

Application of Space Syntax as Presentation and Analysis Technique in the Study of Spatial Integration in Contoured Landform

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ABSTRACT

Recent discussion of spatial integration through the identification of the configuration space focuses on urban areas with relatively flat topography. The vertical element associated with the elevation of physical space in the formation of urban space is often ignored. This paper is a literature review of early stages of a research focuses on application of space syntax techniques for contoured landform. In the assessment of spatial integration on contoured urban area, space syntax can be used as a data presentation and analysis techniques in a graphical way based on the quantification of spatial data, space syntax can be supported by Geographical Information Systems (GIS) to show the empirical conditions of the spatial integration of urban space in three dimensions. Urban space configuration in a contoured area needs to consider the topography, specifically in the development of the movement path that connects the activity in each space between the spaces and activities which affect each other, either in directly related space or in a context of the urban structure.

Keywords: Configuration, Spatial Integration, Space Syntax, Topography

INTRODUCTION

One way that can be used to explore how the social and spatial processes in an urban space that happens all the time is by using space syntax techniques. Space syntax is a method to understand the city as a system. It can provide an understanding naturally evolve of the cities. To establish a framework for understanding the relationship between social and spatial structure, often the analysis of the relationship between social and spatial aspects of the material aspect is only putting forward a physical space without considering the social aspect. Instead of discussion the abstract aspects of social relationships often neglect its relation with the spatial dimension. To study the relationship between entities that are material and the abstract, it takes way to solve the problem. Society must be explained within the context of its spatiality; space must be explained in the context of its sociality. Approach to problem solving done by Hillier and Hanson builds a theory of social logic of space and spatial logic of society [1].

The main focus of configuration with space syntax technique is the relative adjacency or accessibility between different sites, involving graph theory in the measurement of the distance between the nodes and associating it with the density and intensity of human activities that occur in different open spaces and along the path connecting them. Adjacent space is the basic rule to form axial maps: two axial lines intersect is considered as the adjacency. Two spaces, *i* and *j*, are considered adjacent in the dual G-graph, where possible to move freely from a space to another, without passing through the barrier [2].

Space syntax focuses on extrinsic properties (configurational, topology) rather than the intrinsic properties of the form, scale, texture, etc. Based on a theoretical justification, the interrelation between the elements is more important than the individual nature of the space for the structure and function of the system[3]. However, here it is argued that combining the analysis of multi-aspects can provide a more complete explanation of the urban form.

Until now the validity of the space syntax method still remains controversial. There are many critics to the space syntax such outlines the weakness of this technique in projecting the norms of society [4]. A similar statement came from the viewpoint of generalization associated with the social dimension in a particular location. In the weakness of the physic-spatial aspects, space syntax depends on representation of the elements that make up the "edge", which is physically associated with the delineation of three dimensions and how the space defined by the senses, as well as the material forming "boundary" associated with the texture and feel of the surface through the intensity of a massive- transparent area, and visual impact of cognitive [5].

There are some inconsistencies within space syntax, which is known as a technique of urban analysis. Inconsistencies can be observed in the discussion of specific geometry configurations. At the simplest level, systematic analysis of the urban grid texture reveals the difficulty to accept the argument that the space syntax

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allows the modeling that provides a choice of paths for pedestrians. In more complex cases, the distortion of two ideal textures produces a topological discontinuity, leading to an unacceptable situation where one single urban configuration produces two conflicting outcomes when analyzed with space syntax. Some other points need to be considered, such as limitations of space syntax to consider the buildings height, land elevation, and sensitivity to the boundary [6].

Consideration of topography of the region is often not considered important to be resolved. Similarly to the handling of public access connection that is often ignored. Daily relations of the urban life, where there is activity across the urban space, including the scenery, landscape and social aspects of urban life should be emphasized in the planning stages, such as consideration for the sustainability of urban space and economic values of conservation [7].

One of the aspects that influence the physical limitations of the urban development is urban relief with a diverse topography. Urban areas on contoured landform require some consideration in handling. This condition is associated with relations between spaces within an area. In the context of movement across space, "permeability aspects" related to the accessibility and visibility, which connected one space to another. In the urban areas located on contoured landform, elevation and slope also determine the spatial integration of urban areas through a network that connects each node as a response to the landscape characteristics.

Configuration plays a role in creating order and structure of urban space efficiently. The structure of urban space needs to consider the topography of urban area, specifically in the areas of infrastructure development. Development of urban infrastructure, especially roads as movement pathways connecting the activity in each space between the spaces and activities, that affect each other, both in space related directly or in the context of urban space structure.

This paper is a preliminary study as an initial idea to reveal the relationship between spatial integration and socio-spatial interactions of the topography of urban areas on contoured landform. The research benefits are provide a description and prediction of the condition of space utilization that is not only consider visual aesthetics, but also the occupancy and inhabitation based on dialogical aspect between the user's and their urban space on contoured landform.

MATERIALS AND METHODS

The discussion of materials and methods begins with a number of spatial analysis processes graphically by space syntax presentation and analysis technique. The following illustration explains the process of analysis. It begins with the process of redrawing (tracing) of urban axial represented movement routes (street or pedestrian) of the existing map. The displays of urban space image are consists of buildings and open space. The image of urban space can be obtained from multiple data sources, such as a map of the streetline, aerial photographs or scaled maps image. Furthermore, based on Axial Map, it is followed by quantification process using spatial analysis software [8]. Some variant tools discusses in this paper, includes depthmap and Geographical Information Systems (GIS).

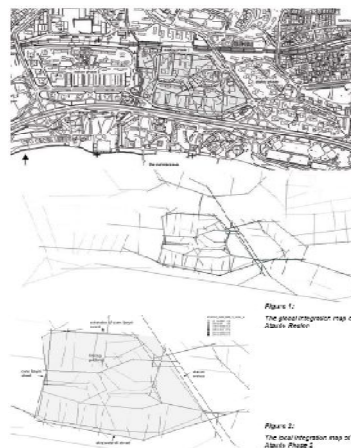


Figure 1: Illustration of the Redrawing Process of Axial Map (displayed without color) [9]

The Axial maps, that shown in the next illustration are drawn based on the processing of Geographic Information Systems such as street line, buildings, space and land use, and topography. Several thematic maps and spatial data are combined to show the paths that make up the integration of spatial movement in urban areas

considering the topography of the urban space. The results of the analysis on the lines described by the movement path are shown in colors, which represent the values of spatial integration.



Figure 2: Illustration of Land Use Map [10]



Figure 3: Illustration of Axial maps featuring Integration Value [10]

Based on the values of the spatial integration obtained from computing and digitization process of spatial data, the interpretation process to explain spatial existence the trends and of the urban space utilization, that was translated from some values (connectivity, integration and intellegibility) are displayed graphically. Values of spatial integration in an urban space is a representation of the "permeability" between spaces that serve as benchmarks in evaluating the spatial integration, which is based on the of urban space diversity in response to the urban relief of the contoured landform

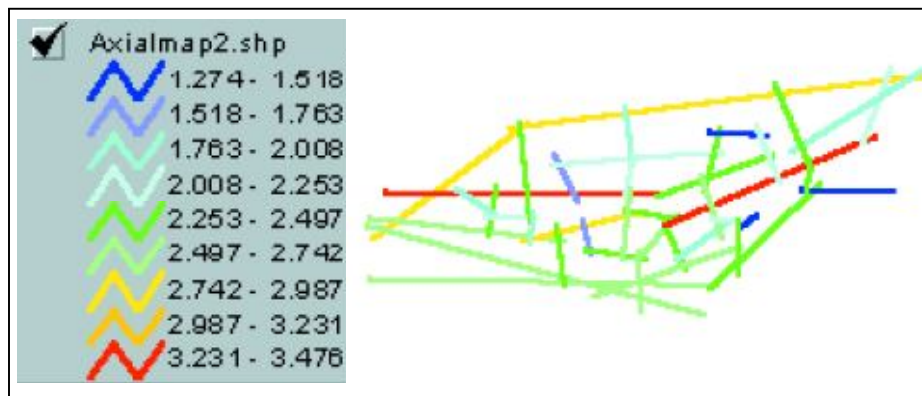


Figure 4: The color displayed represent the value of Integration based on the Axial Map [11]

To explain the results obtained by the quantitative analysis, and find out the correlation between the quantitative data with empirical conditions contained in the field, observation and qualitative data related to the existence of socio-spatial is related in research location.

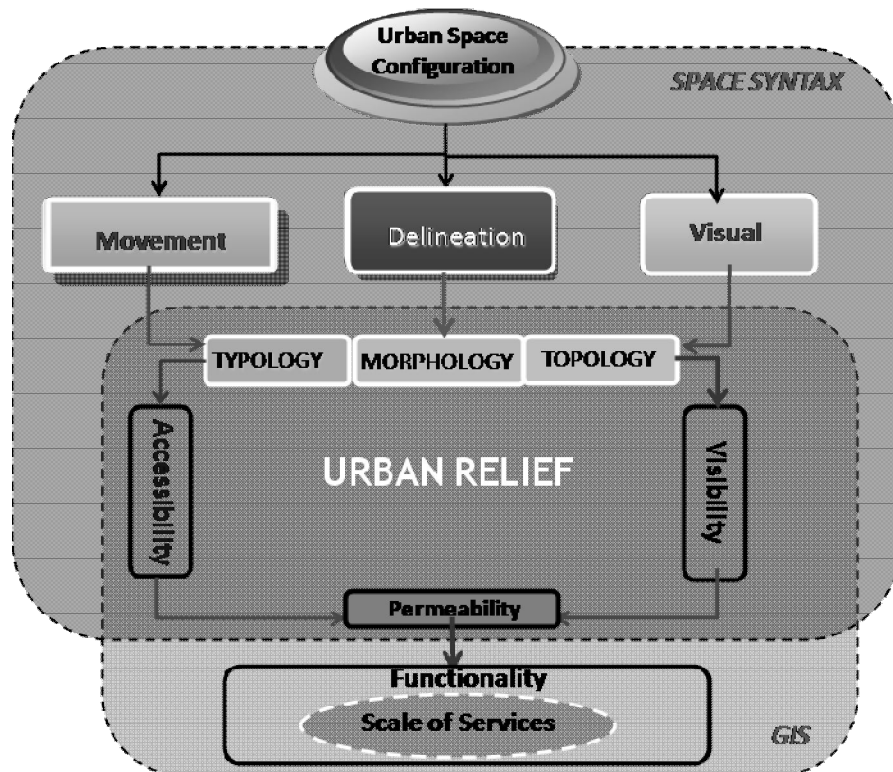


Figure 5: Theoretical Framework

Further analysis of the results shown by the data presentation techniques using graph analysis is supported by other spatial analysis tools, to translate the elevation aspect of the relief with the quantitative way by combining the various elements associated with the formation of space, configuration and socio-spatial. Most space syntax studies concern issues related to urban patterns, but the method is also relevant for studies on the scale of urban design and architecture. It has been used to describe these 'non-discursive' patterns, or configurations, and to explain the morphogenesis of spatial patterns and their social implications. Space syntax could provide an alternative view and model of space for the representation of urban systems. GIS provides a rich data set of spatial integration, analysis and visualisation capabilities that support urban studies. On the other side, the principles that underlie space syntax theory can be extended the modelling capabilities of GIS, particularly in terms of the dissemination of recent advances and experimentation throughout the analysis of urban systems. Such integration can be of value for GIS users involved in the management and planning of urban systems [11].

RESULTS AND DISCUSSION

This research is a literature review of the configurational theory with applications of space syntax techniques in a more contextual perspective, based on the empirical condition on location which has specific characteristics of topography (contoured landform) on the formation of urban space. One of the aspects that influence development of physical limitation is a contoured landform in urban area with an extreme degree of slope. Urban areas on contoured landform require some consideration in handling. On the contoured landform attainment and distances becomes longer to adjust with the topography and influence of the vertical value to the axial line of the path.

The quality of relationship between space formed from the urban space configuration as a space for activities of the citizen, describing the functional quality of the urban space, where the function of space can take place either when the activity took place according to the space without obstructing the activities in other spaces. Factors affecting the quality of the relationship between space in a configuration, such as how each space can interact both physically and visually. Interaction space is physically associated with the physical movement path between space, which determines the extent to which the space can be traversed (accessibility). Spatial interaction visually associated with the shape and placement of space to another space, which determines the extent to which the space can be observed visually (visibility). Accessibility and visibility is a manifestation of the quality of the relationship between physical and visual space that are often analogous to the permeability.

Based on literature review and theoretical framework of research according to empirical facts on the research location in urban area with a contoured landform, further argument is described as follows; Increased activity requires more space as a place for community activities in the neighborhood of the smallest scale to urban scale that considers development aspects in other areas within regionality. In terms of meeting the needs of space for urban activities on the contoured landform, require specific consideration with respect to the landscape characteristic.

Analytical Objects in space syntax is a graphical abstraction of the axial map, as the aim to describe the topology of configuration space geometry. Various measurements can be derived from the graphs [1, 12], from three points to consider:

- connectivity is the local measurement of how many nodes are connected to each node (eg. how many intersections along street line).
- integration is a measurement of the degree in which a node is integrated with or separated from the system as a whole (global integration) although from partial system consist of the number of node for further measures (local integration), based on the calculation of depth for the next steps to the other nodes.
- intelligibility is a measurement of the correlation between connectivity and global integration values for each node in the system. It gives an overview into the global structure of the environment through interpretation of local property.

In space syntax method, graphical model of the space is used to investigate the influence of shape and configuration of the environment on human spatial behavior and experience. A number of measures have been introduced in configurational quantitative representation of the relationship between urban spaces and buildings.

Configurational Approach as the Theoretical Base

Configuration is a set of interdependent relationships in which each is determined by its relation to the others. Regularity as forming a configuration that is based on a systematic process of logical thinking, which explores the complexity of the scheme of relationships between space to the others and between people with the space through activities that take place in space, then shape configurational patterns. Configuration is defined as, adjacency or permeability - between the the complex elements. A configurational relationship is then defined as the relationship extent to which other parts was affected by the simultaneous presence of all three elements, and possibly other elements of complexity [13].

In configurational theory, Space syntax is a tool that provides a powerful technique to evaluate the social, economic and environmental impacts of the proposed accessibility based on the physical layout of space, corridors and vertical relationships that provide a strong influence on movement patterns. Spatial experience is the basis and framework of spatio-temporal knowledge. An abstract framework is discussed as an introduction to understand the spatial experience, at least also depends directly on the spatio-temporal through more experience and more organization. Abstract thought associated with the principles underlying the spatio-temporal order, by definition, are not given directly to the experience. The problem space, abstract thinking it self faced with the basic experience obtained directly [1].

Space Syntax Method in Analysis of Permeability

Space Syntax is a method for measuring the relative accessibility of different locations in a spatial system [1]. Space Syntax is considered as an alternative model of space at the cognitive level, as well as a practical method for analyzing patterns and urban structure with computational techniques. To estimate the accessibility of the structure of the space required Axial Analysis by using the Axial Map. Axial Map, as shown in Figure 6, consists of an abstract space syntax graph to relationship with the streets [14]

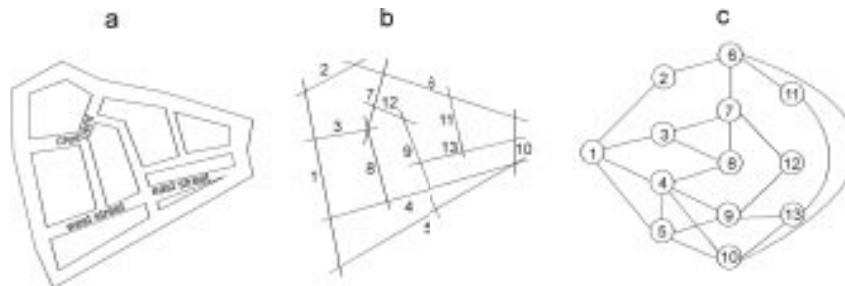


Figure 6: Axial Analytical Process [14]

Axial maps graphic contain the parameters of spatial properties are important. First, the 'Connectivity' is defined as the number of nodes that are connected directly to each individual node in the graph connectivity. Second, the parameter control value that describes the level of choice of each node, represented by nodes that are directly related. The third parameter, Integration is a value that indicates the degree to which a node in a more integrated or separate from the system. This parameter can be used to describe the properties of the spatial configuration of local and global in the understanding of integration or segregation [13]. Most limitations of axial map analysis in space syntax technique seem to be related to the simplified support it uses: a 2D topological description of the street network that does not take into account metric information. The choice of such a simplified support to describe cities might have been a necessity in the early days of space syntax, when computation was less developed. However, it is possible that today's new analysis techniques might open new research directions and lead to better results [19].

Urban Space Utilization in Contoured Landform

On contoured landform quality and properties of site, in general will affect the size of the building by regulating the relations between one to the others. Natural slope, which in some cases above 30% slope, will create an internal relationships are important, especially in terms of access. It can be added to the visual potency and other expressions of the site, depending on the altitude (elevation). The natural quality is the best way to observe the area at the appropriate scale [7]. The study of topography and its emphasis in urban life can be very complex with several considerations. Topographic mapping, often not considered important to be completed, while the handling of public access connection is often ignored, along with the development of future environmental, and other things to be done.

Computational Technique in Spatial Analysis on Contoured Landform

Goodchild and Janelle explain through the analysis of cartography, spatial statistics and geographic information systems (GIS), integrating social science theory and analysis of five spatial aspects. These include: first identify changes in the use of space and changes in regional, second measurement of the physical arrangement and classifying phenomena to detect spatial patterns, third document the temporal spatial patterns to infer processes, fourth assessing the urban movement (for example, migration, trading and consumption patterns) between the specific location as an indicator of spatio temporal interactions, and fifth measuring the spatial association (and association of space and time) to examine the hypothesis of the existence of socio-spatial in the form of spatial integration [15].

Some new computational techniques are being developed, especially in the urban texture exploration. Examples of such development include the use of raster Digital Elevation Model (DEM) in urban areas to reduce some useful parameters, such as visibility, time travel, and the accumulated distance [16]. The analysis of DEMs with image processing techniques has already proven to be an effective way of storing and handling urban 3-D information, conducive to a number of urban analyses [17], [18]. It could be used to derive measures of urban configuration that could complement traditional space syntax. A number of algorithms to analyse urban DEMs have been developed using Matlab, a well-known software package for performing numerical computations with matrices and vectors [18].

All results suggest that DEMs are an effective way to store urban geometry and to derive parameters that could complement traditional space syntax. First, they provide an environment for coding very fast algorithms for urban analysis. Second, they are becoming more readily available: the development of photogrammetry and recent progress in sensing techniques. Third, DEM analysis is compatible with traditional space syntax techniques: not only the tracing of lines of sight, but also the creation of axial maps and the computation of values such as line integration, could be implemented on DEMs. The amount of urban information contained in the DEM is higher than that contained on 2-D vectorial supports and it could easily be reduced to represent the street network as a graph [19].

CONCLUSION

Space syntax offers a significant contribution to the advancement of research in the field of environmental design. In space syntax method, different types of syntax and space configuration can be measured. Besides some utilization in spatial analysis, space syntax still has some weaknesses in the analysis of the physical aspect. The weaknesses include a representation of the elements that make up the "edge" associated with the delineation of the three dimensions and how space is defined. Some of the other points also need to be considered, such as difficulty of space syntax to consider the topography, surface elevation and geometry of the urban area. By considering the three-dimensional aspects such as differences in surface topography, will allow researchers to more accurately describe the urban environment. More over the observer could explore the other models of interactions between environmental and human that give life to a comprehensive urban space. These

descriptions imply the need support from other graphical techniques for space syntax. Integration of Space syntax with GIS can provide an important contribution to the spatial analysis based on urban relief.

The analysis of the spatial integration in the contoured landform by assessment the accessibility and visibility can be expressing the relationship between socio-spatial interaction and urban space configuration. Spatial integration determined by socio-spatial interaction was a response to the topography on urban area. Further results of research, also argues for the benefits of space syntax method as presentation techniques of spatial data to understanding the spatial integration in three dimensions. One of the aspects can be researched by configuration approach is permeability in relation to the topography. It is related to accessibility by physically and visually, in the context of affordability to the urban public facilities that are included in the scope of its services.

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