Natural surveillance is one key factor proposed, in the approach to decrease fear of crime. Building fenestrations and outdoor spaces like terrace, balconies and verandas that extend the interior spaces and the indoor activities, beyond the closed external shell of the buildings, are proposed by CPTED, in their place specific policy guidelines, to help design out fear and crime. In this background, this study on natural surveillance opportunities, explores typological variations of these component outdoor spaces of buildings, in line with variations in size and location. The affordances considered for this study specifically focus on the ways in which these spaces structure the visual fields for the external observer. This paper thus reports the survey of visual preferences exploring the spatial affordances of building spaces and their association with fear of crime.

Keywords. Natural surveillance; typology; fear of crime; visibility analysis.

1. Introduction

Crime is the result of a complex interaction between economic, social and cultural factors, including the physical environment that houses them. Fear of crime is the fear that crime educes and stimulates. Studies have been made in the area of ‘Fear of crime’ for several decades and it still attracts interest from social, economic, political and research perspectives.

Crime triangle theory puts the physical location (opportunity) as one of the three major factors that determine the type of crime or the behaviour of the criminals. Though for a fact we know that building don’t commit crime, studies show that various features of the physical environment contribute to fear of crime. The built environment creates prospect, refuge, gives a feeling of entrapment or concealment,
sets the zone of proximities, enhances belongingness through feeling of territoriality and thus create sense of comfort, safety and security.

The relationship between the physical properties of the built space and the spatial experience it creates, in this case the perception of safety and security, needs generic descriptors of space like geometry, scale, orientation, alignment, etc to facilitate better understanding. These dimensions will help analyse the connection between the architecture of the physical environments and the user behaviour, to obtain biologically and psychologically relevant properties of the built environment. Crime prevention through environmental design (CPTED) recommends location specific policies as guidelines to architects, designers and planners, regarding the layout and design aspects of the component spaces of buildings. But architects with several other dimensions and higher objectives to satisfy, prioritize building fenestrations and outdoor spaces for their lighting and ventilation and scarcely for the surveillance offered.

Thus this study attempts to test several variations of building outdoor spaces, through visibility analysis and visual preference survey, to determine the degree of impact these component outdoor spaces of buildings have on fear of crime.

2. Review of Literature

The perceptions of personal security control the preferences of a user on places and spaces being used because the spatial properties of the built environment influence the subjective experiences of users. Even the building’s exterior, though a mere packaging has close encounters with people and thereby influence their perception of these spaces (Gehl et al., 2006). In Fear of crime studies, emphasis on spatial characteristics are recorded since 1920s and 1930s, in the ecological studies of the Chicago school. Several theories, even from environmental psychology, explain human behaviour and experience by their interdependency with the environment. The evolutionary based theories of environmental preferences suggest that certain spatial settings were advantageous for the survival of a species and therefore corresponding preferences enhanced its fitness. Moffat (1983) proposed six broad categories to first generation place based crime prevention studies; Territoriality, access control, surveillance, target hardening, image/maintenance and active support (Geason et al., 1989). Among these broad areas of concern, surveillance is one key factor in the approach to decrease fear of crime.

2.1. NATURAL SURVEILLANCE

Natural Surveillance is the concept referring to the arrangement of physical design features, the activities and people, in order, to maximize opportunities for surveillance at the right moment in time and space, ultimately preventing crime (Cozens, 2002).
The primary focus of any surveillance strategy is to keep the intruders under observation and the undesirable behaviour under control (Sorensen et al., 2008). Jane Jacobs (1961), in ‘The Death and Life of Great American cities’ suggested that the eyes of local guardians must be scanning the built environment all the time for its design to be safe and successful. Oscar Newman’s (1973) defensible space talks of natural surveillance in addition to territoriality, images and milieu. Crowe (2000) reinforces the importance of natural surveillance alongside maintenance, natural access, control and territorial reinforcement in CPTED design suggestions.

Features of the physical environment play a major role in providing natural surveillance. Natural surveillance of urban places is provided by occupants of the neighbouring buildings and the public on streets (Desyllas et al., 2003). The offenders look for desolated places to avoid being identified or caught while committing a crime. Enhanced surveillance will increase the vulnerability of the offenders. Hence, promoting natural surveillance will increase the risks of offending. Moreover due to the confidence of guardian interference, people feel more secure in areas with high surveillance.

Defensible space theory, situational crime prevention, secured by design (SBD) and CPTED and several place based crime prevention theories intend to promote natural surveillance to alleviate incidence and thus fear of crime’. Natural surveillance provided by building occupants, enhances the perception of personal security of people navigating through a built environment. Thoughtfully designed buildings and planned streets have great potential to increase natural surveillance and thus the feelings of security of the users. The number of unobstructed openings, type of building outdoor spaces and type of activity housed in that space aid people estimate the surveillance offered by the guardians. Both enhanced visibility and increased usage may enhance possibilities for natural surveillance (Welsh, 2009).

3. Purpose of the Study

Empirical research studying the impact of component parts of the built environment while evaluating its effectiveness of interventions in fear of crime is fraught with difficulty (Cozens et al., 2005). Designing by way of understanding typologies have been part of architecture for long and it helps classify and put several alternatives into groups, based on their similarities, as well as, to make distinctions between them (Guney, 2007). This study, with the aid of computer generated block variations will extend the use of typological studies for evaluating visual preferences of buildings, based on the perception of safety. The objective of this experiment is to evaluate the affordances of typological variations in building outdoor spaces, relative to its size and position, towards natural or informal surveillance and thus its impact on fear of crime.
4. Experiment

4.1. OBJECTIVE

Interrelations between spatial variations in buildings and visual preference were tested with this experiment. The visual preference and user’s behavioural response were obtained for hypothetical block models, generated for this purpose. It was hypothesized that these different models of systematically represented variations will influence participant’s visual preference.

In accordance with the overall objective of investigation, the visual preferences obtained via the survey were compared with the visual fields offered by the building through basic isovist calculation.

4.2. EXPERIMENTAL SETUP

Photo simulated models combine flexibility, controlled laboratory conditions, and a good degree of perceptual realism for even the hypothetical buildings. It allows systematic variation of spatial properties of the experimental environments. Thus this study used the basic 3D solid modelling technique of subtractive modelling, to model several variations of recessed outdoor spaces in a two story building, to study the aspect of surveillance towards reduction of fear of crime. The 3D models were created using AutoCAD 2013 and rendered using Autodesk 3ds Max Design 2013. In order to compare these buildings, the variations were normalized according to the range of visibility affordances.

4.3. METHOD

27 Elementary cubes (measuring 3 meters each side) were used to generate a modular geometric system of a block cube (9m x 9m x 9m). Subtractive modelling techniques transform this block cube into several morphological variations. No more than three blocks were removed at a time. Blocks which are not visible from the streets when removed were also left untouched. The ratio between block volume and openness and the isovist surface area calculations helped reduce the number of variations to eighteen options (Figure 1).

All visible side of the elementary cubes were given a door or a window. Each elementary block, when removed, to form an outdoor space, was marked with a 0.6m tall solid parapet wall. Positioning or location of the outdoor spaces and the size were varied in each study model. The resulting variations of the building outdoor spaces were surveyed to obtain the visual preferences of the observers.

Since the study used visibility analysis to verify the results, only one public street was located, 6m in front of the building. The entry to the building block was
oriented to the streets making the building have direct access from the street. There were clear lines of sight between entrance foyer and street. Preset observation points and a block cube of similar dimension on either side of the generated model, with a side setback of 4m, determine the frame limits of the rendered output and also allow the consideration of field of view.

4.4. DATA

The data collected recorded the visual preferences of the participants for the eighteen options grouped under three categories. Three images from three different viewpoints were projected on screen for each option. Images from three viewpoints were to give a 180 degree view around the building to aid participants picture the building block without difficulty. Participants after viewing the images responded to them by answering the questionnaire survey.

4.5. CALCULATIONS

Isovists are viewshed polygons capturing the spatial properties of the built environment by describing the visible area from the user-centred perspective (Benedict, 1979). Thus isovist calculations were included as supplementary additions to help with analysis and study. The visible fields for the same block will vary as a user navigates along it. Hence the method of averaging isovist measurands for the same building from three different points rendered global characteristic values. The horizontal floor area as well as the vertical surface area of the outdoor space, visible to a human eye was calculated. The analysis then tested for interrelations between characteristic values derived from the isovist study and the behavioural data (Figure 2).
4.6. PARTICIPANTS

30 participants (12 female, 17 male) voluntarily participated in the experiment. Participants were all undergraduate university students of the department of architecture.

4.7. ANALYSIS AND RESULT

The questionnaire collected data on the participant’s actual perception of fear of street crime, in the real world. It was observed that 76% of participants feared crime of which 91.6% were women and 66.7% men. For the real world circumstances, 60% of the participants rated surveillance from outdoor spaces as safest while 20% preferred window surveillance. The remaining 20% rated ease of access as the key determinant in fear of street crimes. Thus majority of the participants preferred occupants of the neighbourhood to provide surveillance from outdoor spaces. On the contrary, 63% of the participants expressed comfort providing surveillance through windows and only 26% favoured their guardianship through outdoor spaces.

The section two of the questionnaire that through virtual world models studies the visual preferences of participants, proved that the geometry of architecture do impact the spatial preferences of users. As per the hypothesis and in accordance to the isovist calculations option 2 and 1 were rated very low with option 1 perceived to be the least safe. But, option 6 was perceived a safe building only next to option 4 as against the hypothesis and the isovist predictions. Similarly option 5, though in isovist surface area calculation showed greater...
prospect, was rated the last in the double block subtraction and was ranked below option 3 (Figure 3).

The general perception of safety and security for each option was compared with variables like visibility, natural surveillance, ease of access, building familiarity and hiding spots (Figure 4, 5 and 6). Results show that the perception of blocked views, where clear line of sight were blocked by vertical walls, highly impacted perception of safety and were evidently seen to alter the rating values.
Ease of access and degree of openness also altered the rating values considerably showing the degree of impact it has on people’s perception of fear of crime.

5. Discussion

The experiments presented in this study investigated interrelations between spatial properties of environments on the one hand and spatial experience and behaviour on the other hand. The study mainly targeted the architects, as their visual preferences depend on their understanding of the spaces even in image based
representations. Overall, the participants showed remarkably a good evaluation of the outdoor spaces in terms of the sense of security it offered. The basic initial hypothesis that the size and location of the building outdoor spaces alters the user’s perception of security stands proved by the result. The visibility analysis captured behaviourally relevant environmental properties that support the result in few cases. But there are conflicts in certain other cases. Questionnaire survey of this study points out that the participants’ value familiarity and building design in terms of prospect refuge more than visibility.

6. Conclusions

The case study supports the hypothesis that people’s perception of safety and security is tuned to the way in which the building fenestrations and its outdoor spaces structure their visual fields.

Due to the limited number of tested models and the specificity in terms of the building type, building use etc, further studies have to test the general validity of these findings in different types of spatial settings as well as for a broader range of built structures. In continuation to this study, experiments are being repeated using computer generated parametric models, for various other component parts of the building and several other attributes of the building features, to study the impact of building elements in isolation, before being modelled into a 3D urban space. These findings suggest that further experiments translating the qualitative descriptions of theories such as “prospect and refuge”, “defensible space”, “territoriality/proximities” into empirically testable hypotheses can provide valuable data to verify them as well establish relationships between them.

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