Spatial Syntax Analysis of Tent Layouts.

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1 Abstract

Spatial Syntax is a set of concepts and techniques for the analysis of spatial configurations that were originally developed by Hillier and Hanson in the late 1980's (Space Syntax, 2009). They were intended to be a tool to assist architects and town planners in the modeling of social effects of the built environment. The analysis starts with a grid layout of the study area and then uses one of 3 generally accepted spatial concepts together with one of 3 analysis techniques.

The paper uses a visibility concept and a depth/distance technique to analyse operational tent layouts commonly used by United Nations High Commissioner for Refugees (UNHCR) and others proposed in the shelter literature. While many advantages have been claimed for different layouts (such as the community and security arrangements for a "U" shaped tent layout over a street/row approach) none appear to have been researched, surveyed or tested. Such questions are central to the idea of community, security and protection and ultimately well being of those that Agencies seek to assist.

2 Introduction

Space syntax deals with the relational patterns that arise as space is marked, divided, enclosed, differentiated, shaped, and organized by means of physical boundaries." (Peponis, 2001). How is "built space to be understood as a social artifact, how does it function, how does it support or constrain behavior, how does it reproduce social relationships, how does it generate social effects?" are key questions.

While this is not the language commonly used by humanitarian aid workers when designing tent layouts (typically in emergency camp situations) the fundamental issues raised by Peponis above are the same namely:

- "To provide adequate and safe shelter and living space for refugees" (UNHCR, 2004)
- "In some cases, emergency shelter provision is needed for those whose homes have been destroyed or are unsafe. This may require urgent repair work (including the provision of appropriate tools and locally-used materials), the distribution of tents and tarpaulins for temporary shelter; or sheltering homeless people in public buildings such as schools". (IFRC, 2007)
- "The use of local physical planning practices are used where possible, enabling safe and secure access to and use of shelters and essential services and facilities, as well as ensuring appropriate privacy and separation between individual household shelters. People have sufficient covered space to provide dignified accommodation". (SPHERE, 2004).
- "Privacy and space for personal and group needs" (Davis & Lambert, 1997)
- "Orientation and identity" (Barbister & Kelman, 2002).
- "In contrast, well-planned settlements can have a positive impact which extends beyond the provision of basic shelter. They can help displaced populations in many ways: by strengthening their physical protection and supporting their livelihoods; by minimising natural hazards and the spread of disease; and by managing natural resources in a sustainable way". (Corsellis & Vitale ,2004)

However, these above criteria are commonly reduce down to the simple provision of a tent covered area ($3.5m^2$/person) and the associated land area (varies between $35m^2$ to $45m^2$/person). This seems to be too simplistic.

Barbister and Kelman reiterate a point made earlier by Davis that "shelter must be considered as a process, not as an object" and their paper explores "the processes involved in sheltering people in emergencies, when shelter is understood as a basic human need because without it an individual is extremely vulnerable". Their view that when asked to define the word 'shelter' relief workers will normally describe it as "protection", rather than an object such as a "tent". But an object such as the tent "can exist as an autonomous entity until it is placed within a process involving a sequence within time of intentions, decisions and actions". This paper continues that focus on

process (rather then the product or object) but takes a different tact in reviewing the process. It uses a spatial syntax approach to better achieve the goals of "adequate", "safe", "secure", "appropriate", "privacy", "individual and group"," identity" and social "sustainability". And thereby reach beyond the present 3.5m^2/person and 35m^2 to 45m^2/person criteria.

3 Background to Spatial Syntax

The spatial syntax approach starts by applying a grid layout to the area of concern which is then analysed. This analysis is based on the notion that spaces can be broken down into components, analysed as networks of choices, then represented as maps and graphs that describe the relative connectivity and integration of these grid spaces. It rests on three basic conceptions of space (Wikipedia, 2009):

1. An isovist space is the total area that can be viewed from a point. (Benedikt, 1979)
2. An axial space or line is the longest straight line that can be walked from a grid point (Hillier & Hanson, 1984)
3. Convex space is the space where no line between two grid points crosses the perimeter (Peponis et al, 1997). For example, if the space were modeled as a wire frame diagram then no line between two of its points goes outside the perimeter of the wire frame. All points within the polygon are visible to all other points within the polygon

And 3 common analysis methods that are as follows:

*   Integration measures how many turns or changes of direction one has to make to move from one space to another using the shortest path/s. The term used is "Depth" and the spaces requiring the least average number of turns to reach all other spaces are the most integrated while those with the most are segregated. Integrated areas are mapped as red (hot) and can be characterized as public, busy and community focused. Segregated areas are mapped as blue (cold) areas and are characterized as private, quiet, secluded and out of the way.
*   Choice is a measure of the "flow" through a space and can be visualized as a water source at the start point diving equally at each spatial intersection.
*   Depth Distance is a measure of the overall depth of one space of concern to all other spaces. It is usually shown by a justified graph where spaces 1,2,3,4… depths away are shown on levels 1,2,3,4 respectively. When the mean depth is high resulting in a tree like

structure the system is described as deep and the spaces as far or distant. Where the mean values are low will give a bush like structure and the system is described as shallow and the spaces are near.

For this study an isovist map approach was used with an integration analysis using the space syntax software called DepthMap.

4 Tent Layout

Two generic tent layouts were analysed. Block 1 is a typical row arrangement of 24 tents (or plots) set out on a 50x 60 metre rectangular area and is shown on the left in figure 1 below. The tents are shaded and their size is based on a standard UNHCR tent. They are located at the front of each plot facing either an 8 metre wide road between the neighbouring blocks or a 4 metre wide secondary road through the middle of the 50x 60 metre area. Such a layout is commonly used in camps.

Block 2 uses an alternative "U" shape tent arrangement proposed by UNHCR for 24 tents on the same 50x 60 metre area. Block 2 does not have the 4 metre road but in the field the "U" area is often used for public pedestrian and vehicle access as the 4 metre secondary road in block 1. The tent densities are consequently similar.

Figure 1: The two block tent layouts that were analysed.
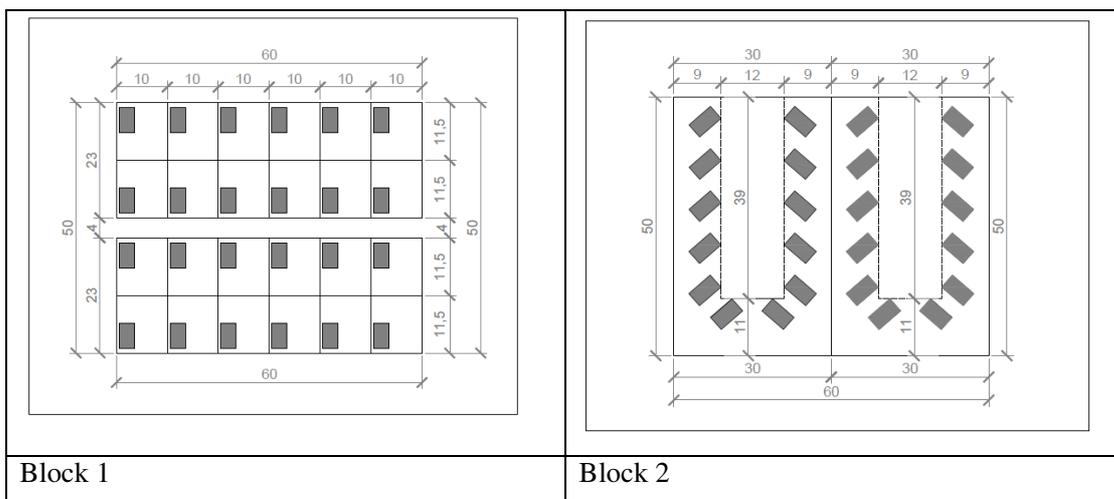
| Block 1 | Block 2 |

Fences are assumed between all the 24 plots in block 1 and around each "U" shape in block 2. The block 2 fence has a small entry point in the rear onto a 4 metre wide secondary road but is fully open to the 8 metre wide road in the front.

Typical in the field arrangements of these are shown in figure 2 below. Both are shown just prior to people coming in to occupy the camps. It was observed that fences were usually one of the first things they constructed.

Figure 2: The two block tent layouts in the field.

Row arrangement without fences. Pakistan 2004.	"U" arrangement without fences in Melaboh, Indonesia 2005.

5 Preliminary Syntax Analysis

There are many spatial factors that could have been varied or modeled as part of this study such as the street widths, the effect of gates and entrance ways, local widening of streets, the location of the tents on plots and whether the plots were fenced or not. The impact of fences was reviewed and the integrated isovist maps for the fenced and non fenced situation s are shown in figure 3 below. The roads are marked by arrows.

The maps strongly suggests that the "back yards" of the tents (when there are no fences) would become public domain (left map of figure 3) compared to the fenced option shown on the right. But there are many other reasons why fencing should be included which include the following:

- It ensures a private area at the rear of the plot for the future construction of a family toilet/bathing area.
- It provides a shelter area for cooking

- It provides a level of privacy for the family
- It provides some level of safety and security (depending on the fence construction) for the family

Hence, fencing was included in the model. Other smaller studies established that the scale of the model was significant and a 3 x 3 arrangement of blocks (3 across by 3 down and hence 9 in total) with the centre block of the 9 being used for comparison.

On the other hand, the tent location had only a local effect on the isovist map and so the tent location shown in figure 1 was retained throughout. Finally, a 1 x 1 metre grid layout was used to ensure that there were at least 3 points inside the 4 metre secondary road.

Figure 3: A preliminary study on the impact of fencing around plots (roads are marked by arrows).

| Without fencing | With fencing |
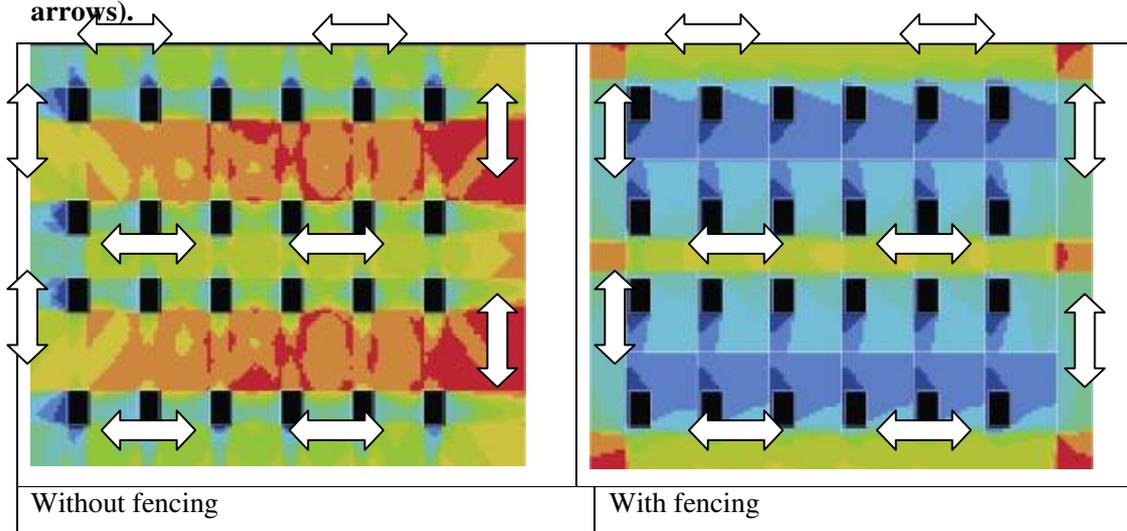
6 Spatial Syntax Analysis

The spatial syntax analysis of block 1 confirms much of what would be intuitively expected. The road intersections are key public areas ("red" coloured zones) with the wider 8 metre road being more significant then the 4 metre one. Nonetheless, the 4 metre road is acting exactly as a secondary road and the tent plots off the road have higher levels of privacy then those on the main road. The corner plots of the block (with the tents on the inner side) have less privacy then those inside the block or with the tent on the outer side. Site planners would usually try to place water tanks in the "red" areas and possibly use the corner plots for female toilets and bathing areas and

possibly laundry areas. Markets, schools and health centres would gravitate to the global "red" coloured areas.

There is the possibility of locating water tanks half way along the 8 metre road and using the adjacent plot for female toilets, bathing and laundry areas. Moreover, if two plots were taken giving direct access into the secondary road at the rear then there could be potentially more community gains in terms of security for those plots along the secondary road area. However, there are two significant points that this syntax analysis suggests that are perhaps not so intuitive which are the following:

- It shows a gradient from the public spaces through to the more private spaces inside the plot. This "intimacy" gradient is seen as fundamental to the notion of identity and social sustainability (Alexander et al, 1977) (Jacobson et al, 2002).
- It highlights that shelter is not only concerned with the space inside the tent but is about the space around the tent and consequently it is this space (rather then shelter) that is the "machine"(Hillier, 2007).

**Figure 4a: The Spatial Syntax Analysis of Block 1.**
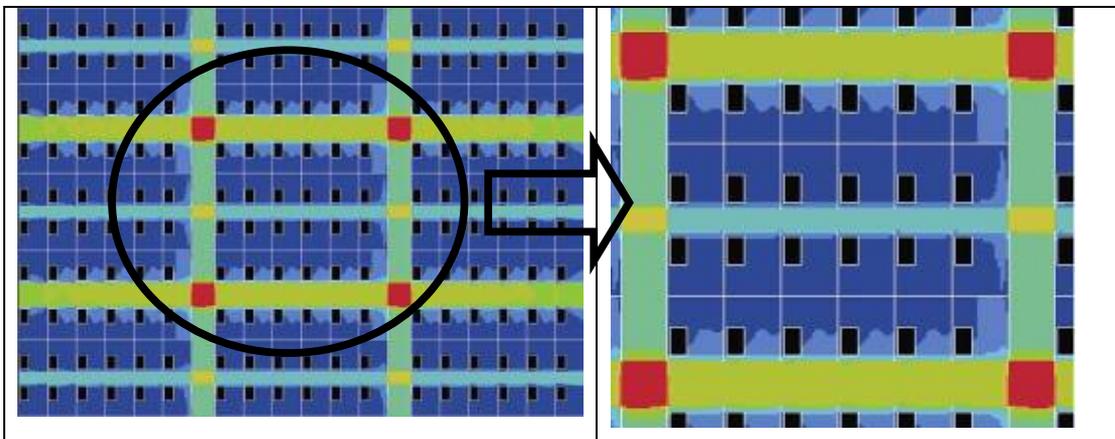
So how does block 1 then compare with block 2?

It has similar intuitive features as block 1 but in addition has a hot (orange coloured area) immediately in front of the "U" and then a large cooler area in front of the tents. And provided there was a "community" living in the 12 tents then such a spatial layout could work well. For example, the area in front of the tents would be a "commons" but one that people would not

normally pass through. Hence people that are not from the 12 tents would be scrutinized more then in the block 1 situation of a public road. Moreover, this scrutiny would/could be from all or any of the 12 tents. In addition, the commons area could service both group activities such as sport and supervision of children at play. The areas at the back or in the front of the "U" could be readily used for female toilets, bathing and laundry areas. However, its one main drawback would be a lack of privacy compared to block 1.

Figure 4b: The Spatial Syntax Analysis of Block 2
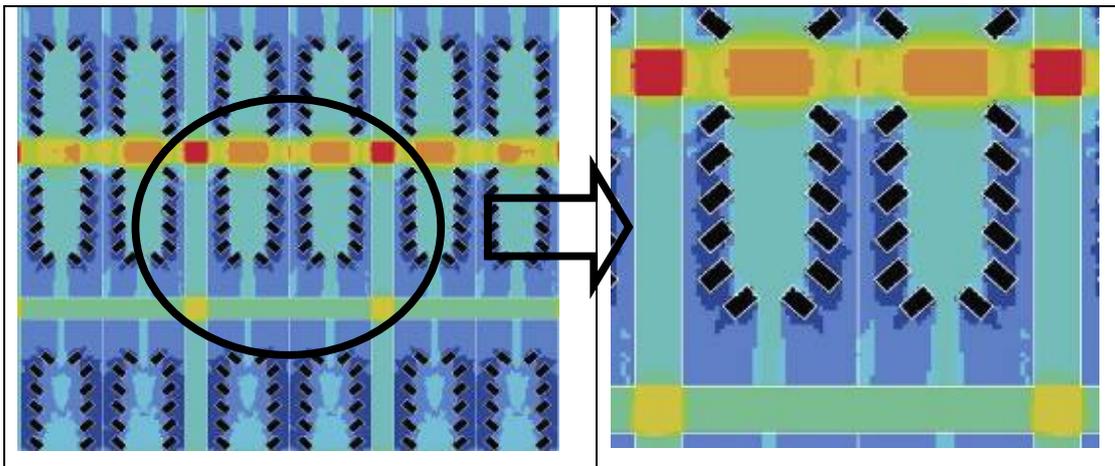
In considering the shelter criteria a comparison between block 1 and 2 does suggest that block 2 would have more advantages (refer to table 1 below).

It should be emphasized that this spatial syntax analysis will change with variations of roads, degree of fencing not forgetting the realities of a site s the analysis assumes a flat site. Consequently, the conclusions drawn are for a typical typology.

Table 1: A comparison of shelter criteria between the blocks

Criteria	Block 1	Block 2
Adequate	Satisfactory	Satisfactory
Safe	Satisfactory	Superior
Secure	Satisfactory	Superior
Appropriate	Satisfactory	Satisfactory
Privacy	Superior	Satisfactory
Individual and group	Satisfactory	Superior
Identity	Satisfactory	Satisfactory
Social sustainability	Satisfactory	Satisfactory
TOTALS (Superior)	1	3

7 Conclusion

Spatial Syntax is a useful tool in comparing and analyzing the qualitative aspects of shelter such as security and privacy. The analysis maps produced can reveal locked in social effects that may not otherwise have been identified. For example it does appear that a "U" shaped tent layout has advantages over a street/row approach that were previously intuitively sensed but could not be quantitatively nor easily verified.

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