

Spatial Analysis of the Potential Placement of Public Open Space in Settlements Using Space Syntax in Taman Griya Jimbaran Residence, Bali

Putu Gede Wahyu Satya Nugraha¹, Cokorda Istri Arina Cipta Utari²,
I Komang Agus Satriawan Tri Saputra³

^{1,2,3}Architecture Department, Warmadewa University, Denpasar, Bali, Indonesia-80239

Email address: putugedewahyu@gmail.com¹

Abstract— One of the highly populated neighborhoods in South Kuta District is Jimbaran Village. The recorded population of Jimbaran Village in 2021 is 42,117, which represents 36.96% of the 113,919 total residents in the South Kuta District. Public space is necessary as a location to socialize since a large population must be balanced with positive social contact. The location of public space needs to be at a convenient area that may serve as a meeting spot. By employing Space syntax analysis, this study seeks to uncover spatial patterns and accessibility in Taman Griya Residence. The Space syntax approach may be used to conduct an analysis based on this data and make suggestions for where in Taman Griya Residence the public spaces should be located. Local and global public open spaces may be included in the public open space that has been obtained for installation. Local public open space may be utilized on Jalan Danau Batur Raya, however, global public open space may be used on Jalan Danau Buyan Barat, which is Jalan Danau Batur Raya's counterpart. Given the high importance placed on comprehensibility ($R=0.953212$), it seems sensible that public open space should be situated where locals can easily access it and where it may be used as a gathering spot. Public open spaces could be segmented into several regions to promote greater social interaction in the residential community.

Keywords— Public open space, settlements, space syntax.

I. INTRODUCTION

One of the most populous neighborhoods in South Kuta District is Jimbaran Village. The recorded population of Jimbaran Village in 2021 is 42,117, which represents 36.96% of the 113,919 total residents in the South Kuta District [1]. One of the settlements in the Jimbaran Village is the Taman Griya Jimbaran Residence. The population is relatively dense with an area of around 36.5 hectares and containing more than 500 housing units. A high population must be balanced with good social interaction so public space is needed as a place to socialize. Social facilities play a big part in residential areas since they turn into places where people congregate. Social events including community gatherings, plays, health programs, and other social events are held at social facilities [2]. The location of public space must be located in a place that is easily accessible and can function as a gathering point. Based on these problems, this study aims to identify spatial patterns and accessibility in Taman Griya Residence by using Space syntax analysis. Based on these data, an analysis can be carried out with the help of the Space syntax technique to

provide recommendations for the appropriate placement of public spaces in Taman Griya Residence. The method used in this research is a quantitative and experimental approach. Through the use of simulation, the researcher created a recommended strategy for this experimental investigation and tested it against a model for problem-solving. In order to see connectedness or interrelationships between spaces and spatial integration of the residential road network, the location of this public space is analyzed using the Space syntax analysis approach using the DepthmapX program. The various locations for the deployment of public open space may then be related to the space's connectedness and integration. A place can have strong accessibility and be simple to reach if there is adequate connectedness and integration of Space syntax. Due to its great accessibility and potential as a tourist attraction and destination, this region might be thought of as the ideal location for public open space.

A. Public Open Space

Public space is basically empty space (open space) which is very useful, with a void it can contain various activities in it. Apart from that, in urban spatial planning, there is open space for city-binding spaces so that there is a link or connection between spaces within the city. This empty space is also called architecture without a roof, where this space, with the parable of the floor, is from the earth, the walls are the presence of buildings and nature around it, and the roof is the sky.

According to Rustam Hakim, that space is a container that is not real but its existence can be felt. This feeling can be obtained from the five senses that humans have, whose function is to feel something. Space can be seen by the naked eye form. Space can also be felt by subtle touches on human skin. Space also has an aroma of the same taste. Rustam Hakim highlighted space as an existence that can be felt both physically and by using the five senses that humans have [3].

When quoted from experts, according to Carr, public space is a place where life together occurs. Of course, activities that occur in public spaces are carried out together, although they can be at different times and for different purposes. Streets, squares and city parks also give shape to the ups and downs of dynamic human life [4]. Meanwhile, Rob Krier (Purwanto, 2014) defines it as the space between urban and regional buildings. Krier explained in more detail physically that public

space is a space that is formed between building masses. This opinion is almost the same as Eko Budihardjo who stated that public space is a space that is outside the building or is in an open space. Krier prefers to call public spaces urban spaces [4].

Public open space functions as a communicative node and means as well as a social binder to create interactions between community groups and as a gathering place on a daily basis and on special occasions [5]. Therefore, it can be concluded that public open space is an open space that is outside the building that can be used by humans, both individually and in groups to carry out daily activities, such as: walking, exercising, recreation, socializing, and others [6].

From the several definitions put forward by several experts, it can be concluded that public open space is an open space that is outside the building that can be used by humans, both individually and in groups to carry out daily activities, such as: walking, exercising, recreation, socialization, and others.

B. Space Syntax

Space syntax is a theory of space and a set of analytical, quantitative, and descriptive tools for analyzing spatial formations in various forms: buildings, cities, interior spaces, or landscapes. The main goal of Space syntax is to find the relationship between humans and the space they inhabit. It is believed that the distinctive characteristics of society exist in the spatial system, and their knowledge is conveyed through space itself, and through spatial organization [7].

Space syntax refers to the relational characteristics of this space as configurations and proposes the idea that it is these characteristics that shape human behavior so that they contain social knowledge. Creating descriptive ways to set up the environment it inhabits in a way that the underlying social meanings may be realized is the aim of space syntax study. The impacts of spatial layout on various social or cultural factors might then be the subject of secondary theories or frequently, practical explanations. Understanding the configuration space, particularly its formative processes and social meanings, is a relevant issue in space syntax study.

Space syntax is a tool that can be used to understand space by focusing on spatial organization, movement patterns, and social meaning. The resulting space design is not only a physical space and static, but as a life that can be felt by its inhabitants. The space syntax analysis system can use the DepthMapX application. This application was developed to facilitate analysis so that the results obtained are easier to understand. The DepthMapX application can be used to analyze individual movements in circulation according to the needs of the analysis. Analysis in the DepthMapX application includes axial line analysis, convex space analysis, visibility graph analysis, and agent analysis [7].

a. Axial Line Analysis

The system of axial line analysis will pay attention to line elements with the research subject being a movement. This system analyses the relationship of interrelated lines. This system is used when carrying out structural analysis in urban, rural, or environmental areas.

b. Convex Space Analysis

The system of convex space analysis will pay attention to social interactions in one space. Analysis of space is based on two aspects, namely space shows non-linear behavior between public spaces and buildings.

c. Visibility Graph Analysis

Visibility graph analysis is used on research subjects who describe a complex behavior. This analysis is based on the field of view seen by the individual so that it can determine the behavior patterns of people in a space. This analysis is used when it requires an analysis of the building.

d. Agent Analysis

The agent analysis system is based on individuals who are in an environment and these individuals are left to make decisions about movement within that environment.

The DepthMapx application uses the visual range overlay method to calculate visual analysis, resulting in the gradation of colors in the spatial configuration. The resulting gradation color becomes a parameter value in calculating the space value. Dark blue is the color with the lowest calculation value, while red is the color with the highest calculation value [7]. The resulting color gradations as parameter values in spatial analysis calculations can be seen in Figure 1 below.

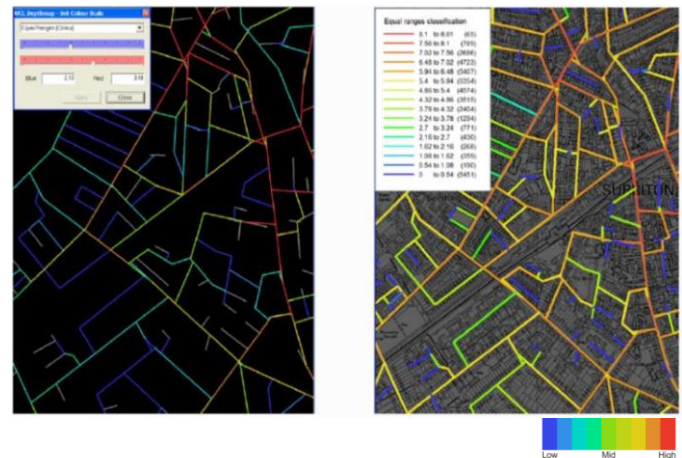


Fig. 1. Example of Space syntax axial line analysis results

C. Connectivity, Integration, and Intelligibility

According to Hillier and Hanson, connectivity essentially only measures the configuration space that is directly related to the other configuration space. In essence, connectivity refers to the number of roads that connect the observed path [8]. Comparing each original space's configuration to other spaces in a system is the process of integration. It typically counts how close the observation space is to all other spaces to determine relative asymmetry (or relative depth) [9].

Integration fundamentally serves as a gauge for a road's (or center's) degree of network integration. Integration could be viewed as the possibility of the final destination. The integration value increases with the number of places that are linked to the observation room. A region may have good accessibility and be the most accessible if there is adequate connectedness and integration of space syntax. Because of its high accessibility, the area might be thought of as the ideal location for placing public open spaces.

The highest measurement step in space syntax is intelligibility. The intelligibility value quantifies the relationship between local scale measurements (connectivity) and global scale measurements (integrity). Therefore, a measure of a spatial configuration's structure is its intelligibility. Unlike connection and integrity measurements, which will result in the results being a property of each space, intelligibility measures' conclusions will become a property of the room configuration system.

II. RESEARCH METHOD

This research used a quantitative method with an experimental approach [9]. In order to determine the possibilities for the placement of public spaces in the form of social amenities in densely populated settlements in Jimbaran Village, the Taman Griya Residence was utilized as a case study in this research. Through connecting integration and connection to the current traffic patterns in these communities. The researcher created a recommended plan by going through a simulation study and testing the problem-solving plan model for this experimental research, which was carried out using simulation [10]. The research case's existing data are used in this simulation study. Only the confines of the investigated and simulated cases are used for intervention.

A. Data collection method

In this study, the purposive sampling method was employed, and the region chosen was one of the densest settlements in Jimbaran Village that lacked suitable public spaces or social services at the time. Purposive sampling, sometimes referred to as the judgement sampling approach, is a deliberate decision made by the researcher based on predetermined criteria in order to increase the sample's long-term representativeness [11]. Data are gathered using both primary and secondary sources. Primary data is gathered by field observations in order to define the actual physical geometry of the route and the observation area. On the other side, secondary data relates to research on space syntax. Using data from the Badung Regency regional map and Google Earth satellite images.

B. Data Analysis

The road network in communities is spatially integrated and connected to the prospective locations for the deployment of public open space using an axial analysis of space syntax. Using DepthmapsX software (Multi-Platform Spatial Network Analysis Software) from UCL, space syntax simulation was carried out. In order to determine the possibilities for the placement of public spaces in the form of social amenities in densely populated settlements in Taman Griya Jimbaran Residence was utilized as a case study in this study.

Based on observations of the organic movement of the various grid layouts of the local road network, this analytical approach replicates spatial arrangement. These actions result from a number of reasons, one of which is the attraction (attractors). The movement of pedestrians' steps is therefore seen to be determined by this attraction [12]. The potential appeal of this area will be utilized to build social amenities that, in general, residents of the community may readily reach.

III. RESULTS

A. Connectivity

To determine the degree of interaction between each room and its neighboring rooms, connectivity measurements are performed. By summing together all the rooms that are directly connected to the observation room, the connection value for each room is calculated. Connectivity is seen as a potential sub-sectional or local goal in the analysis's findings. The findings of the integration research, meanwhile, reflect the region for possible worldwide destinations. The outcome of the Space Syntax connection study is shown in Figure 2 and Table I below.



Fig. 2. Taman Griya Jimbaran residence connectivity analysis

TABLE I. Connectivity Analysis

Attribute	Minimum	Average	Maximum
Connectivity	0	2,45722	6

As can be seen in Figure 2, the dark blue line in Figure 2 shows the minimum connectivity value to be 0 and the red line shows the maximum value to be 6. The average is currently 2,45722. The highest value is located in 3 locations (Table II):

TABLE II. Taman Griya Jimbaran Street Connectivity

No	Name	Score
1	Jl. Danau Batur Raya	6
2	Jl. Danau Buyan Barat	6
3	Jl. Danau Buyan Raya	6

Analysis of the location that will use to build public open space that must be easily reached from residential areas. As can be shown in Table II, some areas have the potential due to their high values. The first site, Jalan Danau Batur Raya, which is close to a crossroads and amenities like markets and restaurants, has a score of 6 out of three. Second, albeit poorly constructed, Jalan Danau Buyan Barat already features a public open area. Last but not least, Jalan Danau Buyan Raya is situated near public amenities including public schools and Banjar as well as at a crossroads. There isn't any undeveloped land, though, to create public open areas. As a result, Jalan

Danau Batur Raya is the ideal site for a public open space according to the connectivity study.

B. Integration

Integration is one of the metrics in space syntax because it is feasible to use this measurement method to examine how space is set up as a system. The computation of this integration also accounts for locations that are not visible from the observation room, while the evaluation of the integrity of space will take into account all other spaces in a spatial arrangement [13].



Fig.3. Taman Griya Jimbaran residence integration

TABLE III. Integration Analysis

Attribute	Minimum	Average	Maximum
Integration	0,210897	1,32793	2,94219

Figure 3 shows that the highest value for integration is 2,94219, and the minimum value is 0,210897 for the dark blue line. The average is 1,32793. The three places with the highest value are shown in Table IV:

TABLE IV. Taman Griya Jimbaran Street Integration

No	Name	Score
1	Jl. Danau Batur Raya	2,92704
2	Jl. Danau Buyan Barat	2,93322
3	Jl. Danau Buyan Raya	2,94219

The street with the highest integration value is Jalan Danau Buyan Raya, making it a high-potential travel route. The distribution of this integrity value, which is related to the idea of natural movement, might lead to a theory regarding the propensity of pedestrians or outdoor activities to take place in areas with high integrity values [14]. However, this location already has government services such as public schools, and Banjar Jalan Danau Batur Raya and Jalan Danau Buyan Barat are the best places to be.

C. Intelligibility

Intelligibility centers on how easily observers (users of space) can comprehend the spatial organization of a given

spatial arrangement. A low intelligibility score, suggests that observers tend to become disoriented because the structure of space (global) cannot be comprehended from the presence of space as a whole portion (local). A high intelligibility score, on the other hand, means that access to other areas is reflected in connectedness at the local scale.

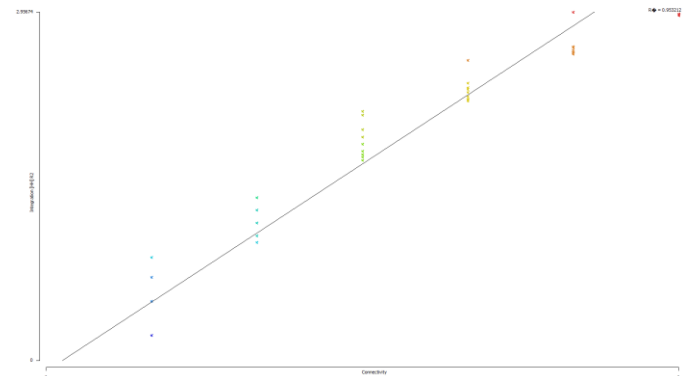


Fig. 4. Taman Griya Jimbaran residence intelligibility scatter map

The distribution of values for connection and integrity in this spatial layout results in high intelligibility ($R = 0.953212$) from a scale of 0 to 1. The axial map connection shows that the central location has excellent closeness to other areas and can function as a gathering space because the highest value is on a separate path from the axial map integrity. Thus, it can be concluded that the selected space which is Jalan Danau Batur Raya (Location 1) can be used as a gathering point in the area. However, looking at the area of the Taman Griya Jimbaran Residence, public open spaces can be made at several points according to the recommendations from the connectivity and integration analysis above.

IV. CONCLUSION

This study may establish the possibility of placing public open space by employing space syntax in Taman Griya Jimbaran Residence with connectivity, integration, and intelligibility approaches. Public open space that is secured for placement may take the shape of both local and regional public open space. Jalan Danau Batur Raya may be used for local public open space, whereas Jalan Danau Batur Raya's equivalent, Jalan Danau Buyan Barat, can be used for global public open space. Since intelligibility is highly valued ($R = 0.953212$), it seems sensible that public open space should be located where it is convenient for residents to reach it and where it may be utilized as a gathering place. To encourage more social contact in the residential neighborhood, public open spaces might be divided into multiple areas.

REFERENCES

[1] Badan Pusat Statistik Kabupaten Badung., "Kecamatan Kuta Selatan Dalam Angka 2022,Badung: BPS Kabupaten Badung, pp. 33, 2022

[2] Yuliasuti, N., Sukmawati, A. M., & Purwoningsih, P, "Utilization of Social Facilities to Reinforce Social Interaction in Formal Housing," *Archnet-IJAR: International Journal of Architectural Research*, Vol.12(1), pp.134–151, 2018.

[3] Hantono, D. "Pengaruh Ruang Terbuka Terhadap Kinerja Pegawai," *Jurnal Arsitektur NALARs* Volume, 12(2), 2013.

- [4] Purwanto,E. "Privatisasi ruang publik dari civic centre menjadi central business district (Belajar dari kasus kawasan Simpang Lima Semarang)." *Tataloka*, Vol.16(3),pp:153-167, 2014.
- [5] Pratiwi,Y, "Transformasi Fungsi Ruang Terbuka Publik Di Perkotaan Studi Kasus: Taman Pedestrian Kecamatan Tenggarong, Kabupaten Kutai Kartanegara, Kalimantan Timur," *Jurnal Arsitektur NALARs*, Vol.15(1),pp. 63-72, 2016.
- [6] Hantono, D. "Pola Aktivitas Ruang Terbuka Publik Pada Kawasan Taman Fatahillah Jakarta," *Jurnal Arsitektur Komposisi*, Vol.11(6), 2017.
- [7] Sa'diyah,A.H, Nugroho, R., & Purwani, O, "Space Syntax Sebagai Metode Perancangan Ruang Pada Galeri Kreatif Di Kota Surakarta," *Jurnal SENTHONG* ,Vol 2 (2), 2019.
- [8] A Rosyidah, L Tambunan, A Nurdini. "Vulnerability Analysis of Fire Evacuation at Urban Kampong Using Space Syntax Method, Penggilingan Jakarta as a Case Study" , IOP Conference Series: Earth and Environmental Science, 2022.
- [9] Ramadhan,T., Ramadhan G., Wijaya,K., & Permana,A.Y., "Kajian Spasial Penempatan Fasilitas Sosial Di Permukiman Padat Kota Bandung Menggunakan Analisis Space Syntax Studi Kasus: Wilayah Kelurahan Burangrang, Kecamatan Lengkong, Kota Bandung," *Arcade Jurnal Arsitektur*, Vol. 2(2), 2018.
- [10] Warada, W., & Mutiara, D. "Analisis Space Syntax Rumah Susun Berbasis Gang Kampung." *In Simposium Nasional RAPI XII* (pp. A59-63), 2013.
- [11] Etikan, I., Musa, S. A., & Alkassim, R. S. "Comparison of Convenience Sampling and Purposive Sampling." *American Journal of Theoretical and Applied Statistics*, Vol 5(1), pp: 1-4. 2016.
- [12] Adiyanto, J. "Kajian Perubahan Ruang Terbuka pada Kawasan Bersejarah dengan Metode Space Syntax (Studi kasus Kawasan Kampung Kapitan Palembang)." *Jurnal Perencanaan Wilayah dan Kota*, Vol.27(2),pp: 103-2016.
- [13] Hillier, B. *Space is the machine: A Configuration Theory of Architecture*. Design Studies (Vol. 18). London: The Press Syndicate of The University of Cambridge, 2007. Available: [https://doi.org/10.1016/S0142-694X\(97\)89854-7](https://doi.org/10.1016/S0142-694X(97)89854-7).
- [14] Hillier, B., Penn, A., Hanson, J., Grajewski, T., & Xu, J. "Natural Movement: or, Configuration and Attraction in Urban Pedestrian Movement." *Environment and Planning B: Planning and Design*, Vol 20, pp. 29-66, 1993.