

THE APPLICATION OF SPACE SYNTAX ANALYSIS IN URBAN PLANNING WITH EXISTING PRACTICE: CASE STUDY OF JAFFNA MUNICIPAL COUNCIL AREA.

V. Mathivathany

Department of Town and Country Planning, University of Moratuwa,
newvathana@gmail.com

Abstract:

The road integration in development activities plays a key role in the urban spatial structure. Many urban issues are increasing without integration among the road system. So, several studies are seeking to address this issue of spatial mobility. Over the past years, many spatial analysis methods have been developed for a better understanding and modeling of real-world phenomena. However, there is still a need for the exploration of new analytical techniques for modeling urban spaces in Jaffna Urban area. Space syntax is the technique that has been used to derive the connectivity of urban or architectural spaces (Hillier 1996, Penn et al. 1998). This paper proposes methodological and practical evaluations of the potential of the space syntax approach and theory. Jaffna Municipal Council Area (M.C) has been analyzed as the case study area with application of urban planning and design. For that purpose a method to assess how connectivity affects the hierarchical structure was developed. Secondary data like map of the regional network were used for this research. Very high, moderate and low criteria were used as connectivity levels using space syntax analysis methods which include the Geographical Information Techniques and tools and Depth map Software. This paper proposes the result that a review of the space syntax theory in urban context and forms of the roads and integration level of roads of Jaffna M.C area were known. When we implement this, integration space map can be avoided and the transportation facilities would be more sustainable in the future and we can make new and innovative decision making on the spatial or physical matters with considering social and other economic impacts also.

Keywords: *Hierarchical Structure, Spatial mobility, Spatial Pattern, Space Syntax*

1.0 INTRODUCTION

The road connectivity in development activities plays a key role in the urban spatial structure. In recent years such developments have been built using a road design concept that uses poor road connectivity. This road patterns does not provide travelers with alternative paths to complete their Journeys and therefore the traffic concentrates on the main arterials. In this background, Space syntax has been recognized as a key development tool in the study of urban morphology and the analysis of urban spatial form. Space syntax is the technique that is normally used to derive the connectivity of urban or architectural spaces (Hillier 1996, Penn et al. 1998). Space syntax tools and theories are particularly used to incorporate space syntax knowledge into either research or practice such as built environment - behavior studies, urban morphological studies, architectural design studies, obesity

and physical fitness. However, space syntax generally concerns geometric connectivity of locations and places based on their spatial links only and does not include costs of moving between places.

2.0 Research problem

Over the past years, many spatial analysis methods have been developed for a better understanding and modeling of real-world phenomena. Many large urban systems or countries are facing growing transportation connectivity problems today. Jaffna urban area also is a rapid growing centre in Sri Lanka after the civil unrest. However, there is still a need for the exploration of new analytical techniques for modeling urban spaces in Jaffna Urban area. Therefore this study is seeking to address the spatial techniques of spatial integration.

Jaffna Municipal Council Area was selected for the detail study which is located in the Jaffna District of the Northern Province on the Southwestern direction of the District. Total extent of the municipal area is 43.7 sq.km. The Municipal area is divided into 23 wards. The Jaffna area is having a natural peninsula surrounded by the natural barriers of the Sea. Due to this, the area is naturally given the peninsula form which character is not seen in any other towns in the Northern Province.

3.0 Objective

The main purpose of this paper is to explore how integrate the roads in the Jaffna M.C Area in adopting space syntax in planning. The following objectives were defined to do this research clearly.

- To review the space syntax theory in urban context
- To analysis the levels of the integration with the existing roads of Jaffna MC Area for future space decision making by Space Syntax Analysis.
- To analysis the forms of the roads, integration and connectivity levels of roads of Jaffna M.C area.

4.0 Methodology

This research is fully depended on the secondary data. The application of this technique initially involves the graphic representation of the Jaffnaurban street network based on the cartographic information of the area. Segment map was built in axial map which segments allowing the analysis of street segments. Then the integration index (topological accessibility or permeability) was used for the analysis.

After the construction of axial and segment maps of these systems, Geographical Information System and Depth map software were used for the calculation of the connectivity matrix and configurationally measures and to identify their configurational features according to the variables from space Syntax studies. Very

high, high, moderate and low or very low criteria were used as integration levels using space syntax analysis methods.

5.0 Result

5.1 Theoretical background - Review of the space syntax theory in urban context

Space syntax theory, a topology-based theory and one of accessibility-related methodologies used for computing connectivity in urban or architectural spaces. In the context of theories it is applied as the innovation, adoption and Planning Support Systems (PSS) in Urban Planning sectors. Space Syntax (SS) Theory was developed in the 1970s by a group led by Bill Hillier and Julienne Hanson at the University College London in collaboration with researches from several countries (Penn & Dalton, 1994). In general, the SS theory defines a city's structure by its road system as seen from topological perspectives, taking into account the existing connections seen from a relational systematic perspective.

Axial maps are fundamentally based on a relational approach of the set of streets making up road system of a city. This approach allows considerations on the topological attributes that each street establishes with its nearby streets (local connections) or with the whole system to which it pertains (global connections). SS is used for the potential application of the theoretical and methodological configuration frame work on traffic allocation studies. Although axial map represents the smallest number of major lines passing through the urban system, the segment map involves the fragmentation of each line into several segments, according to the nodes existing in the urban grid. Thus, there would be further integration between the representation from SS and those traditionally adopted in traffic engineering based on links (segments) and nodes (connections / crossings).

5.1.1 Accessibility Based on Syntax

In space syntax, when converting the continuous space into a connected set of discrete units, it uses the concept of convex space partitioning or simply axial mapping. The procedure to generate the convex map involves taking a given spatial structure and partitioning it into a set of "fewest and fattest" convex spaces (Hillier and Hanson, 1984, pp.97-98). The procedure for generating the convex maps is iterative, starting with the identification of the fattest of the convex spaces and then progressively identifying the next largest one until the entire area is subdivided into a set of convex spaces. Then, the axial map can be drawn on this convex map by laying down the longest strait lines that passes through theses convex spaces (Figure 1-b). On the other hand, traditional way of abstracting street network follows different procedure. It generally uses center lines of streets. Whenever two center lines intersect each other, an intersection is created (Figure 1-c). When representing the configured lines as a graph, space syntax represents each line by a node and each intersection as an edge, while in traditional method, the situation is vice versa,

that is, an intersection becomes a node and a line connecting two nodes becomes an edge.

The resulting axial lines in the axial map can be regarded as the fewest number of visual paths in the existing space where each intersection plays as a turn of sight, which becomes a depth. Thus, in space syntax, only the number of turns along a path rather than actual journey length is counted.

5.1.2 Comparing the Network Representation of Roads



Figure: 01, Real Road Network

Figure:2, Traditional Network

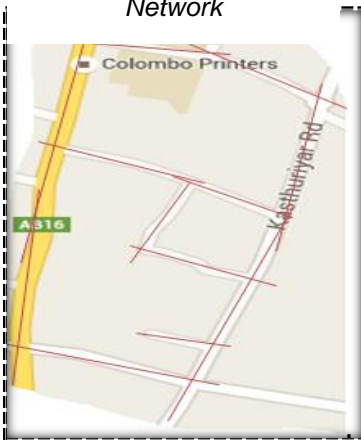


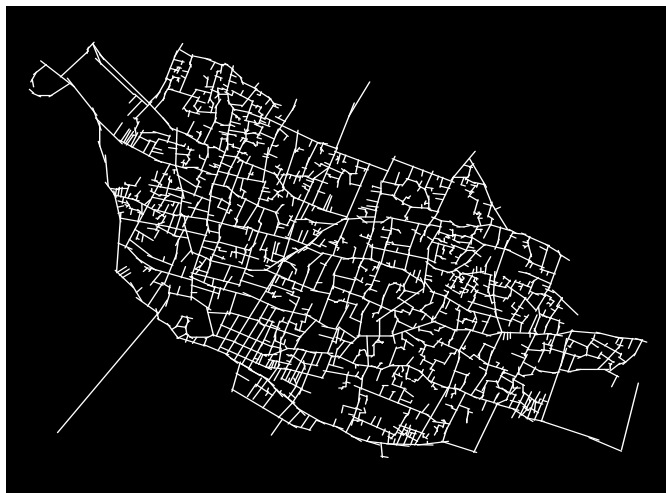
Figure: 3, Axial map

5.2 The forms of the roads and integration levels of roads of Jaffna M.C area.

If we look at in comparison of these road network, we can't consider Jaffna as only separate part because it is tied to a larger scale with all main rung roads which

starting from Fort area. It shows the critical pattern of the main roads and indicates the different kind of pattern in the road hierarchy. If we take centre part of the Study area, more integrated places are shown with grid road pattern. That is why we continue to see the high integration along the A9 road and point Pedro road when we analyze the Jaffna area's road network. When it becomes a larger urban agglomeration we see few characters in the network or pattern. There are sea side linear pattern, Grid pattern and cluster organic pattern as formation of the road network but these are very common in all parts of the area because it also indicate that we are also part of urban agglomeration and it is not very sort of special to Jaffna only. Therefore we are small part of a larger urban agglomeration in the spatial planning system and urban planning model.

Map: 1 Road Patterns in study area through the Axial Lines



If we observe the map 1, that show different patterns of urban road forms in physical land forms. This pattern identification was done through the long methodical process.

5.2.1 Road Pattern in selected areas in Study Area

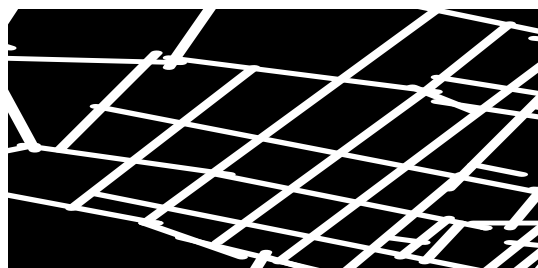


Figure 4. Grid Patterns, Vempady &
1st 2nd 3rd Cross Streets

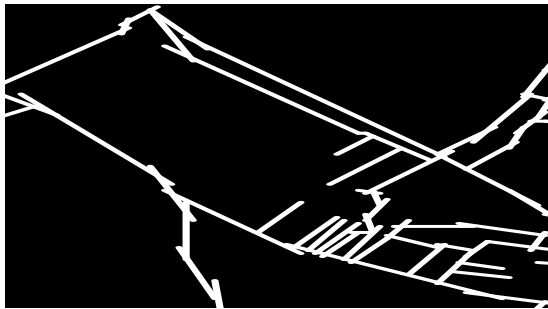


Figure 5, Sea Side Linear Parallels
Kakaithivu jetty



Kurunagarjetty



Ariyalai



Pasaiyoor



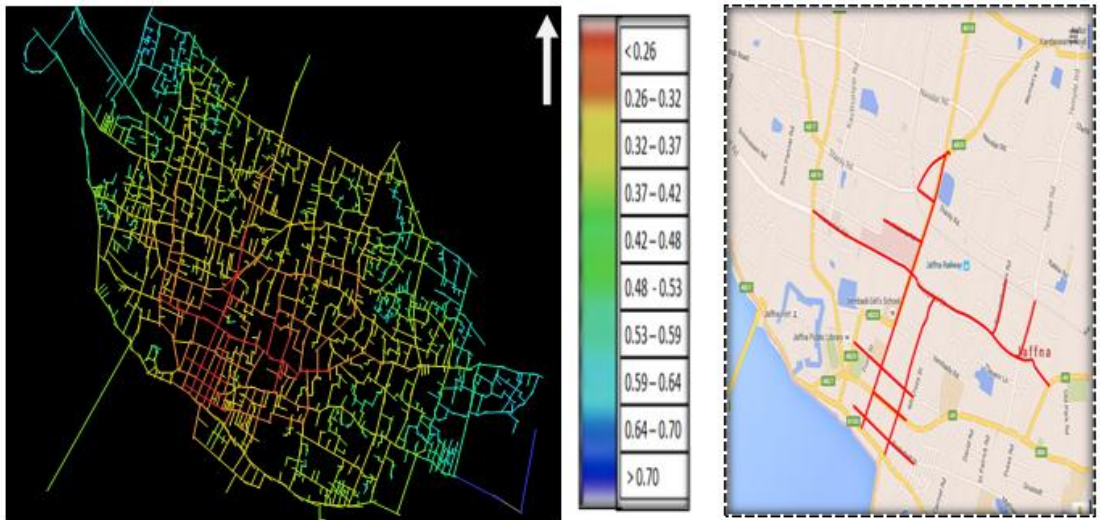
Nallur

Figure 6, Cluster – Organics

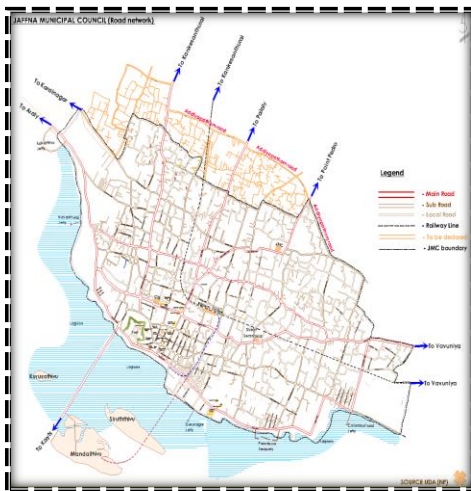
According to the space syntax analysis final map, there is a very big potential for the urban development in the study area because high integration (red color) shows in the centre grid network area. The integration or accessible areas' indication is varying based on roads' accessibility.

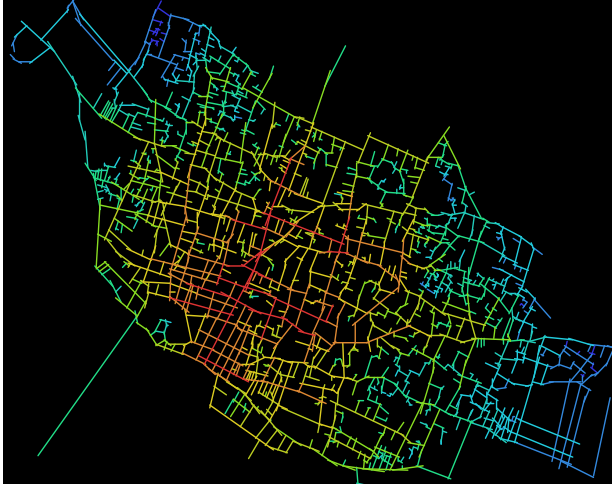
It spreads along some parts of the main arterials roads like first and third cross street, Point Pedro Road, Hospital Road, A9 road, Bankshall Road, Central College Front Road, Victoriya Road, Stantly Road, Sirampiyadi Lane, Rasavinthoddam Road and Temple road. It shows clearly in map.2. These parts of roads are the high integration roads segments in Jaffna Municipal Council Area. This is not enough to the further development activities and integrates to all urban physical land areas. Therefore we need a reroute planning assessment through these scientific analysis methods. New linking roads should be identified and applied into the space syntax analysis. According to those analyses, there should be getting new simulation space syntax maps for some new special development activities. In the existing space syntax map show the existing integration of roads in Jaffna Municipal Council Area.

Map: 02, Existing area's Space syntax map of the Jaffna Municipal Council Area.



Map: 3, Comparison of the real Road System and Axial Space Syntax Map





6.0 Conclusion and Recommendation

Space syntax is the technique that has been used to derive the connectivity of urban or architectural spaces. Space syntax theory, a topology-based theory and one of accessibility-related methodologies used for computing connectivity in urban or architectural spaces.

Jaffna urban systems are facing growing transportation problems today. Because of that, this study is seeking to address this issue of population spatial mobility, including those related to Space associating urban/built space configuration to spatial patterns of movement. Over the past years, there is no any spatial analysis methods have been developed for a better understanding and modeling of real-world phenomena of Jaffna Municipal Council Area. The integration levels of the roads were identified through this research by using Space Syntax analysis. This analysis will help to take the simulation activities and make innovative decision making process in related physical planning activities in Urban Planning aspects. However, there is still a need for the exploration of new analytical techniques for modeling urban spaces in Jaffna Urban area.

Reference

AZIMZADEH, M. AND BJUR, H. (2005), 'Transforming Cities. The role of the configuration of the network of public spaces in urban life'. Proceedings 5th International Space Syntax Symposium, i. Delft, TU Delft, Faculty of Architecture: 295-308.

GRIFFITHS, S. (2009) 'Persistence and Change in the Spatio-temporal Description of Sheffield Parish 1770-1910', in Koch, D., Marcus, L. and Steen J. Proceedings of the 7th International Space Syntax Symposium, Stockholm, KTH Royal Institute of Technology. 37:1-15.

HILLIER, B., HANSON, J., PEPONIS, J. HUDSON, J. & BURDETT, R., 1983, Space Syntax: a different urban perspective, *The Architects Journal*, 30 November, 1983, pp 47-63 London.

HILLIER, B. & HANSON, J., 1984, *The Social Logic of Space*, CUP, Cambridge, 1984.

HILLIER, B., BURDETT, R., PEPONIS, J. & PENN, A., 1987, Creating life, or, does architecture determine anything? *Architecture and Behaviour/Architecture et Comportement*, 3(3) pp233-250.

HILLIER, B., PENN, A. & DALTON, N., 1992, Milton Keynes: Looking back to London, *The Architects Journal*, 15th April 1992, London.

HILLIER, B., PENN, A., HANSON, J., GRAJEWSKI, T. & XU, J. 1993, Natural movement; or, configuration and attraction in urban space use, *Environment and Planning B: Planning and Design*, Vol. 20, 2966, Pion, Brondesbury.

PENN, A. & DALTON, N., 1994, *The Architecture of Society: stochastic simulation of urban movement*, Ch 5, pp85-126, in Gilbert, N. & Doran, J. (eds), *Simulating Society: The computer simulation of social phenomena*, UCL Press, London, 1994.

RATTI, C. 2004, Space syntax: some inconsistencies. *Environment and Planning B: Planning and Design*, v. 31, p. 487-499, 2004a.

STEGEN, G. 1997, Proposal for a methodical use of space syntax analysis in development and land use plans. In: 1st SSS, *Proceedings*. London.