#182

APPLYING SPACE SYNTAX ANALYSIS IN THE DESIGN PROCESS OF A SINGLE-FAMILY HOUSE CONVERSION AIMING AT SUSTAINABILITY AND SAFETY

NICHOLAS MARTINO
Universidade Federal do Rio Grande do Norte – UFRN, Brazil
nicholas.martino@hotmail.com

ABSTRACT

This study addresses a design process to convert an existing single-family house in order to create a more sustainable and safer environment under permaculture guidelines supported by space configuration and visibility analysis. Zone planning in permaculture design, according to Mollison (1988), consists on the definition of abstract boundaries around a home to cover certain functions of the landscape according to the frequency and the need to use them. Those zones are usually intuitively designated by how accessible each area is from the house. Accessibility is therefore a key factor on the conception phase of permaculture designs. Space syntax analysis (Hillier and Hanson, 1984) was applied to explore accessibility relations in order to re-design the garden according to those zoning guidelines, which allows for objectively defining spatial delimitations in sites of different sizes. Visibility Graph Analysis helped to identify the most efficient spots for installing closed-circuit television cameras in order to achieve constant surveillance of the house surroundings. It was also applied to define dimension and placement of openings in the house so that the house dwellers could enjoy the best views of the garden. The study seeks to contribute towards the question of applying such analytical procedures for designing single-family housing units by discussing some of its potentials and limitations.

KEYWORDS

Sustainable Housing, Permaculture, Surveillance, Space Syntax

1. INTRODUCTION

Space syntax techniques were applied during the conception phase of a conversion in a single-family house in order to meet the clients' needs for a more sustainable and safer environment. Two types of problems pointed by the dwellers were solved with the help of space syntax techniques: (1) the transformation of the garden for horticultural and contemplation purposes, considering accessibility and visibility properties and (2) the investigation of the visual relations of the house with its surroundings by means of Visibility Graph Analysis, Turner et al (2001) and Turner (2003), on plans and sections in order to identify blind spots and the most efficient points for installing closed circuit television cameras, CCTV. The applied procedures are described in this paper.

2. GARDEN DESIGN

The main purpose of the design was to adapt the garden for growing vegetables and visual contemplation. Visibility Graph Analysis helped to define openings in order to take advantage of the best views of the site from the house interiors and justified graph analysis helped to organize the productive elements according to permacultural zoning guidelines. The goal of

this topic is to explain how space syntax techniques were applied in the case of this garden design renovation.

Permaculture is "a system of agricultural and social design principles centred on simulating or directly utilizing the patterns and features observed in natural ecosystems" (Mollison, 1988). The main idea is to work with different types of natural elements towards a scheme that is able to produce most of its needs and return its surplus back to the system. Mollison (1988) proposes to organize these elements in the site by defining six abstract zones (from zero to five) around a house according to the frequency and the need to use them. The author does not prescribe metric distances between the zones as permaculture can be applied to an ample range of site dimensions – from a small urban site to a farm – and so the zones are usually intuitively designated by how accessible each area is from the house. In this study, graphic representations of the garden spatial system helped to prescribe the boundary of each zone, which allows for objectively defining these zones in sites of different sizes.

The spatial system of the garden was decomposed into nodes and lines so that each node represents either a convex space or a change of level in the site and each line a connection between these spaces. Because all interior spaces of the home are considered as zone zero according to the permacultural zoning guidelines, the house was considered as one convex space.

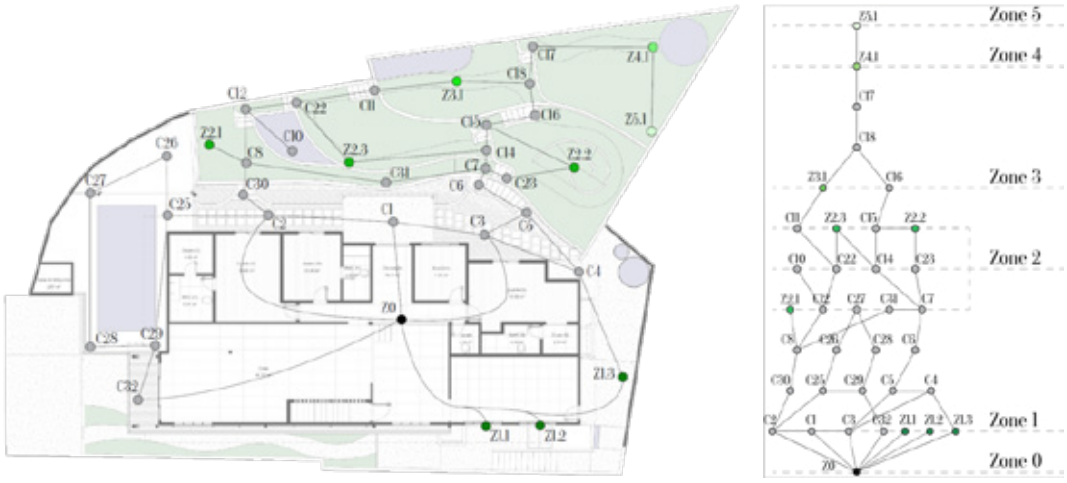

Figure 1 - Zoning process of permacultural design using graph analysis

A justified graph was generated in which the root is the zone zero (Zo in Figure 1) and each zone was defined according to its topological depth from the house. Figure 1 represents the conception process of the permacultural zones in the garden ("Z" stands for a defined zone and "C" for a circulation space). The permacultural design should help to meet the clients' requirements for a productive garden.

Visual step depth representation was used to test different positions of openings overlaid on the landscape plans in order to choose the ones that visually integrate the house with the most interesting spots in the garden design. Figure 2 shows visual Step Depth from the three main rooms of the house and three possible locations for placing the openings in each room, in the middle (Op. 1), in the right corner (Op. 2) and in the left corner (Op. 3).

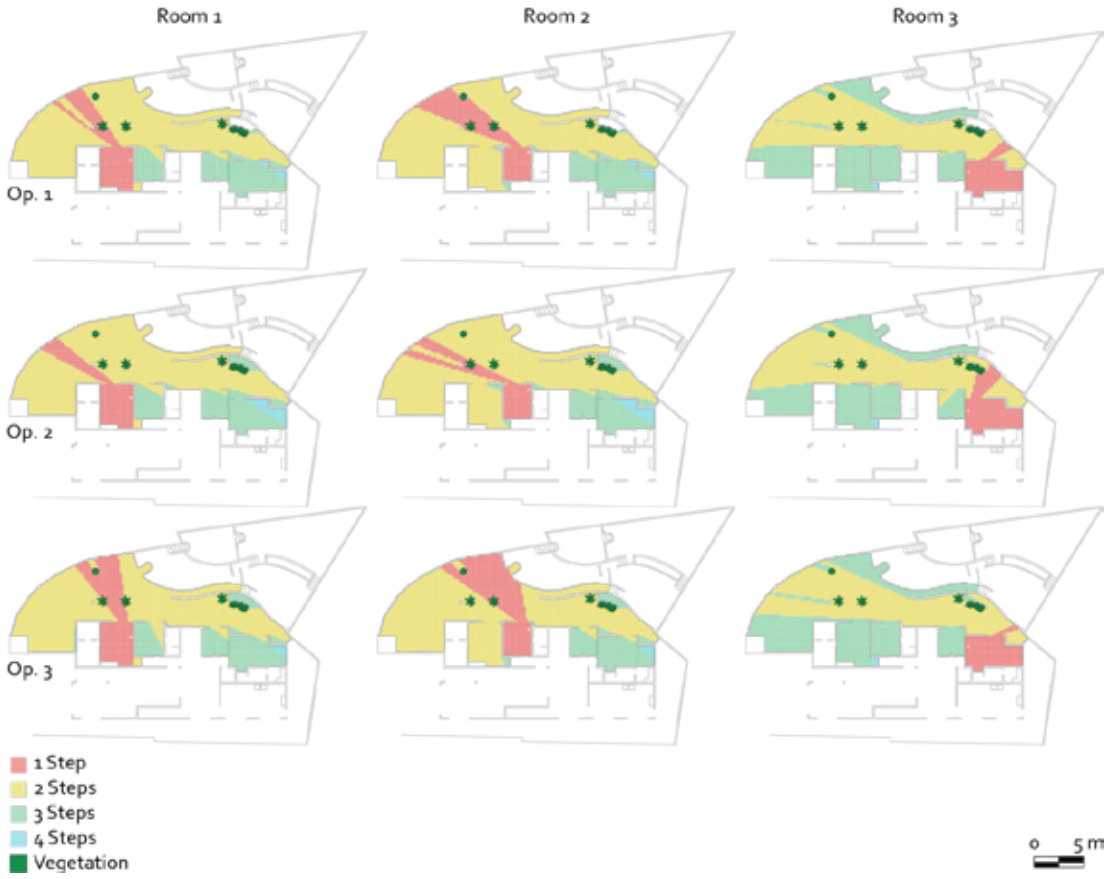

Figure 2 - Placement of openings from the house to the garden

The graphs highlight the best option in order to achieve a better view of the garden from each room: option 3 for room 1, option 1 for room 2 and option 2 for room 3.

3. CONSTANT SURVEILLANCE

In order to meet the clients' needs for a safer home, one of the goals of the renovation is to offer constant surveillance – in this case, the ability to watch any public space close to the house limits from its interiors. Space syntax analysis helped to identify blind spots in the surroundings and to define the points where to install CCTV cameras making sure that all boundaries of the site are visible using a minimum amount of camera devices. The goal of this topic is to explain how space syntax techniques helped to design surveillance means in the house surroundings.

A diagram representing all isovists from the house interiors to the site surroundings helped to identify the current visual relations of the building to the street and thus highlight blind spots that prevent constant surveillance. The 2D analysis using Depthmap (Turner, 2001) was quite limited due to the great differences of level at the site. In an attempt to overcome this issue, the largest isovist that reaches the front facade was represented both in plan and section (Figure 3).

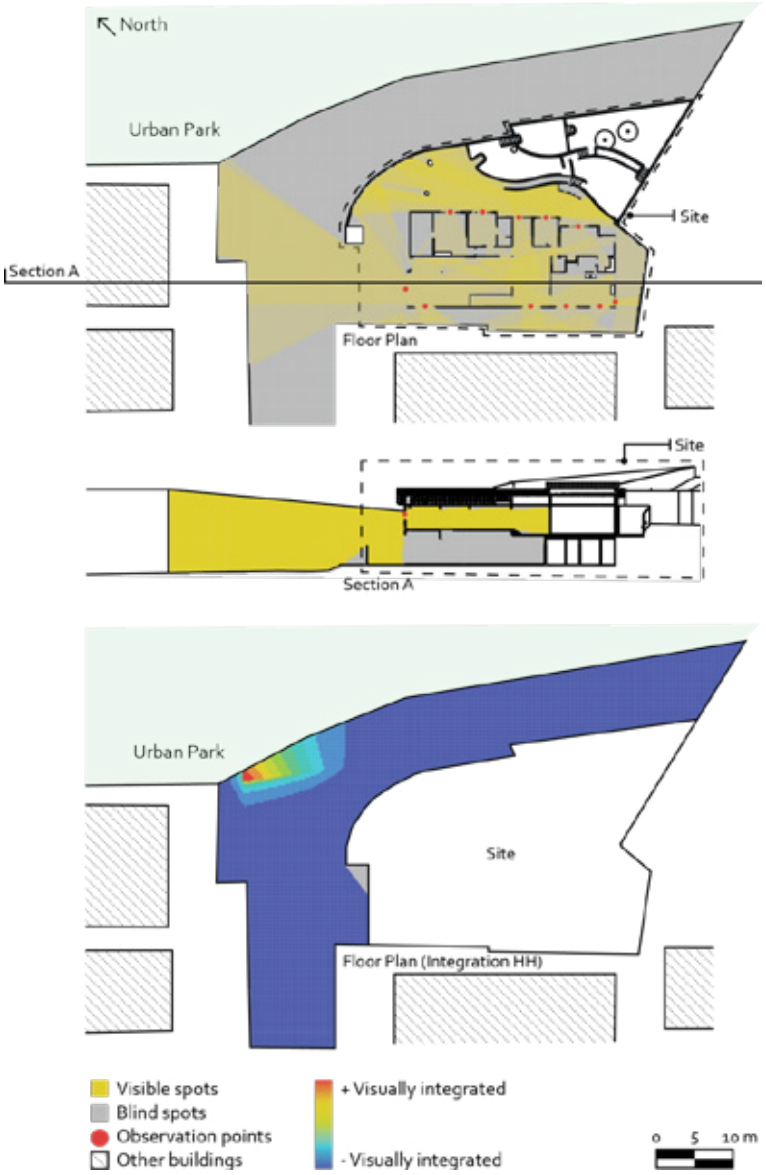

Figure 3 - Isovists from the interiors of the house at the main level and visual integration HH, Turner (2001, 2003), of the house surroundings

The diagrams in Figure 3 highlight: (1) the lack of visual relation from the interior of the house to the street, especially at the north-eastern facade, represented in the Floor Plan and (2) the blind spot caused by the boundary wall at the front facade represented in Section A. In order to solve these issues without loss of privacy, CCTV cameras were recommended to monitor the blind spots through.

Visibility Graph Analysis of the house surroundings helped to design a system that could monitor the maximum amount of blind spots using the minimum amount of camera devices. The system was able to cover almost all blind spots by locating a CCTV camera at the most integrated spot of the house surroundings, as represented by the VGA in Figure 3.

4. CONCLUSIONS

The paper addresses the use of space syntax as a tool for analyse spatial relations and explore different forms supporting the conception phase of architectural design. The techniques used here "objectify what is deeply subjective; namely, the way a person experiences space" (Arnold, 2011) in an attempt to provide means through which the designer may test different accessibility and visual configurations understanding how these relations can affect human experience of space.

Once used in permacultural design, the graphs allowed for the definition of zones that once were intuitively proposed by Mollison (1988). This approach eventually became a method to visualize these permacultural design guidelines. The VGA helped to test different designs and to choose the ones best suited to the needs of the residents. It also supported the identification of blind spots not hit by human vision and the choice of best points for installing the fewest number of CCTV camera devices using their maximum visual field in an attempt to increase the sense of security in the site.

Finally, the techniques were applied both for analysis and for conception of architectural form, reinforcing that space syntax can support generative design processes (Arnold, 2011) not exactly to transform this process into an exceptionally rational practice, but aiming to enrich the "constant negotiation" between creativity and reasoning that is an inevitable part of architecture (Arnold, 2011).

REFERENCES

Arnold, T. (2011), Using Space Syntax to Design an Architecture of Visual Relations, The Journal of Space Syntax 2011, Volume 2, Page: 201-222.

Hillier, B. and Hanson, J. (1984), The Social Logic of Space, Cambridge: Cambridge University Press.

Mollison, B. (1988), Permaculture: A Designer's Manual. Stanley: Tagari Publications.

Turner, A. (2001), "Depthmap: a Program to Perform Visibility Graph Analysis", in Proceedings of the 3rd International Symposium on Space Syntax, Atlanta, Georgia Institute of Technology

Turner, A. (2003), Analysing the visual dynamics of spatial morphology. In: Environment and Planning B, 30(5), 657-676.

Turner, A., Doxa, M., O'Sullivan, D. and Penn A. (2001), From isovists to visibility graphs: A methodology for the analysis of architectural space. In: Environment and Planning B: Planning and Design, 28(1), 103-121.