BUKTI KORESPONDENSI

ARTIKEL JURNAL NASIONAL BEREPUTASI

Judul artikel	:	Space Syntax In Adjustment Of Space Patterns Of Sofbol Stadions In Surabaya
Jurnal	:	JoAE (Journal of Architecture & Environment), 2023, Volume 22(2), 153-168
Penulis	:	Heristama Anugerah Putra

No.	Perihal	Tanggal
1.	Bukti konfirmasi submit artikel dan artikel yang disubmit	20 Mei 2023
2.	Bukti konfirmasi review dan hasil review pertama	30 Mei 2023
3.	Bukti konfirmasi submit revisi pertama, respon kepada reviewer, dan artikel yang diresubmit	30 Mei 2023
4.	Bukti konfirmasi artikel accepted	22 Juli 2023
5.	Bukti konfirmasi artikel published online	31 Oktober 2023

1. Bukti konfirmasi submit artikel dan artikel yang disubmit (20 Mei 2023)

Paper Formatting Guidelines

SPACE SYNTAX IN ADJUSTMENT OF SPACE PATTERNS OF SOFBOL STADIONS IN SURABAYA

Heristama Anugerah Putra*, Prabani Setio Hastorahmanto*
*) Department of Architecture, Faculty of Engineering, Darma Cendika Catholic University
e-mail: heristama.putra@ukdc.ac.id

ABSTRACT

Stadiums generally have a lot of access for entrances and exits, this is related to the spectator capacity of the stadium which is quite a lot. The level of ease of user activity with the existing spatial configuration structure is unknown. The adjustment of the softball stadium plan is intended to provide a level of clarity in the pattern of relationships between spaces and a level of ease of accessibility in achieving these spaces. Apart from that, it is also to know and understand the basic movement patterns of users in it. So that the space syntax analysis method is used to find out clarity regarding the pattern of configuration of relationships between spaces in the ease of outreach of activities for users in the stadium. Analysis related to connectivity, integrity and intelligibility patterns can in a descriptive way provide the appropriate picture results in the form of an axial line. The expected result is that the pattern of relationships between spaces for ease of user activity in them feels very far-reaching, especially on the 1st to 3rd floors. There needs to be a clear link on these floors to understand the spatial configuration structure for the users inside. While the floor that has the most optimal quality with an intelligibility value close to 1 is floor 4, where on this floor the range of activities is quite close together and not too wide.

Keywords: *Stadium, Space syntax, Space configuration, Accessibility, Movement patterns*

INTRODUCTION

Infrastructure development in Indonesia continues to be carried out, especially in the field of sports to focus on improving the world of sports from an early age in terms of coaching. Most of the infrastructure built in the field of sports is in the form of fields, stadiums and other supporting buildings that are useful for the improvement of athletes. However, most of the existing stadiums, especially in Indonesia, still have not implemented the user circulation pattern properly, even though with the ongoing construction, this pattern has been implemented for the

better. As one of the achievements, the stadium has international standards, namely by looking at the quality of the field, besides looking at the direction of circulation and achieving space for users. Good achievement is not only inside the building but can be seen and started from outside the building. Spatial patterns basically have an influence on cultural patterns that arise in society so that they need to be displayed in the formation of new spatial ideas (Aryan & Potangaroa, 2014). The importance of human movement can be the main parameter in developing an area, both large and small scale in the form of buildings (Siregar, 2014).

Seeing this, the author develops and wants to know about movement patterns in buildings from the design results of softball stadiums that have been made. This stadium is located in Surabaya. The planning of a softball stadium is also based on the need for the city of Surabaya as one of the hosts in an international event (Asian Youth Games). The laying of the site itself refers to data from the Surabaya City Development Planning Agency in 2005 (Surabaya, 2005) which is located in the foot of the Suramadu bridge. The stadium is a building that is public and can accommodate many users, including spectators, managers and athletes. Clarity about connectivity, integration and intelligence is needed for all stadium users, both in the outer and inner spaces (Klarqvist, 1993). Broadly speaking, the mass of the softball stadium building is quite large and consists of several outer rooms with wide corridors based on the zoning that has been made in the floor plan design process. (Putra, 2013).

Connectivity is an indicator in calculating interconnected spaces between one space and another. So that it can be concluded as an arrangement of space configurations to obtain the level of interaction with the spaces around it. Integration is a measurement pattern for each space against other spaces that are still in the same space configuration and this is a conclusion point for assessing existing data. Intelligence is a combination of assessments of connectivity and integration which will later show a correlation from the measurement results. These three patterns are used as a measuring tool to obtain achievement results in buildings. Space syntax is able to develop space configurations based on activity and psychological level for each individual (Mahendra, 2007). Not only space on a city scale, space on a building scale can also measure the interaction between space and its users (Puspitasari, 2020).

According to (Putra, 2013) Softball stadiums must provide a level of comfort, safety and clarity for user accessibility in the form of circulation or signage as well as spatial pattern configuration structures. Judging from the large number of users who use the stadium facilities simultaneously, the purpose of this study is to assess and readjust the spatial layout pattern inside and outside the stadium to get maximum accessibility in terms of connectivity and integration. There was a spread of access to activities by visitors based on their individual wishes before, during and after the game took place. This research focuses on the basic pattern of movement and distribution of users to determine the level of ease due to user activity in relation to accessibility which influences and is closely related to the configuration of spatial patterns in a softball stadium. This refers to the suitability of the size of the existing space. However, as the main point, the stadium must be able to provide complete and adequate facilities for each user, especially for the spectators.

THEORY / RESEARCH METHODS

The effectiveness of human mobility can be seen from the flow pattern of each human movement in the relationship between the building and the surrounding environment. The space syntax method is used to adjust and get the right spatial configuration pattern by combining qualitative and quantitative descriptive. In addition, the spatial configuration analysis obtained related to the adjustment of spatial patterns in the stadium is used to determine the layout between spaces so that they function properly and are able to provide convenience or difficulty in achieving space for its users. Space syntax is a method that builds attachments to patterns of relationships between spaces with spatial configurations in measuring instruments of spatial interaction in the form of graphics and statistics. This method also explains the arrangement of spatial configuration patterns, relationships between spaces, and spatial boundaries as well as all the movement of activities in it. The use of Space Syntax analysis is able to form road network patterns to foster integration and connectivity as well as intelligence which is felt to be lacking (Ulvianti, 2018).

According to Permana et al. (2020) in a design building it is necessary to have convenience in terms of circulation where the close distance between the nodes as the observation area with the path which is the circulation path. The use of space syntax is used as a measuring tool in analyzing layout drawings or building plans related to the clarity of space (intelligibility) so that users can easily understand the activities in it. (Nurhalimah & Astuti, 2020). This will later provide an overview of easy accessibility for users in the softball stadium building. Through the use of DepthMap software it is possible to determine the level of connectivity, integrity and intelligence of the spaces in it in relation to the users. Space syntax connectivity calculates the amount of space that exists and is directly related to other spaces but still in a space configuration (Hillier et al., 1986) (Hillier et al., 1993). In connectivity, it is found that the level of interaction between one room and another space that is nearby. Integrity itself measures the position of space to other spaces but still in a spatial configuration (Hillier & Hanson, 1989) (Hillier et al., 1993). In integrity, values are found from all available spaces but the configuration is still the same. Intelligibility shows more about the relationship between connectivity and integrity (Hillier et al., 1986) (Hillier et al., 1993). Intelligibility measurements are able to provide results from spatial systems.

Space syntax is a tool to test and get information related to the desired spatial formation and is based on spatial analysis parameters (Dursun, 2007). Clarity regarding accessibility will be presented in the axial line graph and visibility line graph which makes it easy to search for space in the building. According to Hillier (2007), there are four important elements in analyzing using space syntax, namely:

a. Space syntax in a city space
b. Space syntax provides spatial network analysis tailored to placement, building orientation and grouping
c. Space syntax observes the spatial network related to functional movement patterns

d. Space syntax develops existing theories and is then connected to networks in general to form a character

Objects are interdependent on one another in a network structure pattern and can be referred to as a configuration (Hillier et al., 1986) (Hillier & Hanson, 1989) (Hillier, 2007). Natural movement or so-called human movement sees the parameters of visitor activity in a building (Hillier et al., 1993).

The stadium is a building that contains facilities in the form of a large field and is surrounded by stands or seats for spectators (Ishak, 2019). Because the stadium consists of a large field, the stadium generally functions as a venue for sporting matches and music concerts. Because its function is for events that involve many people, of course the size of the stadium building is also very large to accommodate all visitors. In order to increase the comfort of the stadium building, the stadium will usually be equipped with various facilities and consists of many rooms.

Stadium consists of many types, one of which is a softball stadium. Softball (softball) was first introduced in the United States which then entered Indonesia in 1960. Currently, softball in Indonesia has developed a lot and the athletes have many achievements. Indonesian male athletes are ranked 19th and female 23rd based on the World Baseball and Softball Confederation (WBSC) (Pradnyaswari & Budisetyani, 2018). Judging from the many achievements that have been achieved, this sport is considered to have great potential to be increasingly in demand by the people of Indonesia.

Spaces in Buildings

Spatial planning in architectural composition aims to create good spatial arrangements, have accessibility between spaces that can support user activities in buildings, improve psychological quality for users so as to create a sense of security and comfort, as well as one of the parts that affect the aesthetics of the building. Spatial planning does not only pay attention to geometric shapes but also the arrangement of spaces so as to create harmony. In general, a room is formed from three basic elements, namely the ceiling, walls, and floor (Prabowo et al., 2019).

Space Syntax

Space syntax is a technique that can be used to estimate, analyze, calculate, measure, and interpret a spatial configuration (Barada & Mutiari, 2013). The purpose of using space syntax techniques is to develop an understanding of how space works effectively. This technique already uses computer-based technology and is based on spatial pattern rules through empirical observation of how a spatial pattern will be used so that visitors can find out the movement patterns.

The results of the analysis of space syntax are in the form of intelligibility values or spatial clarity in the space configuration. The intelligibility value will be directly proportional to the level of activity that will occur in the room. The higher the value, the more activities are carried out and the higher the level of accessibility of visitors in a room.

RESULT AND DISCUSSION

The biggest main problem is that there are still many stadiums in Indonesia that have not implemented the pattern of movement of visitors in the building properly and correctly, so that there are still crowds and even density inside the stadium which makes users uncomfortable. In addition, the stadium must be able to provide convenience for visitors who are inside the stadium to access other supporting spaces. The stadium must be able to capture the basic pattern of visitor movement within the building regarding the influence of visitor distribution and accessibility in terms of spatial configuration (Nurhalimah & Astuti, 2020). The circulation of a building must provide convenience in searching for the spaces inside which are based on relevant spatial analysis (Natapov et al., 2015).

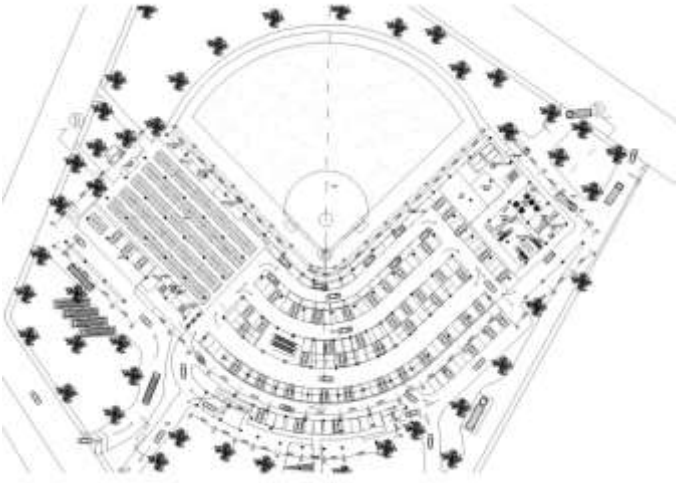


Figure 1. Floor plan of softball stadium 1
Source: Putra, 2013

Figure 2. Floor plan of softball stadium 2
Source: Putra, 2013

The planning capacity of a softball stadium in Surabaya can accommodate as many as 3,000 spectators, so there is a need for parsing and easy accessibility for users in it (Putra, 2013). Density always occurs at the beginning and end of a sports match in the stadium building. Laying out spatial and circulation patterns is important to reduce density and provide convenience for visitors to access various spaces in the stadium. Ease of accessibility can be monitored by means of descriptive qualitative and quantitative to determine the level of connectivity, integrity and intelligence with a space syntax approach. DepthMap is used as a measuring tool in getting measurable data results.

Figure 3. Floor plan of softball stadium 3
Source: Putra, 2013

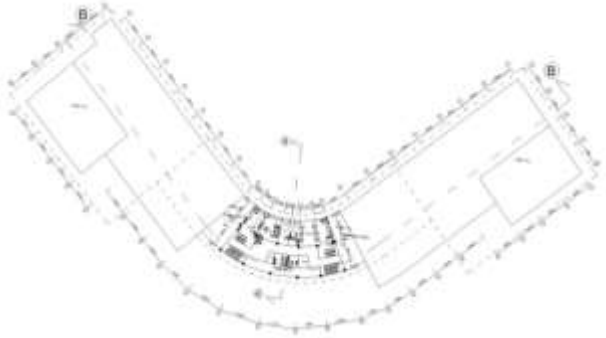


Figure 4. Floor plan of softball stadium 4
Source: Putra, 2013

The softball stadium in Surabaya has a symmetrical floor plan on both sides with various spatial functions inside. The floor plan is implemented to be able to accommodate all visitors who are active in it, either watching matches or carrying out other supporting activities. In Figure 1 to Figure 4 are the spatial formations and floor plans of a softball stadium with conditions prior to calculating data connectivity, integrity and intelligibility analysis. From the design data of the softball stadium building plan from the ground floor to the 3rd floor (Figure 1-4) an

analysis will be carried out to determine the movement patterns of visitors in the room from the spatial configuration arrangement using DepthMap X-0.7.0. This softball stadium building has a floor plan of up to 4 floors which will be known through the use of space syntax analysis for each area of the plan to find out the connectedness in the existence of the inner space.

Connectivity Analysis

In the early stages of the analysis using the principle of axial line connectivity to obtain and know the results of the connectivity connectivity calculation values of the spaces inside on each floor plan of the building. This achievement is to manage the connectivity between the distance and the depth of the softball stadium in Surabaya.

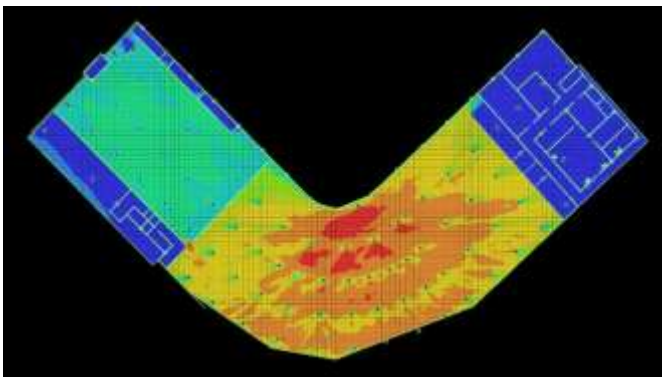


Figure 5. Axial line connectivity floor plan of 1 softball stadium
Source: Research team, 2023

From the value data in Figure 5 for the 1st floor plan of the softball stadium building, it can be seen that the car park area that is on the inside or top side with a smaller number of parking lots has a very high level of circulation interaction. The high level of circulation interaction is due to the shorter travel length of the car vehicle lane when compared to the circulation area of the car park below it. It can also be said that the parking area on the upper side has a sharper circulation curve than the circulation path for car vehicles below, which is also the area most frequently traversed by car vehicles. In principle, the range is shorter, but the density of vehicles is denser and more.

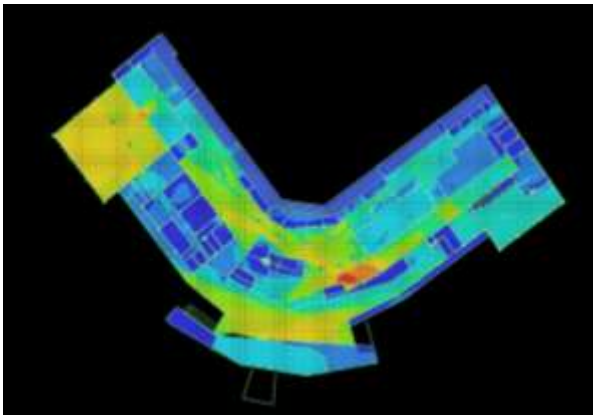


Figure 6. Axial line connectivity 2nd floor plan of softball stadium
Source: Research team, 2023

For the softball stadium building on the 2nd floor, by looking at Figure 6, it can be judged that the exit area has the highest spatial interaction. This is because of the visitor movement patterns in the building which are mandatory and always accumulate in this area when a match is over. In addition, visitors must have a short exit behavior to avoid long-term accumulation in the building, so access to multiple exits is a must have for a stadium. The exit area of the stadium building must also be able to provide good flow of circulation from inside to outside of the building, whether an emergency occurs or not. It can be said that the exit area of this building has the highest connection with the entrance area or gate ticketing. Where this area is directly next to each other, with the intention of making it easier for visitors when they have entered the softball stadium building and can come back out of this stadium building.

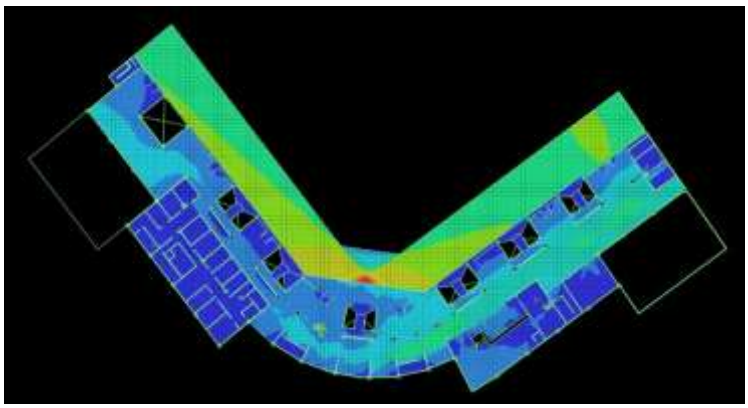


Figure 7. Axial line connectivity 3rd floor plan of softball stadium
Source: Research team, 2023

On the 3rd floor of the softball stadium building as shown in Figure 7, the results of the assessment showed that the largest interaction area was in the center of the spectator stands area. This point is the area directly behind the softball pitcher and hitter. In addition, this area is also the most comfortable point in getting the

viewing angle for the audience to watch a softball match. In other words, the tribune area is the area most in demand by the audience every time there is a softball game with easy access to reach it. Meanwhile, the other seats in the adjacent tribune area are ranked in a hierarchical order for the level of comfort in watching the match.

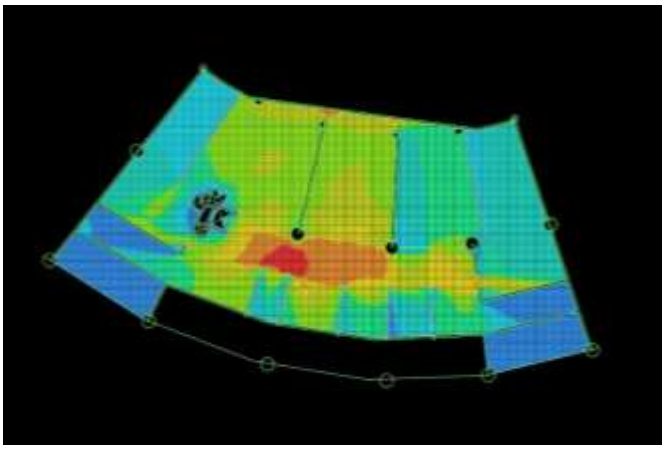


Figure 8. Axial line connectivity 4th floor plan of softball stadium
Source: Research team, 2023

Functionally, the 4th floor of the softball stadium building is more for private matters. Here it consists of spaces that are not allowed and cannot be accessed by the general public. It can be seen in Figure 8 where the 4th floor of the softball stadium for the results of the interaction assessment between rooms is the largest in the central circulation area, directly in front of the access to the VIP elevator opening. This point is the most widely accessed because the main access to this floor only uses vertical circulation, namely the elevator, apart from the existence of an emergency staircase which can be used as vertical circulation in the event of an emergency on or on this floor. This area also acts as a liaison between the rooms on the 4th floor and the floor below.

Integrity Analysis

The next stage is also an analysis using the principle of axial line integrity. At this stage the value of integration is an aspect of one's ease in achieving a space. This is seen from the aspect of circulation path density related to the effectiveness of accessibility in buildings between spaces.

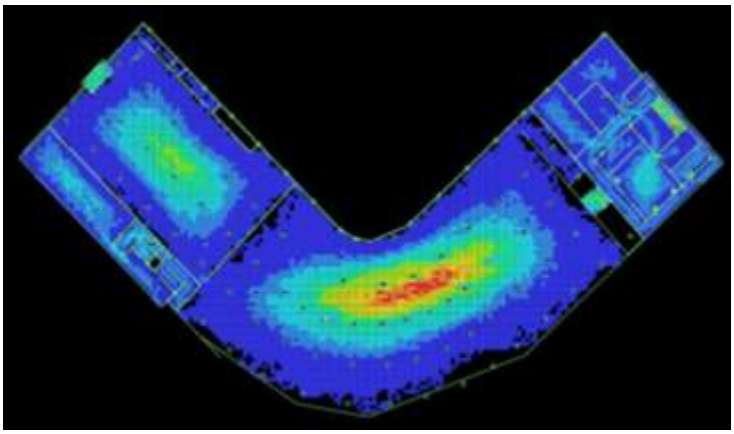


Figure 9. Axial line integrity floor plan of 1 softball stadium
Source: Research team, 2023

From the results of the integrity analysis for the floor plan of the softball building on the 1st floor, it was found that the middle part of the car park area has a very high integrity value. This makes this area the easiest to reach and reach and integrated with various surrounding spaces. This area itself is an open area without any partitions so that softball stadium users can easily reach it. This floor itself is dominated by service and public zoning spaces.

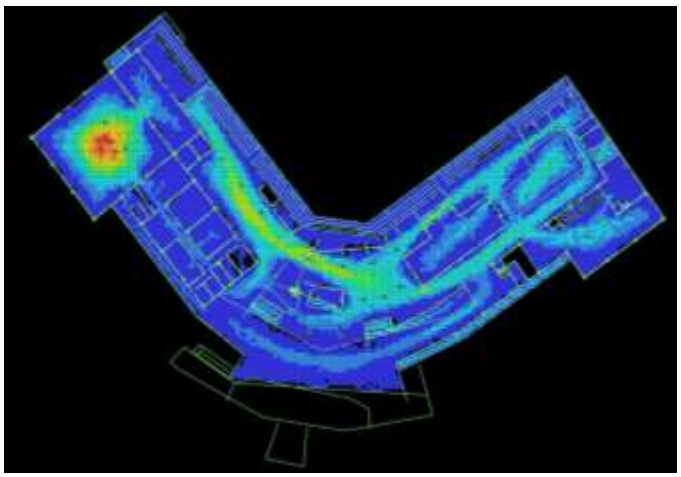


Figure 10. Axial line integrity floor plan of 2 softball stadium
Source: Research team, 2023

Meanwhile, on the 2nd floor plan, the integrity results were the easiest to achieve for the other rooms, namely in the indoor training area. This area has the largest and widest spatial scale so that the reach point is easier to find. This space can easily reach the inner or upper corridor area of the softball

building plan which can then be reached back easily to other parts of the room.

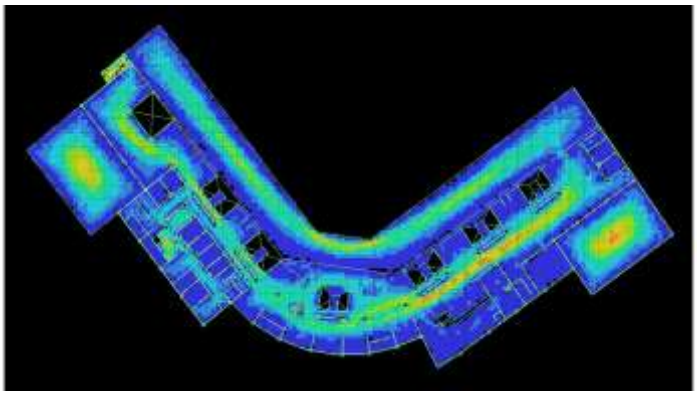


Figure 11. Axial line integrity floor plan 3 softball stadium
Source: Research team, 2023

When seen in Figure 11, in outline the integrity pattern of the softball building on the 3rd floor plan, it can be seen that the achievement points are scattered in several areas. Here it can be concluded that the areas that can easily reach and have the highest achievement with other spaces are in the inner corridor. In this area, visitors can easily reach one room with another which is designed to form an open space without a partition.

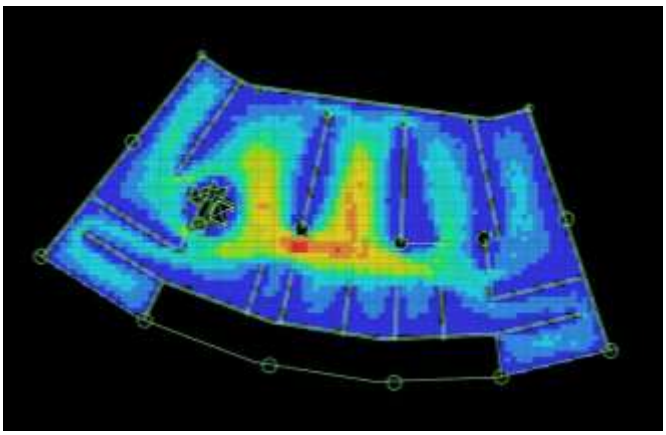


Figure 12. Axial line integrity floor plan 4 softball stadium
Source: Research team, 2023

While the results of the calculation analysis using the axial line integrity pattern on the 4th floor, it was found that the area that is easiest for users to reach is the corridor space. Where this area is the main access to get to the surrounding rooms considering that this floor only has a few special rooms or rooms (VIP). So indirectly the corridor on this floor plays a major role in making it easy to reach other spaces.

Intelligibility Analysis

The intelligibility value is obtained from the analysis of the results of the relationship between the connectivity value and the integrity value, in which the intelligibility value is to obtain the clarity value of the two variables. In principle, the relationship between a space can be easily recognized if the values of the two variables are getting stronger.

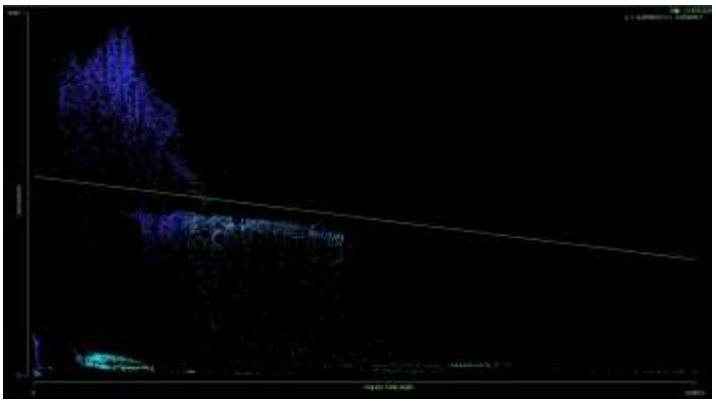


Figure 13. Axial line intelligibility floor plan of a softball stadium
Source: Research team, 2023

For the results of the intelligibility analysis on the first floor of the softball stadium building, from Figure 13, a value of 0.0072 is obtained, which is due to the spatial arrangement pattern in the stadium which is wide and open in the parking lot area. So that the reach of people in accessing one room to another is quite far due to the broad floor plan. So that with this form, it can be seen that the condition of the spatial configuration system is not optimal and that everyone in their activities is not sufficiently available. Clearer spatial patterns are needed so that the attainment and relationships between spaces can be easily understood by stadium visitors.

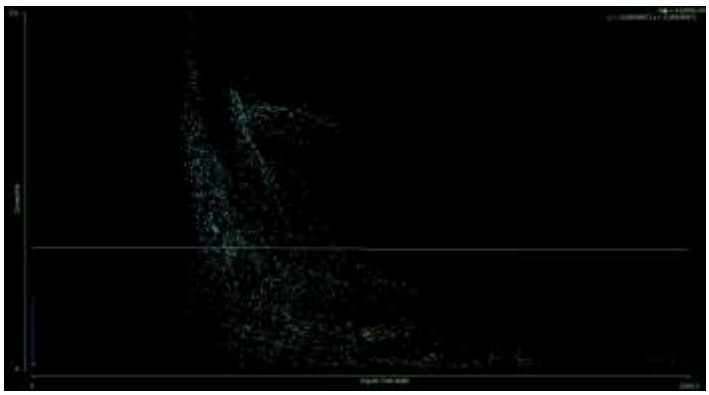


Figure 14. Axial line intelligibility softball stadium floor plan 2
Source: Research team, 2023

On the 2nd floor of the softball stadium plan, there are spaces that are quite complex and more general in nature because this floor is the point where the floor area has the most reach and access to other rooms. The results of the intelligibility analysis value on the 2nd floor plan are 4.53093, which means that this floor has a spatial configuration structure that is not very good in terms of ease of accessibility. This makes the quality of the space for the convenience of activities not available properly and requires rearrangement of the placement of the spaces.

Figure 15. Axial line intelligibility floor plan of 3 softball stadium
Source: Research team, 2023

Meanwhile, on the 3rd floor (Figure 15) in the floor plan of this softball stadium, the intelligence analysis results obtained a value of 0.00083. From the results of these figures it is also concluded that on the 3rd floor it is still not well organized for the conditions of the existing rooms. This is because on this floor there are many circulation paths with a large enough area for access to the stands. Therefore, the condition of the spatial pattern structure with the floor plan configuration still does not provide ease of activity for the audience. So it is necessary to clarify the access paths in the stadium for each space configuration for visitors.

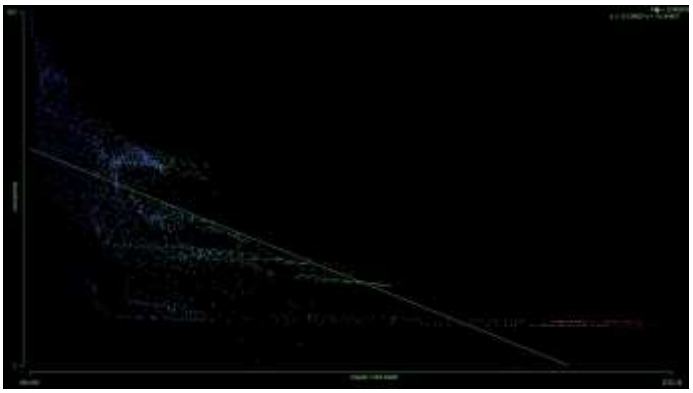


Figure 16. Axial line intelligibility softball stadium 4th floor plan
Source: Research team, 2023

When seen in Figure 16, the results of the intelligibility analysis are obtained with a value of 0.546, which means that it has a spatial configuration that is close to number 1 where the structure and configuration of the spaces inside are good. This makes optimal quality and ease of achievement clear for each space. The 4th floor plan has an area that is quite small or not as large as the floors below it, so that the reach and reach between the spaces becomes clearer and better. So that in setting the distance between spaces it must be clear the boundaries and the direction of achievement in each of these spaces.

CONCLUSIONS

By mapping the axial line pattern for the correlation of space syntax connectivity and integrity, it can be concluded that the circulation pattern of reaching a space is for one's convenience and the relationship related to the distance and depth of space with the number of available spaces is influenced by the function and extent of the space formed. From the results of data processing using the space syntax it is also concluded that visitors will choose and pass through areas that have spaces with broad shapes in dimensions and are easy to reach between one room and another. In addition, space syntax is able to provide analysis results related to the spread for users in softball stadium buildings and movements to and from other spaces that start from spaces with high intensity. In the pattern of inter-room relationships for ease of user activity, it feels very far-reaching, especially on the 1st to 3rd floors. There needs to be a clear link on these floors to understand the spatial configuration structure for the users inside. While the floor that has the most optimal quality with an intelligibility value close to 1 is floor 4, where on this floor the range of activities is quite close together and not too wide. So that in general it can be concluded that the shape of the room, the size of the room and the area of the room have a big influence on the formation of accessibility for the ease of reaching in a room in the softball stadium building plan.

Suggestions from the results of this space syntax analysis research are that basically a softball stadium building has a spatial composition with various functions in it, so that the spatial composition that can be used as a standard is to readjust it in order to help bring out the exact shape and layout of a softball stadium next.

ACKNOWLEDGMENT

We thank LPPM Darma Cendika Catholic University for supporting all of this research activity from start to finish and for the publication of this publication so that its implementation can run well. We also thank all the lecturers in the UKDC architecture study program for their support and attention. It is also hoped that this research will be able to provide benefits to the government both at the center and in the regions as a reference in facilitating user activities in the stadium.

REFERENCES

Aryan, N. P., & Potangaroa, R. (2014). *Space and Culture Using Space Syntax for the Tenganan Pageringsingan Housing of Bali, Indonesia*.

Barada, W. P., & Mutiari, D. (2013). Analisis Space Syntax Rumah Susun Berbasis Gang Kampung. *Simposium Nasional RAPI XII*, 59–63.

Dursun, P. (2007). Space syntax in architectural design. *6th International Space Syntax Symposium*, 1–56.

Hillier, B. (2007). *Space is the machine: a configurational theory of architecture*. Space Syntax.

Hillier, B., Burdett, R., Peponis, J., & Penn, A. (1986). Creating life: or, does architecture determine anything? *Architecture & Comportement/Architecture & Behaviour*, *3*(3), 233–250.

Hillier, B., & Hanson, J. (1989). *The social logic of space*. Cambridge university press.

Hillier, B., Penn, A., Hanson, J., Grajewski, T., & Xu, J. (1993). Natural movement: or, configuration and attraction in urban pedestrian movement. *Environment and Planning B: Planning and Design*, *20*(1), 29–66.

Ishak, L. F. (2019). Perancangan Sistem Buka Tutup Atap Stadion Otomatis Berbasis Mikrokontroler ATMEGA 328P. *Jurnal Litek : Jurnal Listrik Telekomunikasi Elektronika*, *16*(2), 36. https://doi.org/10.30811/litek.v16i2.1456

Klarqvist, B. (1993). *A Space Syntax Glossary. Nordisk Arkitektur for Skning,(2). 11, 12*.

Mahendra, W. (2007). Logika Konfigurasi Ruang dan Aspek Psikologi Ruang Bagi Lansia. *Jurnal Rekayasa Perencanaan*, *4*(1).

Natapov, A., Kuliga, S., Dalton, R. C., & Hölscher, C. (2015). Building circulation typology and space syntax predictive measures. *Proceedings of the 10th International Space Syntax Symposium*, *12*, 13–17.

Nurhalimah, D., & Astuti, D. W. (2020). Analisis Hubungan Konfigurasi Ruang dengan Penyebaran Pengunjung Pasar Klewer Menggunakan Space Syntax. *Jurnal Sinektika*, *17*(1), 13–20.

Permana, A. Y., Permana, A. F. S., & Andriyana, D. (2020). Konfigurasi ruang berdasarkan kualitas konektivitas ruangan dalam perancangan kantor: Space syntax analysis. *Jurnal Arsitektur Zonasi*, *3*(2), 155–170.

Prabowo, A., Al-Ghifari, M. A. A., Fadlilah, F. N., Pakuan, G. M., & Zulfahmi, M. H. (2019). Identifikasi Material Berkelanjutan Pada Ruang Luar Dan Ruang Dalam Bangunan Kantor. *Jurnal Arsitektur ZONASI*, *2*(3), 160. https://doi.org/10.17509/jaz.v2i3.19492

Pradnyaswari, A. A. A., & Budisetyani, I. G. P. W. (2018). Hubungan Kecerdasan Emosional Dengan Kecemasan Bertanding Pada Atlet Softball Remaja Putri Di Bali. *Jurnal Psikologi Udayana*, *5*(01), 218. https://doi.org/10.24843/jpu.2018.v05.i01.p20

Puspitasari, C. (2020). Metode analisis space syntax pada penelitian interaksi kota multibudaya. *Lakar: Jurnal Arsitektur*, *3*(01).

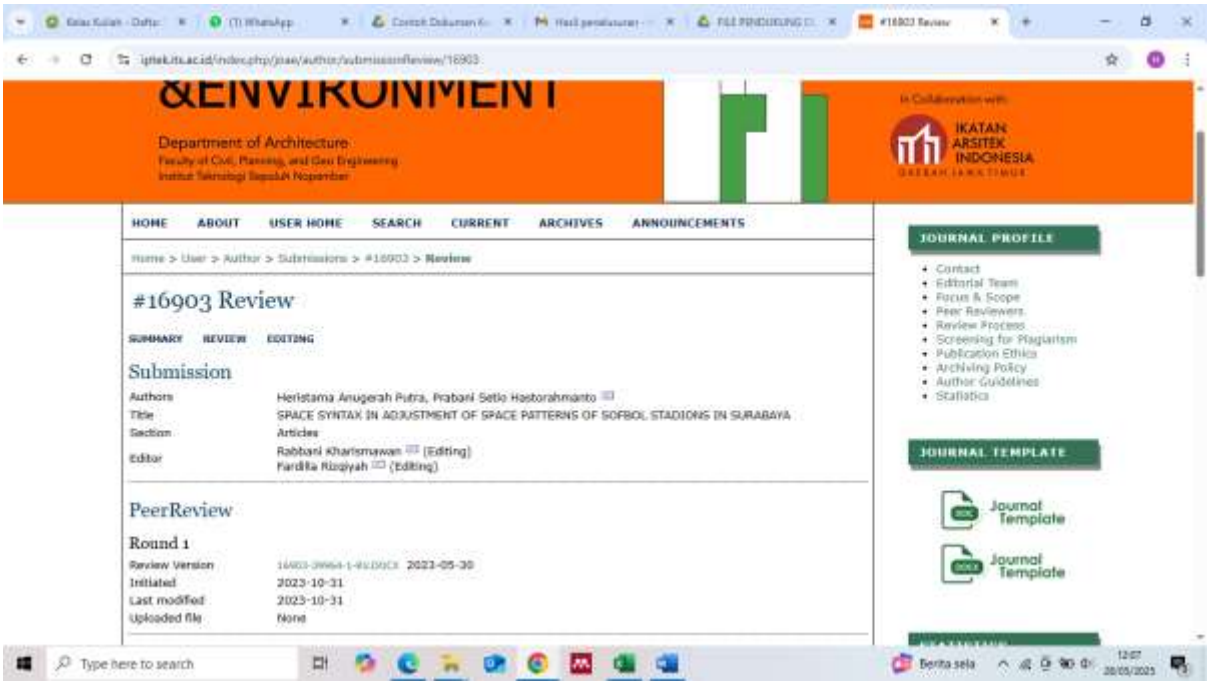
Putra, H. A. (2013). Stadion dan Fasilitas Pelatihan Sofbol di Surabaya. *EDimensi*

Arsitektur Petra, *1*(2), 269–275.

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

Surabaya, B. P. P. K. (2005). Rencana detail tata ruang kawasan unit pengembangan. *Surabaya: BAPPEKO*.

2. Bukti konfirmasi review dan hasil review pertama (30 Mei 2023)



Paper Information:

Title	:	SPACE SYNTAX IN ADJUSTMENT OF SPACE PATTERNS OF SOFBOL STADIONS IN SURABAYA
Author(s)	:	

Recommendation:

Please put an "√" in the appropriate box bellow

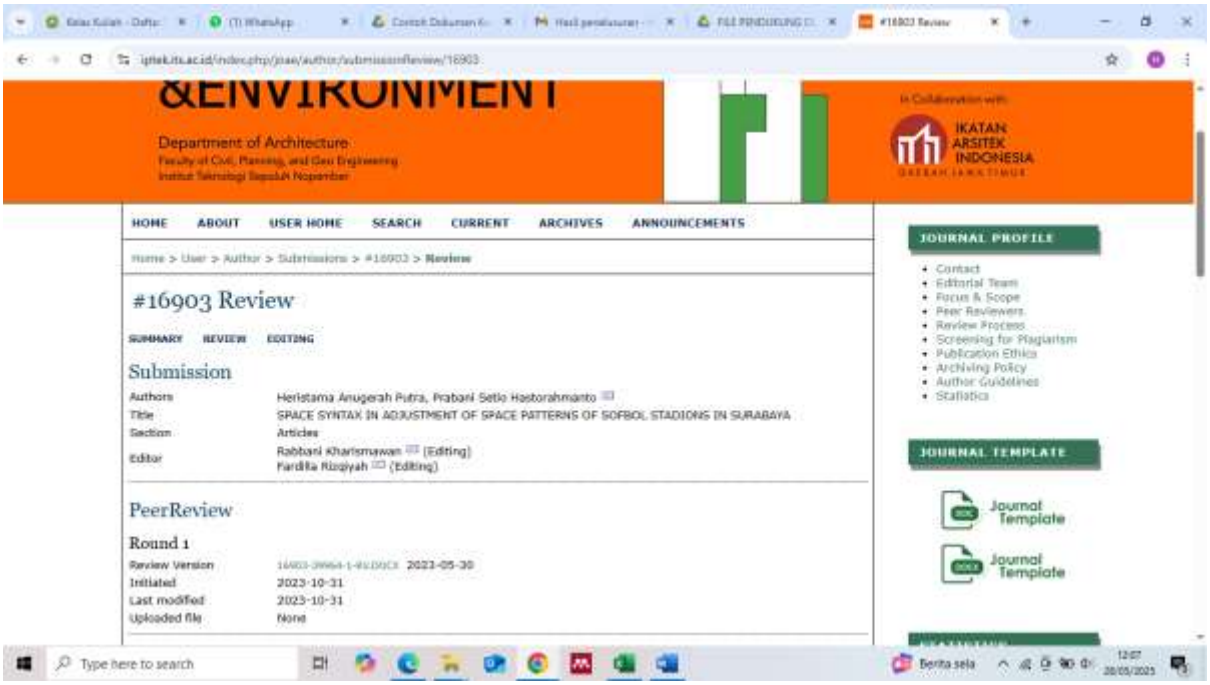
		Correction to the substance of the paper
		Correction to the English grammar
	V	Accepted with revision
		Rejected **None of these**

Comments to Author(s):

The last part of the summary should be improved in order to provide wider understanding of the result of the study

It is important to provide brief information on the building itself including the surrounding area

3. Bukti konfirmasi submit revisi pertama, respon kepada reviewer, dan artikel yang diresubmit (30 Mei 2023)



Paper Formatting Guidelines

SPACE SYNTAX IN ADJUSTMENT OF SPACE PATTERNS OF SOFBOL STADIUM IN SURABAYA

Heristama Anugerah Putra*, Prabani Setio Hastorahmanto*
*) Department of Architecture, Faculty of Engineering, Darma Cendika Catholic University
e-mail: heristama.putra@ukdc.ac.id

ABSTRACT

Stadiums generally have a lot of access for entrances and exits, this is related to the spectator capacity of the stadium which is quite a lot. The level of ease of user activity with the existing spatial configuration structure is unknown. The adjustment of the softball stadium plan is intended to provide a level of clarity in the pattern of relationships between spaces and a level of ease of accessibility in achieving these spaces. Apart from that, it is also to know and understand the basic movement patterns of users in it. So that the space syntax analysis method is used to find out clarity regarding the pattern of configuration of relationships between spaces in the ease of outreach of activities for users in the stadium. Analysis related to connectivity, integrity and intelligibility patterns can in a descriptive way provide the appropriate picture results in the form of an axial line. The expected result is that the pattern of relationships between spaces for ease of user activity in them feels very far-reaching, especially on the 1st to 3rd floors. There needs to be a clear link on these floors to understand the spatial configuration structure for the users inside. While the floor that has the most optimal quality with an intelligibility value close to 1 is floor 4, where on this floor the range of activities is quite close together and not too wide.

Keywords: *Stadium, Space syntax, Space configuration, Accessibility, Movement patterns*

INTRODUCTION

Infrastructure development in Indonesia continues to be carried out, especially in the field of sports to focus on improving the world of sports from an early age in terms of coaching. Most of the infrastructure built in the field of sports is in the form of fields, stadiums and other supporting buildings that are useful for the improvement of athletes. However, most of the existing stadiums, especially in Indonesia, still have not implemented the user circulation pattern properly, even though with the ongoing construction, this pattern has been implemented for the

better. As one of the achievements, the stadium has international standards, namely by looking at the quality of the field, besides looking at the direction of circulation and achieving space for users. Good achievement is not only inside the building but can be seen and started from outside the building. Spatial patterns basically have an influence on cultural patterns that arise in society so that they need to be displayed in the formation of new spatial ideas (Aryan & Potangaroa, 2014). The importance of human movement can be the main parameter in developing an area, both large and small scale in the form of buildings (Siregar, 2014).

Seeing this, the author develops and wants to know about movement patterns in buildings from the design results of softball stadiums that have been made. This stadium is located in Surabaya. The planning of a softball stadium is also based on the need for the city of Surabaya as one of the hosts in an international event (Asian Youth Games). The laying of the site itself refers to data from the Surabaya City Development Planning Agency in 2005 (Surabaya, 2005) which is located in the foot of the Suramadu bridge. The stadium is a building that is public and can accommodate many users, including spectators, managers and athletes. Clarity about connectivity, integration and intelligence is needed for all stadium users, both in the outer and inner spaces (Klarqvist, 1993). Broadly speaking, the mass of the softball stadium building is quite large and consists of several outer rooms with wide corridors based on the zoning that has been made in the floor plan design process. (Putra, 2013).

Connectivity is an indicator in calculating interconnected spaces between one space and another. So that it can be concluded as an arrangement of space configurations to obtain the level of interaction with the spaces around it. Integration is a measurement pattern for each space against other spaces that are still in the same space configuration and this is a conclusion point for assessing existing data. Intelligence is a combination of assessments of connectivity and integration which will later show a correlation from the measurement results. These three patterns are used as a measuring tool to obtain achievement results in buildings. Space syntax is able to develop space configurations based on activity and psychological level for each individual (Mahendra, 2007). Not only space on a city scale, space on a building scale can also measure the interaction between space and its users (Puspitasari, 2020).

According to (Putra, 2013) Softball stadiums must provide a level of comfort, safety and clarity for user accessibility in the form of circulation or signage as well as spatial pattern configuration structures. Judging from the large number of users who use the stadium facilities simultaneously, the purpose of this study is to assess and readjust the spatial layout pattern inside and outside the stadium to get maximum accessibility in terms of connectivity and integration. There was a spread of access to activities by visitors based on their individual wishes before, during and after the game took place. This research focuses on the basic pattern of movement and distribution of users to determine the level of ease due to user activity in relation to accessibility which influences and is closely related to the configuration of spatial patterns in a softball stadium. This refers to the suitability of the size of the existing space. However, as the main point, the stadium must be able to provide complete and adequate facilities for each user, especially for the spectators.

THEORY / RESEARCH METHODS

The effectiveness of human mobility can be seen from the flow pattern of each human movement in the relationship between the building and the surrounding environment. The space syntax method is used to adjust and get the right spatial configuration pattern by combining qualitative and quantitative descriptive. In addition, the spatial configuration analysis obtained related to the adjustment of spatial patterns in the stadium is used to determine the layout between spaces so that they function properly and are able to provide convenience or difficulty in achieving space for its users. Space syntax is a method that builds attachments to patterns of relationships between spaces with spatial configurations in measuring instruments of spatial interaction in the form of graphics and statistics. This method also explains the arrangement of spatial configuration patterns, relationships between spaces, and spatial boundaries as well as all the movement of activities in it. The use of Space Syntax analysis is able to form road network patterns to foster integration and connectivity as well as intelligence which is felt to be lacking (Ulvianti, 2018).

According to Permana et al. (2020) in a design building it is necessary to have convenience in terms of circulation where the close distance between the nodes as the observation area with the path which is the circulation path. The use of space syntax is used as a measuring tool in analyzing layout drawings or building plans related to the clarity of space (intelligibility) so that users can easily understand the activities in it. (Nurhalimah & Astuti, 2020). This will later provide an overview of easy accessibility for users in the softball stadium building. Through the use of DepthMap software it is possible to determine the level of connectivity, integrity and intelligence of the spaces in it in relation to the users. Space syntax connectivity calculates the amount of space that exists and is directly related to other spaces but still in a space configuration (Hillier et al., 1986) (Hillier et al., 1993). In connectivity, it is found that the level of interaction between one room and another space that is nearby. Integrity itself measures the position of space to other spaces but still in a spatial configuration (Hillier & Hanson, 1989) (Hillier et al., 1993). In integrity, values are found from all available spaces but the configuration is still the same. Intelligibility shows more about the relationship between connectivity and integrity (Hillier et al., 1986) (Hillier et al., 1993). Intelligibility measurements are able to provide results from spatial systems.

Space syntax is a tool to test and get information related to the desired spatial formation and is based on spatial analysis parameters (Dursun, 2007). Clarity regarding accessibility will be presented in the axial line graph and visibility line graph which makes it easy to search for space in the building. According to Hillier (2007), there are four important elements in analyzing using space syntax, namely:

a. Space syntax in a city space
b. Space syntax provides spatial network analysis tailored to placement, building orientation and grouping
c. Space syntax observes the spatial network related to functional movement patterns

d. Space syntax develops existing theories and is then connected to networks in general to form a character

Objects are interdependent on one another in a network structure pattern and can be referred to as a configuration (Hillier et al., 1986) (Hillier & Hanson, 1989) (Hillier, 2007). Natural movement or so-called human movement sees the parameters of visitor activity in a building (Hillier et al., 1993).

The stadium is a building that contains facilities in the form of a large field and is surrounded by stands or seats for spectators (Ishak, 2019). Because the stadium consists of a large field, the stadium generally functions as a venue for sporting matches and music concerts. Because its function is for events that involve many people, of course the size of the stadium building is also very large to accommodate all visitors. In order to increase the comfort of the stadium building, the stadium will usually be equipped with various facilities and consists of many rooms.

Stadium consists of many types, one of which is a softball stadium. Softball (softball) was first introduced in the United States which then entered Indonesia in 1960. Currently, softball in Indonesia has developed a lot and the athletes have many achievements. Indonesian male athletes are ranked 19th and female 23rd based on the World Baseball and Softball Confederation (WBSC) (Pradnyaswari & Budisetyani, 2018). Judging from the many achievements that have been achieved, this sport is considered to have great potential to be increasingly in demand by the people of Indonesia.

Spaces in Buildings

Spatial planning in architectural composition aims to create good spatial arrangements, have accessibility between spaces that can support user activities in buildings, improve psychological quality for users so as to create a sense of security and comfort, as well as one of the parts that affect the aesthetics of the building. Spatial planning does not only pay attention to geometric shapes but also the arrangement of spaces so as to create harmony. In general, a room is formed from three basic elements, namely the ceiling, walls, and floor (Prabowo et al., 2019).

Space Syntax

Space syntax is a technique that can be used to estimate, analyze, calculate, measure, and interpret a spatial configuration (Barada & Mutiari, 2013). The purpose of using space syntax techniques is to develop an understanding of how space works effectively. This technique already uses computer-based technology and is based on spatial pattern rules through empirical observation of how a spatial pattern will be used so that visitors can find out the movement patterns.

The results of the analysis of space syntax are in the form of intelligibility values or spatial clarity in the space configuration. The intelligibility value will be directly proportional to the level of activity that will occur in the room. The higher the value, the more activities are carried out and the higher the level of accessibility of visitors in a room.

RESULT AND DISCUSSION

The biggest main problem is that there are still many stadiums in Indonesia that have not implemented the pattern of movement of visitors in the building properly and correctly, so that there are still crowds and even density inside the stadium which makes users uncomfortable. In addition, the stadium must be able to provide convenience for visitors who are inside the stadium to access other supporting spaces. The stadium must be able to capture the basic pattern of visitor movement within the building regarding the influence of visitor distribution and accessibility in terms of spatial configuration (Nurhalimah & Astuti, 2020). The circulation of a building must provide convenience in searching for the spaces inside which are based on relevant spatial analysis (Natapov et al., 2015).

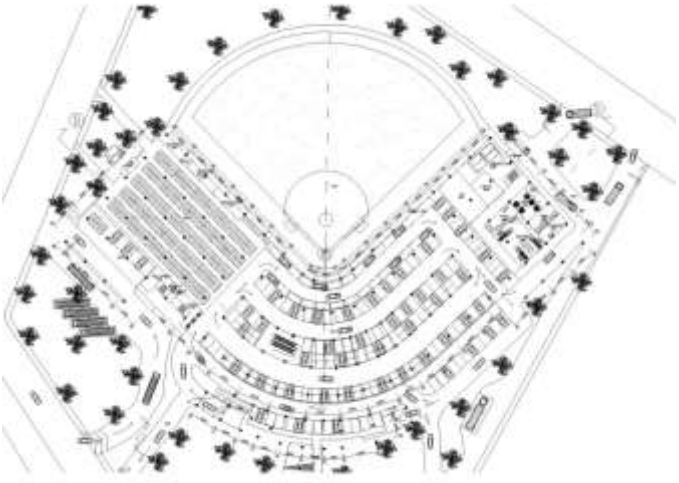


Figure 1. Floor plan of softball stadium 1
Source: Putra, 2013

Figure 2. Floor plan of softball stadium 2
Source: Putra, 2013

The planning capacity of a softball stadium in Surabaya can accommodate as many as 3,000 spectators, so there is a need for parsing and easy accessibility for users in it (Putra, 2013). Density always occurs at the beginning and end of a sports match in the stadium building. Laying out spatial and circulation patterns is important to reduce density and provide convenience for visitors to access various spaces in the stadium. Ease of accessibility can be monitored by means of descriptive qualitative and quantitative to determine the level of connectivity, integrity and intelligence with a space syntax approach. DepthMap is used as a measuring tool in getting measurable data results.

Figure 3. Floor plan of softball stadium 3
Source: Putra, 2013

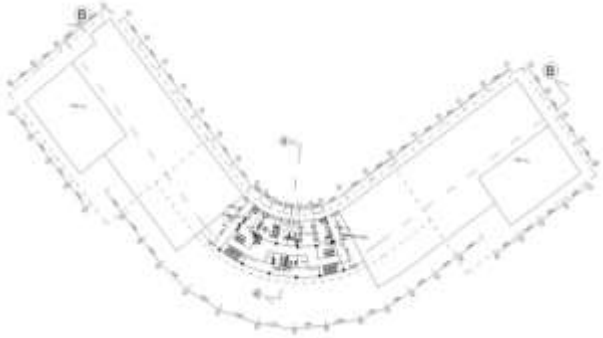


Figure 4. Floor plan of softball stadium 4
Source: Putra, 2013

The softball stadium in Surabaya has a symmetrical floor plan pattern on both sides with various spatial functions inside. The floor plan implemented is able to accommodate all visitors who are active in it, whether watching matches or carrying out other supporting activities. The building consists of several zones to make it easier for users inside to carry out their activities so that their functions and purposes do not mix up. The zoning presented in this softball stadium building is athlete zoning, manager zoning, spectator zoning and match organizer zoning. In some of

these zoning areas, there are several spaces that are interconnected for the needs of the activities within them. The spaces presented are adjusted to the function and capacity that has been planned according to the function of each zoning and are not mixed between one zoning and another. In Figures 1 to Figure 4 are the spatial formation and floor plan of the softball stadium with the conditions before the connectivity, integrity and intelligibility data analysis calculations were carried out. From the design data of the softball stadium building plan from the ground floor to the 3rd floor (Figure 1-4) an analysis will be carried out to determine the movement patterns of visitors in space from the spatial configuration using DepthMap X-0.7.0. This softball stadium building has a floor plan of up to 4 floors which will be known through the use of space syntax analysis for each area of the floor plan to determine the connectivity in the existence of the interior space.

Connectivity Analysis

In the early stages of the analysis using the principle of axial line connectivity to obtain and know the results of the connectivity connectivity calculation values of the spaces inside on each floor plan of the building. This achievement is to manage the connectivity between the distance and the depth of the softball stadium in Surabaya.

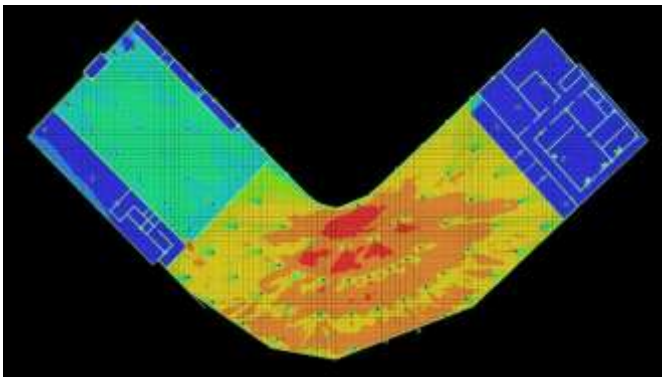


Figure 5. Axial line connectivity floor plan of 1 softball stadium
Source: Research team, 2023

From the value data in Figure 5 for the 1st floor plan of the softball stadium building, it can be seen that the car park area that is on the inside or top side with a smaller number of parking lots has a very high level of circulation interaction. The high level of circulation interaction is due to the shorter travel length of the car vehicle lane when compared to the circulation area of the car park below it. It can also be said that the parking area on the upper side has a sharper circulation curve than the circulation path for car vehicles below, which is also the area most frequently traversed by car vehicles. In principle, the range is shorter, but the density of vehicles is denser and more.

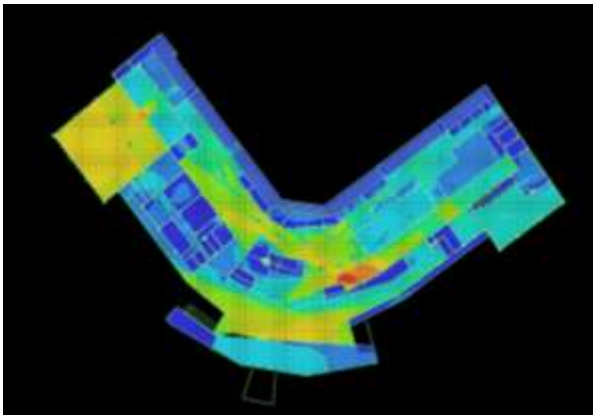


Figure 6. Axial line connectivity 2nd floor plan of softball stadium
Source: Research team, 2023

For the softball stadium building on the 2nd floor, by looking at Figure 6, it can be judged that the exit area has the highest spatial interaction. This is because of the visitor movement patterns in the building which are mandatory and always accumulate in this area when a match is over. In addition, visitors must have a short exit behavior to avoid long-term accumulation in the building, so access to multiple exits is a must have for a stadium. The exit area of the stadium building must also be able to provide good flow of circulation from inside to outside of the building, whether an emergency occurs or not. It can be said that the exit area of this building has the highest connection with the entrance area or gate ticketing. Where this area is directly next to each other, with the intention of making it easier for visitors when they have entered the softball stadium building and can come back out of this stadium building.

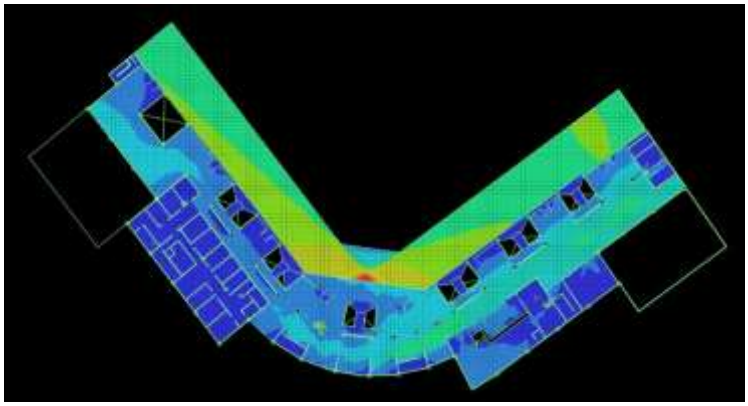


Figure 7. Axial line connectivity 3rd floor plan of softball stadium
Source: Research team, 2023

On the 3rd floor of the softball stadium building as shown in Figure 7, the results of the assessment showed that the largest interaction area was in the center of the spectator stands area. This point is the area directly behind the softball pitcher and hitter. In addition, this area is also the most comfortable point in getting the

viewing angle for the audience to watch a softball match. In other words, the tribune area is the area most in demand by the audience every time there is a softball game with easy access to reach it. Meanwhile, the other seats in the adjacent tribune area are ranked in a hierarchical order for the level of comfort in watching the match.

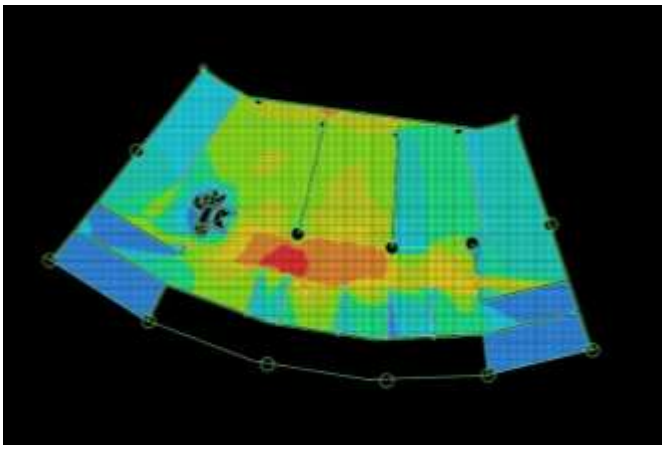


Figure 8. Axial line connectivity 4th floor plan of softball stadium
Source: Research team, 2023

Functionally, the 4th floor of the softball stadium building is more for private matters. Here it consists of spaces that are not allowed and cannot be accessed by the general public. It can be seen in Figure 8 where the 4th floor of the softball stadium for the results of the interaction assessment between rooms is the largest in the central circulation area, directly in front of the access to the VIP elevator opening. This point is the most widely accessed because the main access to this floor only uses vertical circulation, namely the elevator, apart from the existence of an emergency staircase which can be used as vertical circulation in the event of an emergency on or on this floor. This area also acts as a liaison between the rooms on the 4th floor and the floor below.

Integrity Analysis

The next stage is also an analysis using the principle of axial line integrity. At this stage the value of integration is an aspect of one's ease in achieving a space. This is seen from the aspect of circulation path density related to the effectiveness of accessibility in buildings between spaces.

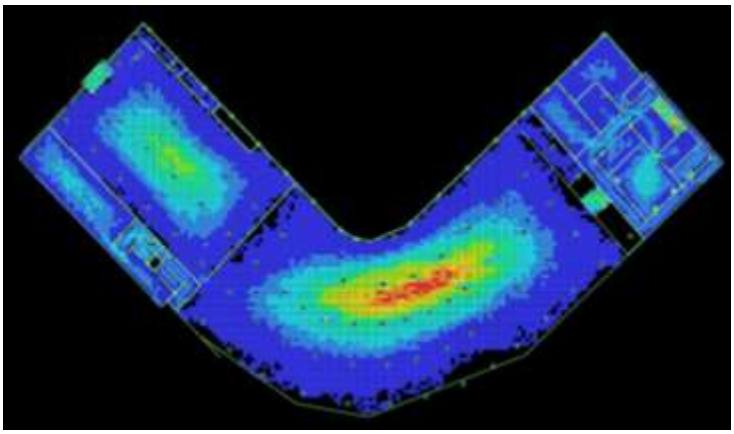


Figure 9. Axial line integrity floor plan of 1 softball stadium
Source: Research team, 2023

From the results of the integrity analysis for the floor plan of the softball building on the 1st floor, it was found that the middle part of the car park area has a very high integrity value. This makes this area the easiest to reach and reach and integrated with various surrounding spaces. This area itself is an open area without any partitions so that softball stadium users can easily reach it. This floor itself is dominated by service and public zoning spaces.

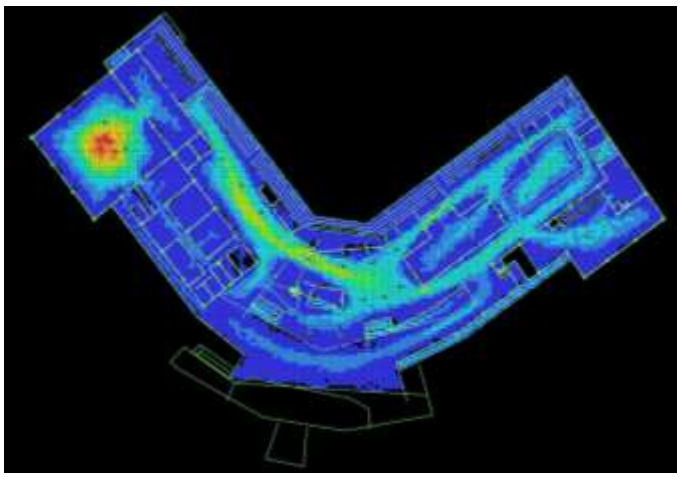


Figure 10. Axial line integrity floor plan of 2 softball stadium
Source: Research team, 2023

Meanwhile, on the 2nd floor plan, the integrity results were the easiest to achieve for the other rooms, namely in the indoor training area. This area has the largest and widest spatial scale so that the reach point is easier to find. This space can easily reach the inner or upper corridor area of the softball

building plan which can then be reached back easily to other parts of the room.

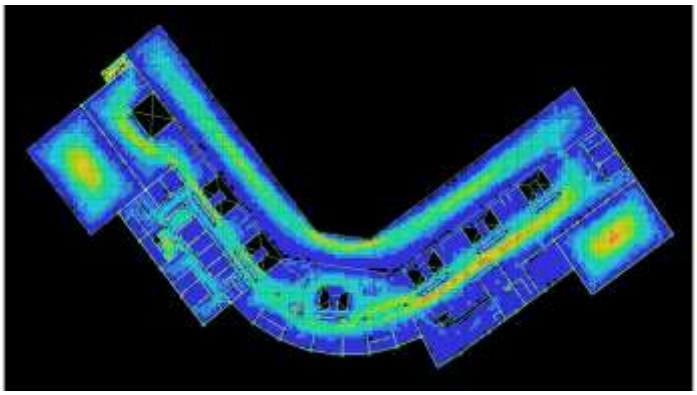


Figure 11. Axial line integrity floor plan 3 softball stadium
Source: Research team, 2023

When seen in Figure 11, in outline the integrity pattern of the softball building on the 3rd floor plan, it can be seen that the achievement points are scattered in several areas. Here it can be concluded that the areas that can easily reach and have the highest achievement with other spaces are in the inner corridor. In this area, visitors can easily reach one room with another which is designed to form an open space without a partition.

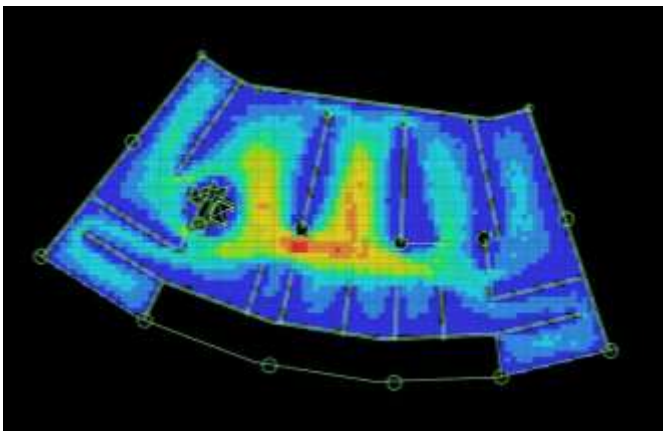


Figure 12. Axial line integrity floor plan 4 softball stadium
Source: Research team, 2023

While the results of the calculation analysis using the axial line integrity pattern on the 4th floor, it was found that the area that is easiest for users to reach is the corridor space. Where this area is the main access to get to the surrounding rooms considering that this floor only has a few special rooms or rooms (VIP). So indirectly the corridor on this floor plays a major role in making it easy to reach other spaces.

Intelligibility Analysis

The intelligibility value is obtained from the analysis of the results of the relationship between the connectivity value and the integrity value, in which the intelligibility value is to obtain the clarity value of the two variables. In principle, the relationship between a space can be easily recognized if the values of the two variables are getting stronger.

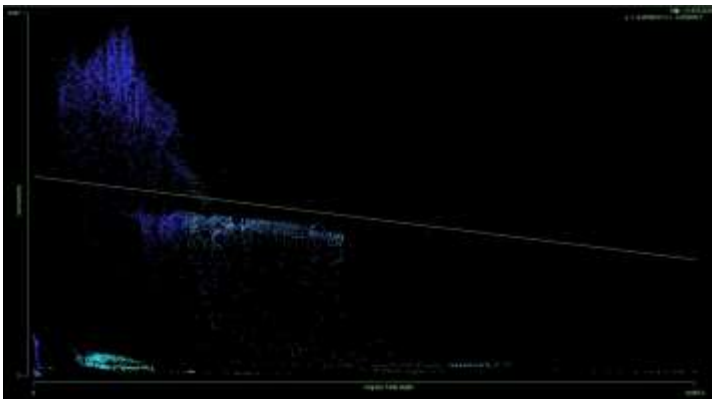


Figure 13. Axial line intelligibility floor plan of a softball stadium
Source: Research team, 2023

For the results of the intelligibility analysis on the first floor of the softball stadium building, from Figure 13, a value of 0.0072 is obtained, which is due to the spatial arrangement pattern in the stadium which is wide and open in the parking lot area. So that the reach of people in accessing one room to another is quite far due to the broad floor plan. So that with this form, it can be seen that the condition of the spatial configuration system is not optimal and that everyone in their activities is not sufficiently available. Clearer spatial patterns are needed so that the attainment and relationships between spaces can be easily understood by stadium visitors.

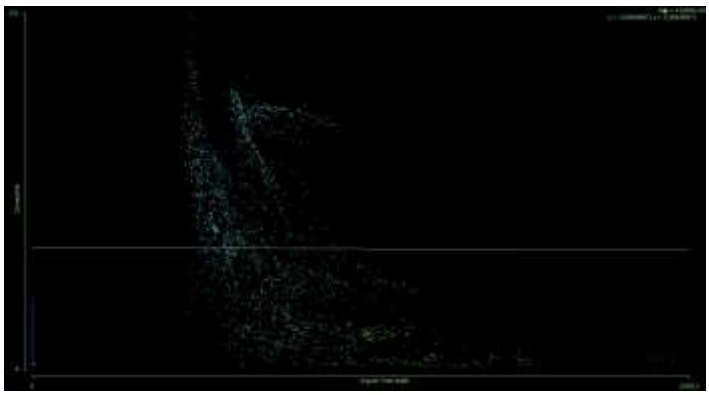


Figure 14. Axial line intelligibility softball stadium floor plan 2
Source: Research team, 2023

On the 2nd floor of the softball stadium plan, there are spaces that are quite complex and more general in nature because this floor is the point where the floor area has the most reach and access to other rooms. The results of the intelligibility analysis value on the 2nd floor plan are 4.53093, which means that this floor has a spatial configuration structure that is not very good in terms of ease of accessibility. This makes the quality of the space for the convenience of activities not available properly and requires rearrangement of the placement of the spaces.

Figure 15. Axial line intelligibility floor plan of 3 softball stadium
Source: Research team, 2023

Meanwhile, on the 3rd floor (Figure 15) in the floor plan of this softball stadium, the intelligence analysis results obtained a value of 0.00083. From the results of these figures it is also concluded that on the 3rd floor it is still not well organized for the conditions of the existing rooms. This is because on this floor there are many circulation paths with a large enough area for access to the stands. Therefore, the condition of the spatial pattern structure with the floor plan configuration still does not provide ease of activity for the audience. So it is necessary to clarify the access paths in the stadium for each space configuration for visitors.

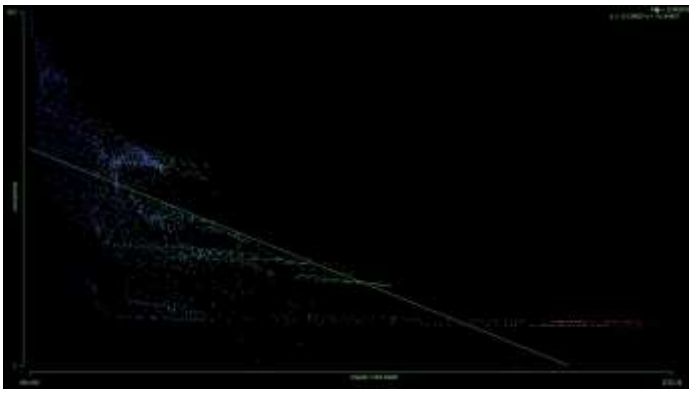


Figure 16. Axial line intelligibility softball stadium 4th floor plan
Source: Research team, 2023

When seen in Figure 16, the results of the intelligibility analysis are obtained with a value of 0.546, which means that it has a spatial configuration that is close to number 1 where the structure and configuration of the spaces inside are good. This makes optimal quality and ease of achievement clear for each space. The 4th floor plan has an area that is quite small or not as large as the floors below it, so that the reach and reach between the spaces becomes clearer and better. So that in setting the distance between spaces it must be clear the boundaries and the direction of achievement in each of these spaces.

CONCLUSIONS

By mapping the axial line pattern for the correlation of space syntax connectivity and integrity, it can be concluded that the circulation pattern of achieving a space for a person's convenience and the relationship related to the distance and depth of space with the amount of space available is influenced by the function and area of the space formed. From the results of data processing using space syntax, it was also concluded that visitors will choose and pass through areas that have spaces that are large in terms of dimensions and easy to reach between one space and another. Apart from that, space syntax is able to provide analysis results related to distribution for users in the softball stadium building as well as movement to and from other spaces starting from high intensity spaces. The pattern of relationships between spaces for ease of user activity feels very far reaching, especially on floors 1 to 3. There needs to be a clear connection on these floors to understand the structure of the space configuration for the users there. Meanwhile, the floor that has the most optimal quality with an intelligibility value close to 1 is the 4th floor, where on this floor the activity area is quite close together and not too wide. So, in general, it can be concluded that the shape of the space, the size of the space and the area of the space have a big influence on the formation of accessibility and ease of achievement in a space in the softball stadium building plan. In general, the conclusion is that in designing a building, especially a softball stadium, the space requirements must be clear and easy for users to achieve. Apart from that, the connection between spaces to support user activities in the building must be easily known through the connectedness of the configuration between the spaces. The zoning divider is important to create separation between users and to make it easier to divide the accessibility and quality of distribution of each zone.

The suggestion from the results of this space syntax analysis research is that basically a softball stadium building has a spatial composition that has various functions within it, so the layout of the spatial composition that can be used as a standard is to readjust it to help produce the right shape and plan for a softball stadium. next.

ACKNOWLEDGMENT

We thank LPPM Darma Cendika Catholic University for supporting all of this research activity from start to finish and for the publication of this publication so that its implementation can run well. We also thank all the lecturers in the UKDC

architecture study program for their support and attention. It is also hoped that this research will be able to provide benefits to the government both at the center and in the regions as a reference in facilitating user activities in the stadium.

REFERENCES

Aryan, N. P., & Potangaroa, R. (2014). *Space and Culture Using Space Syntax for the Tenganan Pageringsingan Housing of Bali, Indonesia*.

Barada, W. P., & Mutiari, D. (2013). Analisis Space Syntax Rumah Susun Berbasis Gang Kampung. *Simposium Nasional RAPI XII*, 59–63.

Dursun, P. (2007). Space syntax in architectural design. *6th International Space Syntax Symposium*, 1–56.

Hillier, B. (2007). *Space is the machine: a configurational theory of architecture*. Space Syntax.

Hillier, B., Burdett, R., Peponis, J., & Penn, A. (1986). Creating life: or, does architecture determine anything? *Architecture & Comportement/Architecture & Behaviour*, *3*(3), 233–250.

Hillier, B., & Hanson, J. (1989). *The social logic of space*. Cambridge university press.

Hillier, B., Penn, A., Hanson, J., Grajewski, T., & Xu, J. (1993). Natural movement: or, configuration and attraction in urban pedestrian movement. *Environment and Planning B: Planning and Design*, *20*(1), 29–66.

Ishak, L. F. (2019). Perancangan Sistem Buka Tutup Atap Stadion Otomatis Berbasis Mikrokontroler ATMEGA 328P. *Jurnal Litek : Jurnal Listrik Telekomunikasi Elektronika*, *16*(2), 36. https://doi.org/10.30811/litek.v16i2.1456

Klarqvist, B. (1993). *A Space Syntax Glossary. Nordisk Arkitektur for Skning,(2). 11*, *12*.

Mahendra, W. (2007). Logika Konfigurasi Ruang dan Aspek Psikologi Ruang Bagi Lansia. *Jurnal Rekayasa Perencanaan*, *4*(1).

Natapov, A., Kuliga, S., Dalton, R. C., & Hölscher, C. (2015). Building circulation typology and space syntax predictive measures. *Proceedings of the 10th International Space Syntax Symposium*, *12*, 13–17.

Nurhalimah, D., & Astuti, D. W. (2020). Analisis Hubungan Konfigurasi Ruang dengan Penyebaran Pengunjung Pasar Klewer Menggunakan Space Syntax. *Jurnal Sinektika*, *17*(1), 13–20.

Permana, A. Y., Permana, A. F. S., & Andriyana, D. (2020). Konfigurasi ruang berdasarkan kualitas konektivitas ruangan dalam perancangan kantor: Space syntax analysis. *Jurnal Arsitektur Zonasi*, *3*(2), 155–170.

Prabowo, A., Al-Ghifari, M. A. A., Fadlilah, F. N., Pakuan, G. M., & Zulfahmi, M. H. (2019). Identifikasi Material Berkelanjutan Pada Ruang Luar Dan Ruang Dalam Bangunan Kantor. *Jurnal Arsitektur ZONASI*, *2*(3), 160. https://doi.org/10.17509/jaz.v2i3.19492

Pradnyaswari, A. A. A., & Budisetyani, I. G. P. W. (2018). Hubungan Kecerdasan Emosional Dengan Kecemasan Bertanding Pada Atlet Softball Remaja Putri Di Bali. *Jurnal Psikologi Udayana*, *5*(01), 218.

https://doi.org/10.24843/jpu.2018.v05.i01.p20

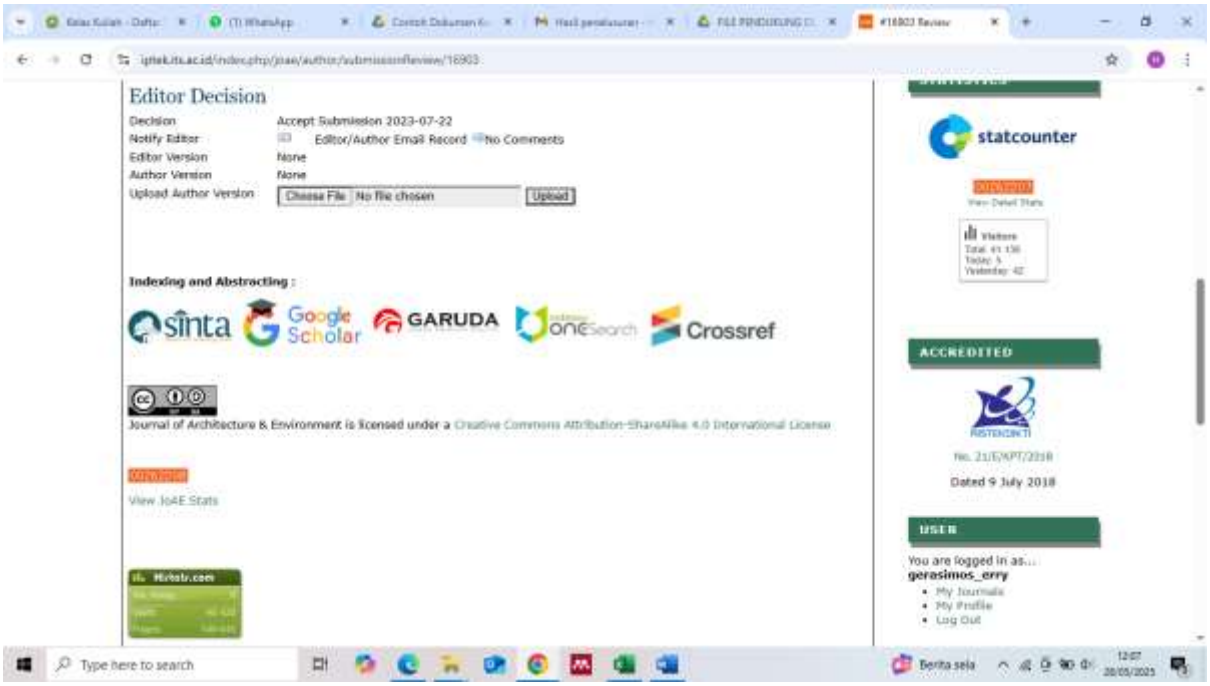
Puspitasari, C. (2020). Metode analisis space syntax pada penelitian interaksi kota multibudaya. *Lakar: Jurnal Arsitektur*, *3*(01).

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

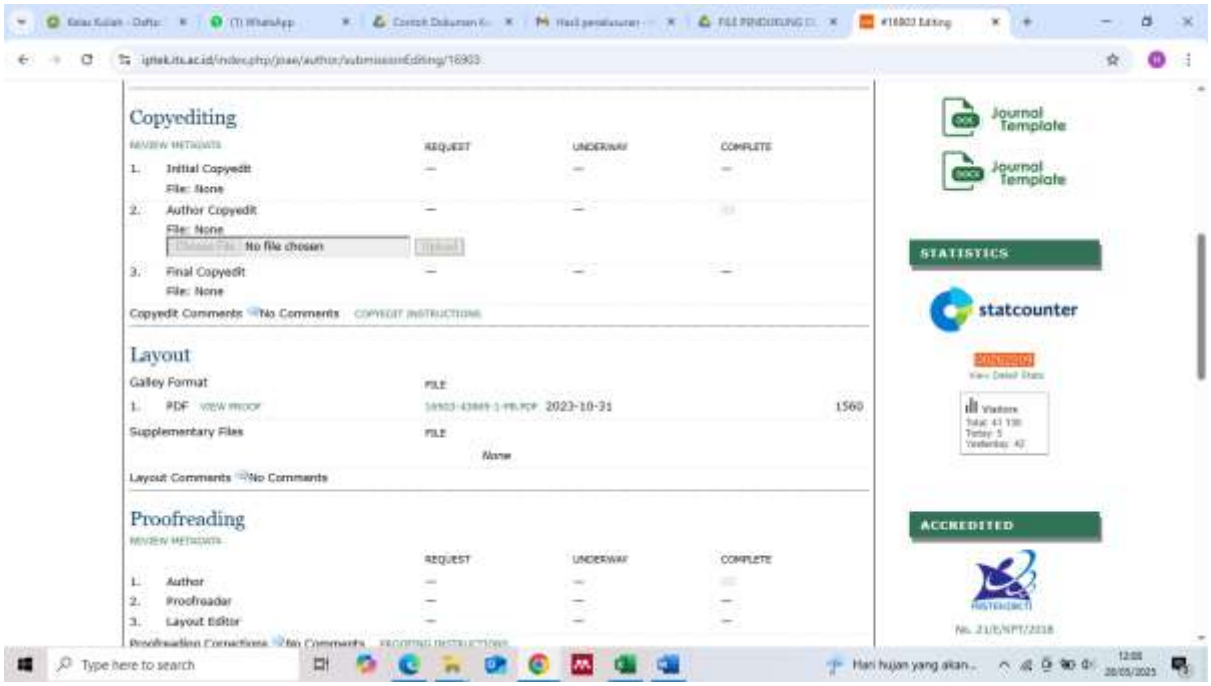
Siregar, J. P. (2014). Metodologi dasar space syntax dalam analisis konfigurasi ruang. *Malang: Universitas Brawijaya*.

Surabaya, B. P. P. K. (2005). Rencana detail tata ruang kawasan unit pengembangan. *Surabaya: BAPPEKO*.

4. Bukti konfirmasi artikel accepted (22 Juli 2023)



5. Bukti konfirmasi artikel published online (31 Oktober 2023)



SPACE SYNTAX IN ADJUSTMENT OF SPACE PATTERNS OF SOFBOL STATIONS IN SURABAYA

Heristama Anugerah Putra*, Prabani Setio Hastorahmanto*
*) Department of Architecture, Faculty of Engineering, Darma Cendika Catholic University
e-mail: heristama.putra@ukdc.ac.id

ABSTRACT

Stadiums generally have much access to entrances and exits; this is related to the spectator capacity of the stadium, which is quite a lot. The ease of user activity with the existing spatial configuration structure is unknown. The adjustment of the softball stadium plan is intended to provide a level of clarity in the pattern of relationships between spaces and a level of ease of accessibility in achieving these spaces. Apart from that, it is also essential to know and understand the fundamental movement patterns of users in it. The space syntax analysis method is used to find clarity regarding the pattern of configuration of relationships between spaces in the ease of outreach of activities for users in the stadium. Analysis related to connectivity, integrity and intelligibility patterns can provide the appropriate picture results in an axial line. The expected result is that the pattern of relationships between spaces for ease of user activity in them feels very far-reaching, especially on the 1st to 3rd floors. There needs to be a clear link on these floors to understand the spatial configuration structure for the users inside. The floor with the most optimal quality with an intelligibility value close to 1 is floor 4, where on this floor, the range of activities is relatively close together and not too wide.

Keywords: *Stadium, Space syntax, Space configuration, Accessibility, Movement patterns*

INTRODUCTION

Infrastructure development in Indonesia continues to be carried out, especially in sports, to focus on improving the world of sports from an early age in terms of coaching. Most of the infrastructure built in the field of sports is in the form of fields, stadiums and other supporting buildings that are useful for the improvement of athletes. However, most of the existing stadiums, especially in Indonesia, still need to implement the user circulation pattern properly, even though with the ongoing construction, this pattern has been implemented for the better. As one of the achievements, the stadium has international standards, namely by looking at the quality of the field, besides looking at the direction of circulation and achieving space for users. Good achievement is not only inside the building but can be seen and started

from outside. Spatial patterns influence cultural patterns that arise in society, so they must be displayed in forming new spatial ideas (Aryan & Potangaroa, 2014). The importance of human movement can be the main parameter in developing an area, both large and small scale, in the form of buildings (Siregar, 2014).

Seeing this, the author develops and wants to know about movement patterns in buildings from the design results of softball stadiums that have been made. This stadium is located in Surabaya. The planning of a softball stadium is also based on the need for the city of Surabaya as one of the hosts of an international event (Asian Youth Games). The laying of the site itself refers to data from the Surabaya City Development Planning Agency in 2005 (Surabaya, 2005), which is located at the foot of the Suramadu Bridge. The stadium is a building that is public and can accommodate many users, including spectators, managers and athletes. Clarity about connectivity, integration and intelligence is needed for all stadium users, both in the outer and inner spaces (Klarqvist, 1993). The mass of the softball stadium building is quite large and consists of several outer rooms with wide corridors based on the zoning that has been made in the floor plan design process. (Putra, 2013).

Connectivity is an indicator in calculating interconnected spaces between one space and another. So that it can be concluded as an arrangement of space configurations to obtain the level of interaction with the spaces around it. Integration is a measurement pattern for each space against other spaces that are still in the same space configuration, and this is a conclusion point for assessing existing data. Intelligence is a combination of assessments of connectivity and integration, which will later show a correlation from the measurement results. These three patterns are used as a measuring tool to obtain achievement results in buildings. Space syntax can develop space configurations based on activity and psychological level for each individual (Mahendra, 2007). Not only space on a city scale but space on a building scale can also measure the interaction between space and its users (Puspitasari, 2020).

According to (2013), Softball stadiums must provide a level of comfort, safety and clarity for user accessibility in the form of circulation or signage as well as spatial pattern configuration structures. Judging from the large number of users who use the stadium facilities simultaneously, the purpose of this study is to assess and readjust the spatial layout pattern inside and outside the stadium to get maximum accessibility in terms of connectivity and integration. There was a spread of access to activities by visitors based on their wishes before, during and after the game took place. This research focuses on the basic pattern of movement and distribution of users to determine the level of ease due to user activity regarding accessibility, which influences and is closely related to the configuration of spatial patterns in a softball stadium. This refers to the suitability of the size of the existing space. However, as the main point, the stadium must provide complete and adequate facilities for each user, especially for the spectators.

THEORY / RESEARCH METHODS

The effectiveness of human mobility can be seen from the flow pattern of each human movement in the relationship between the building and the surrounding environment. The space syntax method is used to adjust and get the correct spatial configuration pattern by combining qualitative and quantitative descriptive. In addition, the spatial configuration analysis obtained related to the adjustment of spatial patterns in the stadium is used to determine the layout between spaces so that they function correctly and can provide convenience or difficulty in achieving space for its users. Space syntax is a method that builds attachments to patterns of relationships between spaces with spatial configurations in measuring instruments of spatial interaction in the form of graphics and statistics. This method also explains the arrangement of spatial configuration patterns, relationships between spaces, and spatial boundaries, as well as all the movement of activities in it. Space Syntax analysis can form road network patterns to foster integration connectivity and intelligence, which is lacking (Ulvianti, 2018).

According to Permana et al. (2020,) in a design building, it is necessary to have convenience in terms of circulation where the close distance between the nodes is the observation area with the path, which is the circulation path. Space syntax is used as a measuring tool in analyzing layout drawings or building plans related to the clarity of space (intelligibility) so that users can easily understand its activities. (Nurhalimah & Astuti, 2020). This will later provide an overview of easy accessibility for users in the softball stadium building. Through the use of DepthMap software, it is possible to determine the level of connectivity, integrity and intelligence of the spaces about the users. Space syntax connectivity calculates the amount of space that exists and is directly related to other spaces but still in a space configuration (Hillier et al., 1986) (Hillier et al., 1993). In connectivity, it is found that the level of interaction between one room and another space that is nearby. Integrity measures the position of space to other spaces but still in a spatial configuration (Hillier & Hanson, 1989) (Hillier et al., 1993). In integrity, values are found from all available spaces, but the configuration is still the same. Intelligibility shows more about the relationship between connectivity and integrity (Hillier et al., 1986) (Hillier et al., 1993). Intelligibility measurements can provide results from spatial systems.

Space syntax is a tool to test and get information related to the desired spatial formation and is based on spatial analysis parameters (Dursun, 2007). Clarity regarding accessibility will be presented in the axial line graph and visibility line graph, which makes it easy to search for space in the building. According to Hillier (2007), there are four essential elements in analyzing using space syntax, namely:

a. Space syntax in a city space
b. Space syntax provides spatial network analysis tailored to placement, building orientation and grouping.
c. Space syntax observes the spatial network related to functional movement patterns.
d. Space syntax develops existing theories and is then connected to networks in general to form a character.

Objects are interdependent on one another in a network structure pattern and can be referred to as a configuration (Hillier et al., 1986) (Hillier & Hanson, 1989) (Hillier, 2007). Natural movement,t or human movement, is the parameter of visitor activity in a building (Hillier et al., 1993).

The stadium is a building that contains facilities in the form of a large field and is surrounded by stands or seats for spectators (Ishak, 2019). Because the stadium consists of a large field, the stadium generally functions as a venue for sporting matches and music concerts. Because its function is for events that involve many people, of course, the size of the stadium building is also huge to accommodate all visitors. In order to increase the comfort of the stadium building, the stadium will usually be equipped with various facilities and many rooms.

Stadiums consist of many types, one of which is a softball stadium. Softball (softball) was first introduced in the United States and then entered Indonesia in 1960. Currently, softball in Indonesia has developed a lot, and the athletes have many achievements. Indonesian male athletes are ranked 19th and females 23rd based on the World Baseball and Softball Confederation (WBSC) (Pradnyaswari & Budisetyani, 2018). Judging from the many achievements that have been achieved, this sport has excellent potential to be increasingly in demand by the people of Indonesia.

Spaces in Buildings

Spatial planning in architectural composition aims to create suitable spatial arrangements, have accessibility between spaces that can support user activities in buildings, and improve psychological quality for users to create a sense of security and comfort, as well as one of the parts that affect the aesthetics of the building. Spatial planning does not only pay attention to geometric shapes but also the arrangement of spaces to create harmony. In general, a room is formed from three essential elements, namely the ceiling, walls, and floor (Prabowo et al., 2019).

Space Syntax

Space syntax is a technique that can be used to estimate, analyze, calculate, measure, and interpret a spatial configuration (Barada & Mutiari, 2013). The purpose of using space syntax techniques is to develop an understanding of how space works effectively. This technique already uses computer-based technology and is based on spatial pattern rules through empirical observation of how a spatial pattern will be used so visitors can find the movement patterns.

The results of the space syntax analysis are in the form of intelligibility values or spatial clarity in the space configuration. The intelligibility value will be directly proportional to the level of activity in the room. The higher the value, the more activities are carried out and the higher the accessibility of visitors in a room.

RESULTS AND DISCUSSION

The most significant problem is that there are still many stadiums in Indonesia that need to implement the pattern of movement of visitors in the building properly and correctly, so there are still crowds and even density inside the stadium, which makes users uncomfortable. In addition, the stadium must provide convenience for visitors inside the stadium to access other supporting spaces. The stadium must capture the basic pattern of visitor movement within the building regarding the influence of visitor distribution and accessibility in terms of spatial configuration (Nurhalimah & Astuti, 2020). The circulation of a building must provide convenience in searching for the spaces inside, which are based on relevant spatial analysis (Natapov et al., 2015).

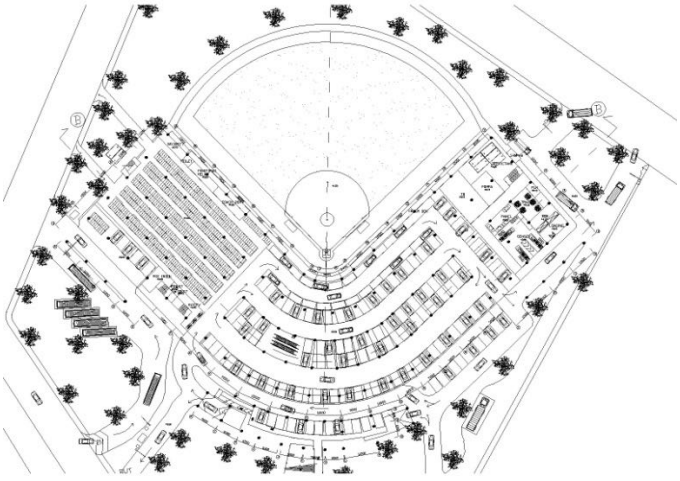


Figure 1. Floor plan of softball stadium 1
Source: Putra, 2013

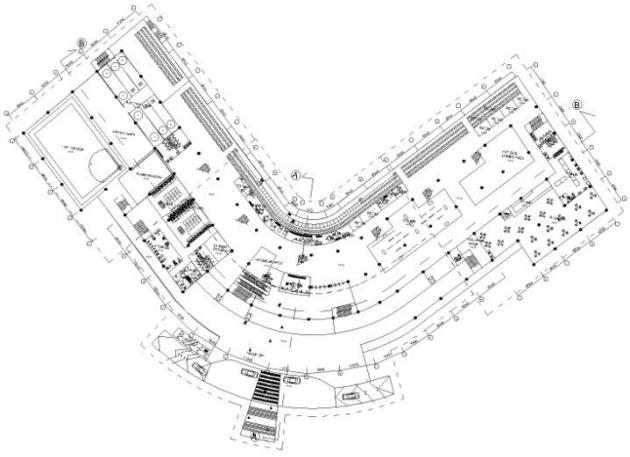


Figure 2. Floor plan of softball stadium 2
Source: Putra, 2013

The planning capacity of a softball stadium in Surabaya can accommodate as many as 3,000 spectators, so there is a need for parsing and easy accessibility for users (Putra, 2013). Density always occurs at the beginning and end of a sports match in the stadium building. Laying out spatial and circulation patterns is essential to reduce density and provide convenience for visitors to access various spaces in the stadium. Ease of accessibility can be monitored using descriptive qualitative and quantitative methods to determine the level of connectivity, integrity and intelligence with a space syntax approach. DepthMap is used as a measuring tool for getting measurable data results.

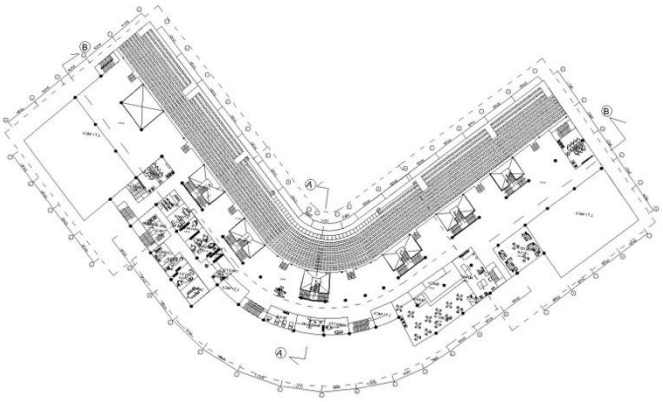


Figure 3. Floor plan of softball stadium 3
Source: Putra, 2013

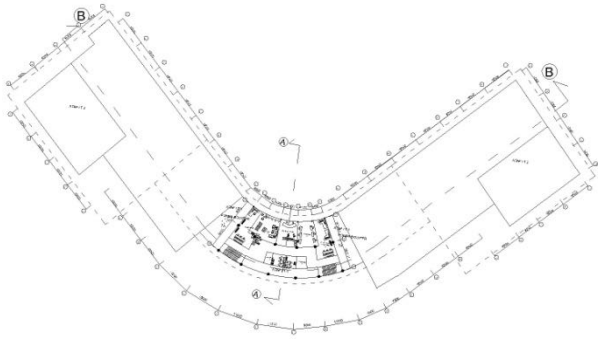


Figure 4. Floor plan of softball stadium 4
Source: Putra, 2013

The softball stadium in Surabaya has a symmetrical floor plan on both sides with various spatial functions inside. The floor plan is implemented to be able to accommodate all visitors who are active in it, either watching matches or carrying out other supporting activities. In Figure 1 to Figure 4 are the spatial formations and floor plans of a softball stadium with conditions prior to calculating data connectivity, integrity and intelligibility analysis. From the design data of the softball stadium building plan from the ground floor to the 3rd floor (Figure 1-4), an analysis will be carried out to determine the movement patterns of visitors in the room from the spatial

configuration arrangement using DepthMap X-0.7.0. This softball stadium building has a floor plan of up to 4 floors, which will be known through the use of space syntax analysis for each area of the plan to find out the connectedness in the existence of the inner space.

Connectivity Analysis

In the early stages of the analysis, you are using the principle of axial line connectivity to obtain and know the results of the connectivity calculation values of the spaces inside each floor plan of the building. This achievement is to manage the connectivity between the distance and the depth of the softball stadium in Surabaya.

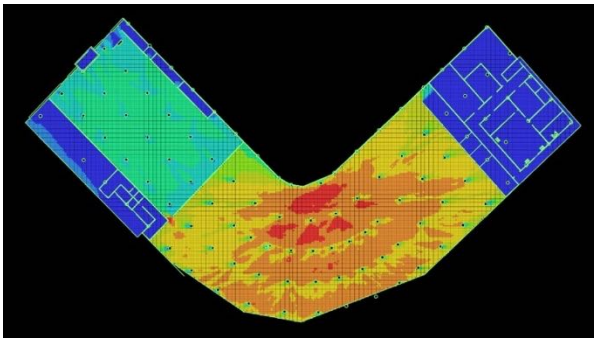


Figure 5. Axial line connectivity floor plan of 1 softball stadium
Source: Research team, 2023

From the value data in Figure 5 for the 1st-floor plan of the softball stadium building, it can be seen that the car park area on the inside or top side with fewer parking lots has a very high level of circulation interaction. The high level of circulation interaction is due to the shorter travel length of the car vehicle lane when compared to the circulation area of the car park below it. The parking area on the upper side has a sharper circulation curve than the circulation path for vehicles below, which is also the area most frequently traversed by car vehicles. In principle, the range is shorter, but the density of vehicles is denser and more.

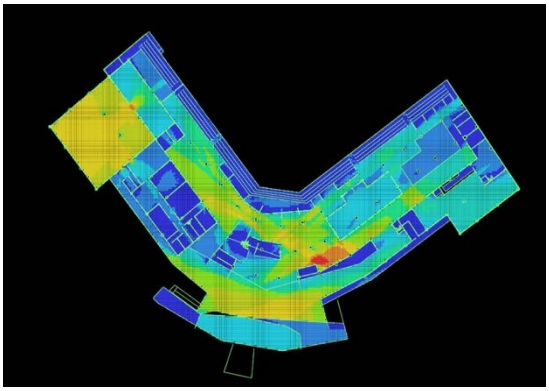


Figure 6. Axial line connectivity 2nd floor plan of softball stadium

Source: Research team, 2023

For the softball stadium building on the 2nd floor, by looking at Figure 6, it can be judged that the exit area has the highest spatial interaction. This is because of the visitor movement patterns in the building, which are mandatory and always accumulate in this area when a match is over. In addition, visitors must have a short exit behaviour to avoid long-term accumulation in the building, so access to multiple exits is a must-have for a stadium. The exit area of the stadium building must also be able to provide a good circulation flow from inside to outside of the building, whether an emergency occurs or not. The exit area of this building has the highest connection with the entrance area or gate ticketing, which are directly next to each other, to make it easier for visitors when they enter the softball stadium building and come back out of it.

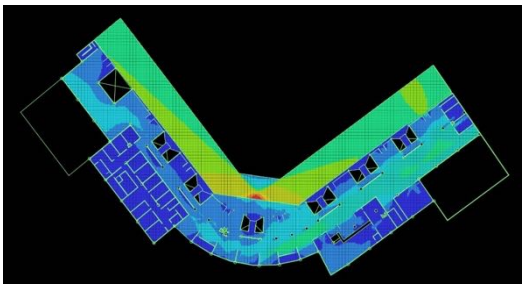


Figure 7. Axial line connectivity 3rd floor plan of softball stadium
Source: Research team, 2023

On the 3rd floor of the softball stadium building, as shown in Figure 7, the assessment results showed that the largest interaction area was in the centre of the spectator stands area. This point is the area directly behind the softball pitcher and hitter. In addition, this area is also the most comfortable point in getting the viewing angle for the audience to watch a softball match. In other words, the tribune area is most in demand by the audience whenever there is a softball game with easy access. Meanwhile, the other seats in the adjacent tribune area are ranked hierarchically for the comfort level in watching the match.

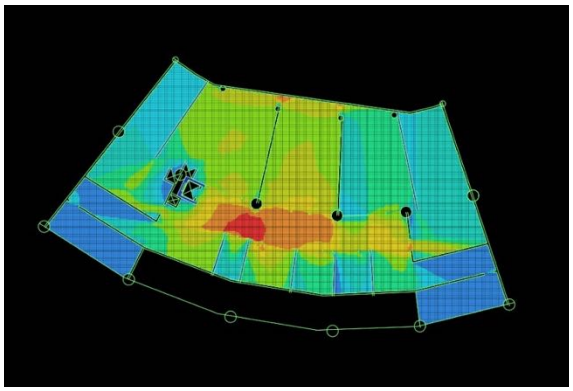


Figure 8. Axial line connectivity 4th floor plan of softball stadium
Source: Research team, 2023

Functionally, the 4th floor of the softball stadium building is more for private matters. Here, it consists of spaces that are not allowed and cannot be accessed by the general public. It can be seen in Figure 8 where the 4th floor of the softball stadium for the results of the interaction assessment between rooms is the largest in the central circulation area, directly in front of the access to the VIP elevator opening. This point is the most widely accessed because the primary access to this floor only uses vertical circulation, namely the elevator, apart from an emergency staircase, which can be used as vertical circulation in the event of an emergency on or on this floor. This area also acts as a liaison between the rooms on the 4th floor and the floor below.

Integrity Analysis

The next stage is also an analysis using the principle of axial line integrity. At this stage, the value of integration is an aspect of one's ease in achieving a space. This is seen from the aspect of circulation path density related to the effectiveness of accessibility in buildings between spaces.

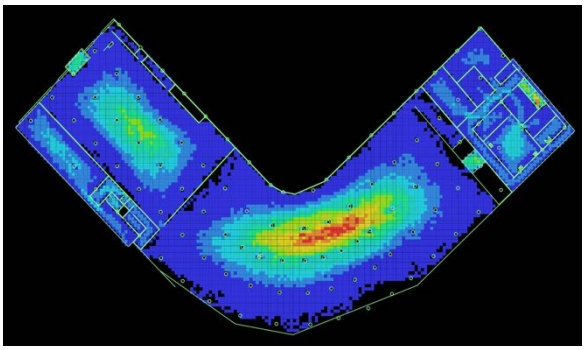


Figure 9. Axial line integrity floor plan of 1 softball stadium
Source: Research team, 2023

From the results of the integrity analysis for the floor plan of the softball building on the 1st floor, it was found that the middle part of the car park area has a very high integrity value. This makes this area the easiest to reach and reach and integrate with various surrounding spaces. This area itself is an open area without any partitions so that softball stadium users can easily reach it. This floor itself is dominated by service and public zoning spaces.

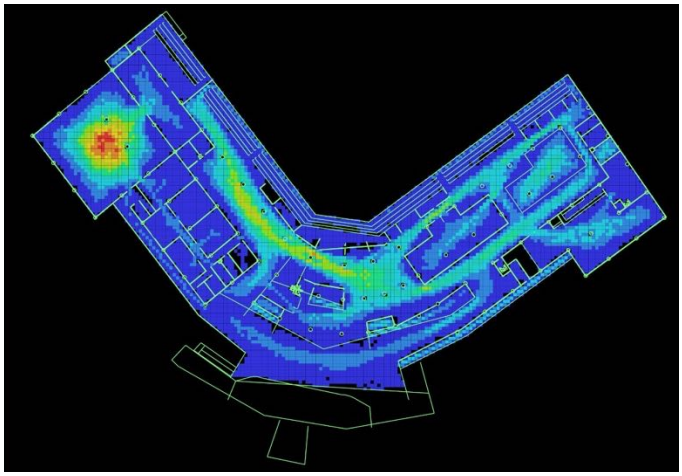


Figure 10. Axial line integrity floor plan of 2 softball stadium
Source: Research team, 2023

Meanwhile, on the 2nd floor plan, the integrity results were the easiest for the other rooms, namely in the indoor training area. This area has the most significant and broadest spatial scale so that the reach point is easier to find. This space can easily reach the inner or upper corridor of the softball building plan, which can be reached back easily to other parts of the room.

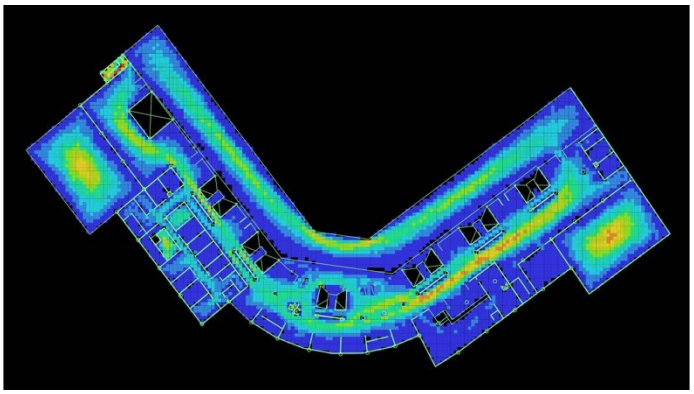


Figure 11. Axial line integrity floor plan three softball stadium
Source: Research team, 2023

In Figure 11, in the outline of the integrity pattern of the softball building on the 3rd-floor plan, it can be seen that the achievement points are scattered in several areas. Here, the areas that can easily reach and have the highest achievement with other spaces are in the inner corridor. In this area, visitors can easily reach one room with another, designed to form an open space without a partition.

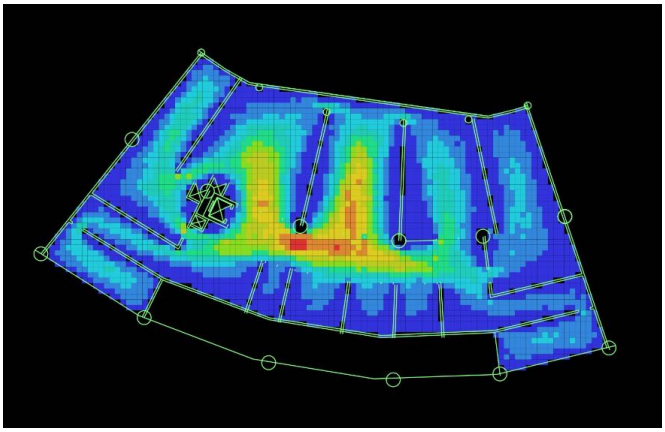


Figure 12. Axial line integrity floor plan four softball stadium
Source: Research team, 2023

While the results of the calculation analysis using the axial line integrity pattern on the 4th floor, it was found that the area that is easiest for users to reach is the corridor space. This area is the primary access to the surrounding rooms, considering that this floor only has a few unique rooms or rooms (VIP). The corridor on this floor plays a significant role in making it easy to reach other spaces.

Intelligibility Analysis

The intelligibility value is obtained from the analysis of the results of the relationship between the connectivity value and the integrity value, in which the intelligibility value is to obtain the clarity value of the two variables. In principle, the relationship between a space can be easily recognized if the values of the two variables are getting stronger.

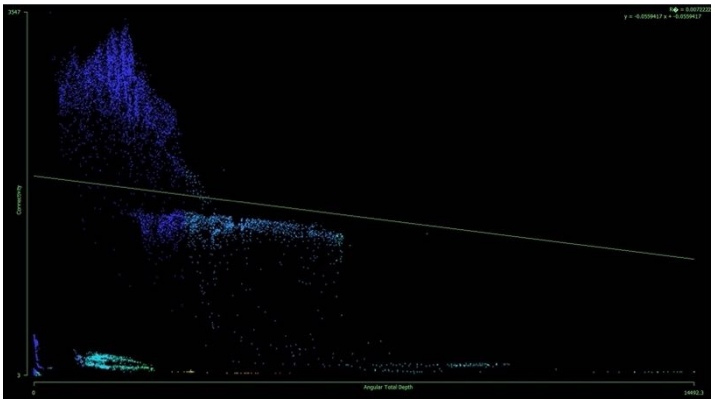


Figure 13. Axial line intelligibility floor plan of a softball stadium
Source: Research team, 2023

For the results of the intelligibility analysis on the first floor of the softball stadium building, from Figure 13, a value of 0.0072 is obtained, which is due to the

spatial arrangement pattern in the stadium, which is wide and open in the parking lot area so that the reach of people in accessing one room to another is quite far due to the broad floor plan. So, with this form, the condition of the spatial configuration system is not optimal, and everyone in their activities needs to be sufficiently available. More precise spatial patterns are needed so that stadium visitors can easily understand the attainment and relationships between spaces.

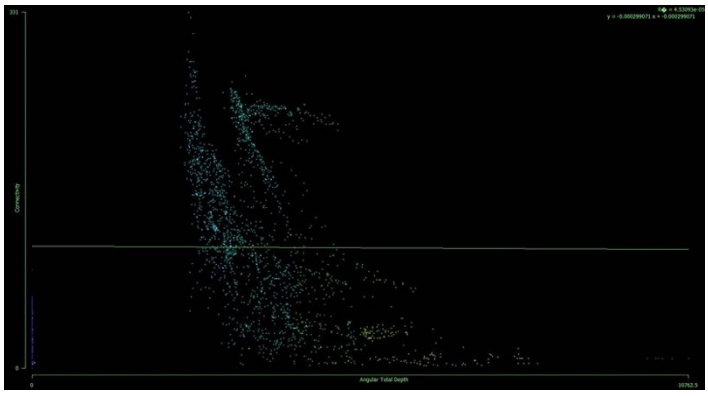


Figure 14. Axial line intelligibility softball stadium floor plan 2
Source: Research team, 2023

On the 2nd floor of the softball stadium plan, some spaces are complex and more general because this floor is the point where the floor area has the most reach and access to other rooms. The results of the intelligibility analysis value on the 2nd-floor plan are 4.53093, which means that this floor has a spatial configuration structure that is not very good in terms of ease of accessibility. This makes the quality of the space for the convenience of activities not available properly and requires rearrangement of the placement of the spaces.

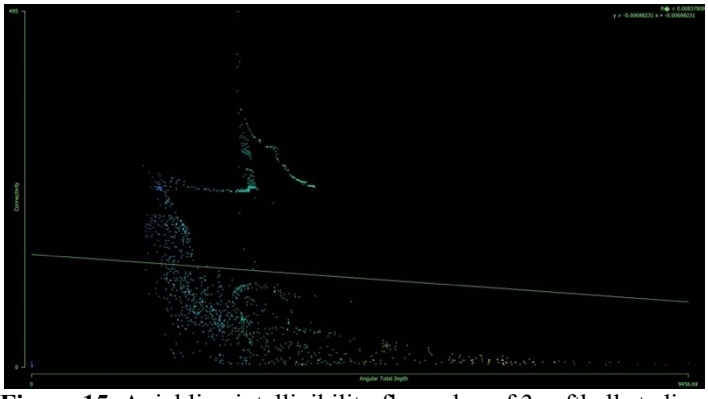


Figure 15. Axial line intelligibility floor plan of 3 softball stadium
Source: Research team, 2023

Meanwhile, on the 3rd floor (Figure 15), in the floor plan of this softball stadium, the intelligence analysis results obtained a value of 0.00083. From the results of these figures, it is also concluded that the 3rd floor still needs to be better organized for the

conditions of the existing rooms. This is because, on this floor, there are many circulation paths with a large enough area for access to the stands. Therefore, the condition of the spatial pattern structure with the floor plan configuration still needs to provide ease of activity for the audience. So, it is necessary to clarify the access paths in the stadium for each space configuration for visitors.

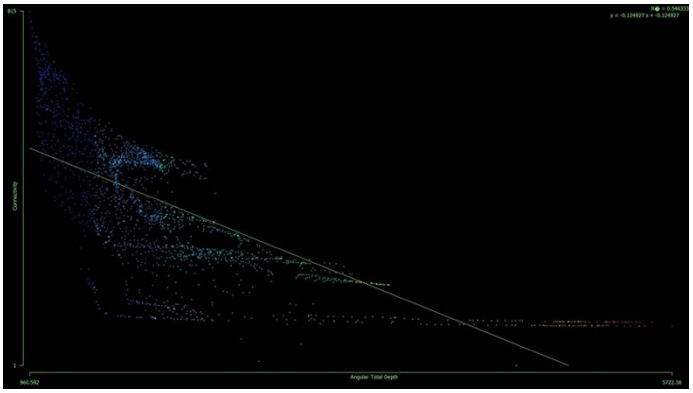


Figure 16. Axial line intelligibility softball stadium 4th-floor plan
Source: Research team, 2023

As seen in Figure 16, the results of the intelligibility analysis are obtained with a value of 0.546, which means that it has a spatial configuration close to number 1, where the structure and configuration of the spaces inside are good. This makes optimal quality and ease of achievement clear for each space. The 4th-floor plan has an area relatively small or not as large as the floors below it so that the reach and reach between the spaces become more transparent and better. So, in setting the distance between spaces, the boundaries and the direction of achievement in each of these spaces must be clear.

CONCLUSIONS

By mapping the axial line pattern for the correlation of space syntax connectivity and integrity, it can be concluded that the circulation pattern of reaching space is for one's convenience and the relationship related to the distance and depth of space with the number of available spaces is influenced by the function and extent of the space formed. From the results of data processing using the space syntax, it is also concluded that visitors will choose and pass through areas with spaces with broad shapes in dimensions and are easy to reach between one room and another. In addition, space syntax can provide analysis results related to the spread for users in softball stadium buildings and movements to and from other spaces that start from high-intensity spaces. In the pattern of inter-room relationships for ease of user activity, it feels very far-reaching, especially on the 1st to 3rd floors. There needs to be a clear link on these floors to understand the spatial configuration structure for the users inside. The floor that has the most optimal quality with an intelligibility value close to 1 is floor 4, where on this floor, the range of activities is relatively close together and not too wide.

In general, it can be concluded that the shape of the room, the size of the room and the area of the room have a significant influence on the formation of accessibility for the ease of reaching a room in the softball stadium building plan.

Suggestions from the results of this space syntax analysis research are that a softball stadium building has a spatial composition with various functions in it. Hence, the spatial composition that can be used as a standard is to readjust it to help bring out the exact shape and layout of a softball stadium next.

ACKNOWLEDGMENT

We thank LPPM Darma Cendika Catholic University for supporting all of this research activity from start to finish and for the publication of this publication so that its implementation can run well. We also thank all the lecturers in the UKDC architecture study program for their support and attention. It is also hoped that this research will benefit the central government and the regions as a reference in facilitating user activities in the stadium.

REFERENCES

Aryan, N. P., & Potangaroa, R. (2014). *Space and Culture Using Space Syntax for the Tenganan Pegringsingan Housing of Bali, Indonesia*.

Barada, W. P., & Mutiari, D. (2013). Analisis Space Syntax Rumah Susun Berbasis Gang Kampung. *Simposium Nasional RAPI XII*, 59–63.

Dursun, P. (2007). Space syntax in architectural design. *6th International Space Syntax Symposium*, pp. 1–56.

Hillier, B. (2007). *Space is the machine: a configurational theory of architecture*—space Syntax.

Hillier, B., Burdett, R., Peponis, J., & Penn, A. (1986). Creating life: Or does architecture determine anything? *Architecture & Comportement/Architecture & Behaviour*, *3*(3), 233–250.

Hillier, B., & Hanson, J. (1989). *The social logic of space*. Cambridge University Press.

Hillier, B., Penn, A., Hanson, J., Grajewski, T., & Xu, J. (1993). Natural movement: or configuration and attraction in urban pedestrian movement. *Environment and Planning B: Planning and Design*, *20*(1), 29–66.

Ishak, L. F. (2019). Perancangan Sistem Buka Tutup Atap Stadion Otomatis Berbasis Mikrokontroler ATMEGA 328P. *Jurnal Litek : Jurnal Listrik Telekomunikasi Elektronika*, *16*(2), 36. https://doi.org/10.30811/litek.v16i2.1456

Klarqvist, B. (1993). *A Space Syntax Glossary. Nordisk Arkitektur for Skning,(2). 11, 12*.

Mahendra, W. (2007). Logika Konfigurasi Ruang dan Aspek Psikologi Ruang Bagi Lansia. *Jurnal Rekayasa Perencanaan*, *4*(1).

Natapov, A., Kuliga, S., Dalton, R. C., & Hölscher, C. (2015). We are building circulation typology and space syntax predictive measures. *Proceedings of the*

10th International Space Syntax Symposium, *12*, 13–17.

Nurhalimah, D., & Astuti, D. W. (2020). Analisis Hubungan Konfigurasi Ruang dengan Penyebaran Pengunjung Pasar Klewer Menggunakan Space Syntax. *Jurnal Sinektika*, *17*(1), 13–20.

Permana, A. Y., Permana, A. F. S., & Andriyana, D. (2020). Konfigurasi ruang berdasarkan kualitas konektivitas ruangan dalam perancangan kantor: Space syntax analysis. *Jurnal Arsitektur Zonasi*, *3*(2), 155–170.

Prabowo, A., Al-Ghifari, M. A. A., Fadlilah, F. N., Pakuan, G. M., & Zulfahmi, M. H. (2019). Identifikasi Material Berkelanjutan Pada Ruang Luar Dan Ruang Dalam Bangunan Kantor. *Jurnal Arsitektur ZONASI*, *2*(3), 160. https://doi.org/10.17509/jaz.v2i3.19492

Pradnya Swari, A. A. A., & Budi Setyani, I. G. P. W. (2018). Hubungan Kecerdasan Emosional Dengan Kecemasan Bertanding Pada Atlet Softball Remaja Putri Di Bali. *Jurnal Psikologi Udayana*, *5*(01), 218. https://doi.org/10.24843/jpu.2018.v05.i01.p20

Puspitasari, C. (2020). Metode analisis space syntax pada penelitian interaksi kota multibudaya. *Lakar: Jurnal Arsitektur*, *3*(01).

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

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

Surabaya, B. P. P. K. (2005). Rencana detail tata ruang kawasan unit pengembangan. *Surabaya: BAPPEKO*.

This Page is Intentionally Left Blank