. *NALARs*, *17*(2), 113–128.

Saputri, D. A., Arifianti, E. R., & Damayanti, F. S. (2022). Kriteria redesain pola penataan pujasera Stadion Bandung berdasarkan aktivitas dan perilaku pengguna. *G-Tech: Jurnal Teknologi Terapan*, *6*(2), 306–315.

Sari, P., & Bomo, D. P. (2022). Desain Wayfinding dalam Keterbacaan dan Pelaksanaan Studi Kasus Jakarta International Stadium. *Jurnal Ilmiah Arsitektur*, *12*(2), 116–130.

Setiawan, T., Tanuwidjaja, G., & Muhaidhori, M. A. (2019). Peningkatan Rancangan Wayfinding (Menemukan Jalan) untuk Sekolah Penyandang Disabilitas Visual di Surabaya dan Peluang Pengembangannya untuk Bangunan Publik Lainnya. *ATRIUM: Jurnal Arsitektur*, *5*(1), 23–30.

Siregar, J. P. (2014). Metodologi dasar space syntax dalam analisis konfigurasi ruang. *Malang: Universitas Brawijaya*.

Turner, A. (2001). Depthmap: a program to perform visibility graph analysis. *Proceedings of the 3rd International Symposium on Space Syntax*, *31*, 12–31.

Wijaya, K., Ananda, E. P., Soekardi, R. R., & Nurrohman, F. (2024). KAJIAN SPASIAL AKSESIBILITAS KAWASAN PERBELANJAAN MENGGUNAKAN ANALISIS SPACE SYNTAX. *Jurnal Arsitektur ARCADE: Vol*, *8*(4).