

Research Article

Analysing the conglomeration of various urban pockets through the lens of environmental design for crime prevention: A case of Kolkata

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Historically, the built fabric of Kolkata had a dynamic morphological influence. The influences transfigured from the rulers; nawabs to British capitalism; zamindaris to political sweepstakes. This dynamism is not idiosyncratic and can essentially be distinctive upon closer inspection of the morphological carpet of Kolkata. Upon inspection it becomes evident how, from the very beginning, crime prevention was catered through the built fabric, irrespective of changes in architectural styles over time. Thus, be it central/north Kolkata or suburbs, the buildings would often have elevated, publicly accessible sitting platforms in front of houses, often referred to as 'Dalan'. These 'Dalan's' served multiple purposes, but most importantly catering to the four principles of Crime Prevention Through Environmental Design (CPTED) guidebook.

With the increasing demand, the housing market bloomed to the construction of just one particular type of building in Kolkata. This typology is, apartment; be it apartment buildings or complexes. This scenario has created a cacophony of build fabric, slowly resulting in losing the city's identity. Most importantly resulting in losing the natural security systems of the city. Thus, to maintain the natural security system, addressing the discombobulated policy, planning and political juxtaposition, is a subject on its own. However, denominating simple measures, towards the problem that can bring out the desired outcome, is the way forward. Measures related to case-wise urban design, planning and design interventions.

The research paper aims to address the issue and provide simple implementable environmental design measures. The research paper would focus on ward-level requirement-wise intervention. Wards selected across Kolkata Metropolitan Area (KMA). The selection of wards would provide an

opportunity to gaze across the KMA urban to the sub-urban morphological carpet. Upon selection, the probable solution is to have a holistic approach. An approach that would also incorporate the 'Defensible Space Theory' by Oscar Newman. Furthermore, the solution would help create the 'fit-all' category. With this category, the solution can easily be implemented in urban Kolkata core to sub-urban Barrackpore. Though, the scope of the paper will be limited to KMA. However, the 'fit-all' category would have the potential to be implemented in other urban areas as well.

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1. Introduction

The conurbation of urban agglomeration is a natural way forward to the proliferation of the population. This synonym creates a conglomerate quality in urban fabric which dictates the behavioural pattern of the stakeholder (Shaw Clifford R, 1931). This behavioural pattern was taken into consideration early on for historic cities across the globe. The pattern here is domineered by socio-economic causes. Causes, which are a direct analogy of urbanization as mentioned in the 'Economics of Crime' (Bruce L. Benson, 2010). A relatively new field caused by rapid urbanization, a form of development; industrialization, specialization and economic development (Malik, 2016). Development which also is a conglomerate aspect of labour market pooling, trade, services, education, higher income, economic relations and sumptuous lifestyle becomes the pillars of urbanization (Malik, 2016). These pillars affect the architectural styles and their changes, which is a direct relation with the impetuous urbanized behavioural pattern.

The human behavioural pattern with urbanization is a conundrum of necessity and inducement. Crime becomes the inevitable part of the inducement. Thus, the need for crime prevention arose. Multiple approaches were formulated namely the legal system, social approaches, approaches related to crime perpetrators and environmental design (M.Hedayati Marzbali, 2012). The methods for crime prevention are designed to influence fear towards crime as mentioned in the Crime Prevention Through Environmental Design (CPTED); which is perceived to be a better solution. However, architecture also influences crime to occur and also reduces it. A design of the building and its exterior function has the ability to deter crime in an area (Newman, 1973).

CPTED have formulated various guidelines for crime prevention, though the guidelines are difficult to put through the Indian urban context. Furthermore, residential areas are catered based solely on the observation method which again is based on perception, responsibility and action (Minnery, 2005) (Hedayati, 2009). This observation method is also influenced by the surrounding built fabric (Newman, 1973). Urban agglomerations in India can be contextualized with all the aspects of being historic conurbations with modern issues related to crime. Thus, addressing CPTED guidelines with architectural design in cities becomes crucial. Therefore, the objective of this study is to identify and analyse the architecture and planning-wise perception of people towards CPTED elements in regard to crime. The analysis is intended to validate crime prevention and understanding of the present context of a particular urban agglomeration of India. In this instance, the case of Kolkata.

2. Literature Review

The physical environment has a great influence on crime, fear of crime and the quality of life. That relationship has become more evident in recent decades as mentioned in designing safer communities: NCPC (Council, 1997). Crime Prevention through environmental design reveals multifarious varied landscapes that weave Urban Planning, Architecture, Psychology and Criminology. Researchers, Professionals and practitioners have explored the tangled relationship between Built environments and Crime rates, attempting to understand the influence of design elements on criminal behaviour.

The word 'Crime' is defined from the Latin word *Krinios* which means 'to accuse' (Jahnavi S, 2020). In India, the definition of crime can be found in the Indian Penal Code (IPC), which is the primary criminal code of the country. The IPC defines various offences and provides the legal framework for dealing with criminal activities. The basic definition of a crime in Indian law revolves around the concept of an "offence." Section 40 of the Indian Penal Code defines "offence" as follows: "An offence is a thing made punishable by this Code." Section 2(n) of the IPC defines "punishable offence" as follows: "Punishable offence" means an offence for which, under this Code, the offender is, by a competent court, liable to be punished." In brief, a crime, or offence, in Indian law refers to an act or omission that is specifically listed in the Indian Penal Code or any other law and is punishable by a court of law. The "offences" are classified under broad categories such as: Against persons, Against property, Against Public order, Against Decency and Morality, Against the state, Against Public Health and Safety, Against Women, Against Children, Against Marriage and Family, Cyber Crimes, Economic Offenses, and Environmental Offenses. Moreover, there is no specific enumeration of "types of crimes" in the IPC. Hence, conceptualizing the term "Crime"

remains ambiguous and so does “Crime prevention”. Till today, there is no one comprehensive guideline for our country’s context available, leaving apart a particular state. The crime Prevention field needs a document that could introduce CPTED concepts in practical terms for people working in communities.

According to the 2019 report from the National Crime Record Bureau, property crimes such as theft, burglary, and dacoity stand out as the most prevalent offences. Subsequently, crimes like assault, kidnapping, and sexual offences, including rape, come in the following ranks. According to NCRB data, the national average crime rate per lakh population of India stood at 2.1. West Bengal stands to be 4th in India in crime against minors. In 2021, among all the crimes committed against minors 2021, 67% of cases were related to kidnapping and abduction. Though Kolkata has been ranked as the safest city, the number of ‘serious offences’ increased to 1080 in 2021, from 981 in 2020 and 961 in 2019. In terms of Kidnapping of women, West Bengal is in the third position with 7,403 cases after Uttar Pradesh and Maharashtra as per the newspaper ‘The Siasat Daily’. This manifold increase in the crime rate over the years has increased a lot of fear and anxiety in the public domain.

Fear towards crime can be explained as an emotional reaction as well as a sense of fear and anxiety that compels the individual to believe himself to be in a state of danger from the threat of crime (Stephen Farrall, 2007). Hence, it is important to engage in crime prevention measures to decrease both the occurrences of criminal activities and the sense of fear associated with them.

Crime prevention through environmental design (CPTED) is a tool for identifying, preventing, and solving local crime problems (Council, 1997). CPTED comprises four essential components: (a) Territoriality: This concept reinforces the sense of ownership and proprietary concern among legitimate space users, discouraging potential offenders and minimizing opportunities for criminal acts by deterring unauthorized users. (b) Surveillance: Rooted in physical design, surveillance facilitates natural monitoring by residents and their representatives. It contributes to effective guardianship by fostering an environment where potential wrongdoers recognize the possibility of being observed. This increased risk of intervention, capture, and legal action can dissuade offenders. (c) Maintenance and Target Hardening: This facet emphasizes sustaining a positive image and consistent upkeep of the physical environment, sending affirmative signals to all users. Introducing elements of target hardening elevates the efforts required for criminals to execute their activities, acting as a deterrent. (d) Access Control: The notion of access control restricts criminals’ access to potential targets while amplifying their perception of risk. By denying easy access to targets and creating an atmosphere of heightened risk, this element diminishes

crime opportunities. CPTED's four elements collaboratively shape a safer environment by reducing crime opportunities, enhancing guardianship, and curbing the appeal for criminal activities.

However, the measurement of all these elements of CPTED within research is still found to be limited (M.Hedayati Marzbali, 2012) (Stephen Farrall, 2007). Analysing various Indian Cities has revealed the significance of the CPTED essential components in deterring criminal activities. While existing studies underscore the potential efficacy of CPTED principles, there remains a gap for further research and implementation, considering the dynamic nature of urbanization and its impact on crime patterns across India.

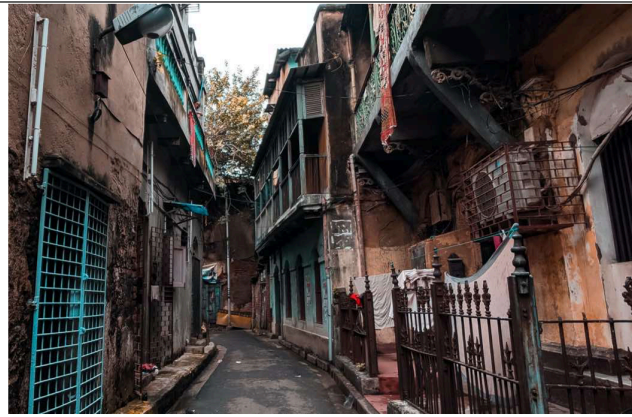
One of the methods that consider the elements of CPTED is through placemaking. Place Making: A way to improve the quality of various places in a neighbourhood or space by using art, which plays a significant role in creating a conscious and unified effect in developing the space. Various research has been done where art is used to connect different detached social groups, which finally promotes compatibility and compassion among the resident. This quality of space finally helps in creating a secure society by decreasing mutual violence, a very prompt reaction to the person who breaks the rule & enforcement of the law (Pandey, 2023) (M.Hedayati Marzbali, 2012).

In this study, three entirely different spatial localities have been considered with a common character in all of them. For the research paper, all four CPTED indicators have been considered for the analysis along with the observation method in context to the surrounding built environment of the localities to get a comprehensive result.

3. Methodology

The study involves three residential areas with an institution in each of the selected localities in Kolkata. The chosen sites are spread across Kolkata Metropolitan Area (KMA) with each site depicting a distinct perspective-based behavioural pattern analogy. Site A is chosen in the central core where the urban fabric had witnessed reverse gentrification and their correlation with an educational institute in terms of crime. Site B is adjacent to the city centre but a planned area where the planning was done to accommodate middle-income groups (Saha, 2021). However, at present residing high-income groups, thus, an area depicting gentrification. This is done in the context of an educational institute which caters students from across Kolkata and outside. Site C is chosen on the outskirts of Kolkata in Rahara, with a nationally renowned educational institute encompassed in residential typology.

Site A - College Square, central Kolkata. Institute – Presidency College



Site B - Salt Lake, FE Block, adjacent to the city core. Institute – Bidhannagar Municipal School (BMS Kolkata)



Site C - Rahara, Sahid Bedi, Kolkata periphery. Institute – Rahara Ramkrishna Mission



The sites chosen primarily are non-gated residence characteristics with an educational institute. This would not only help understand the correlation of perception towards timed activity spaces and twenty-four-hour activity spaces. Furthermore, this selection of areas was adopted from the guidelines specified in the report 'An Exploration of Sense of Community and Fear of Crime in Gated and non-gated communities' by Wilson and Doenges. The criteria of selection are followed as mentioned in the report, however, adopted and altered in the context of the city. The criteria are (1) The size of the residential property area. In the context of Kolkata, which is measured in 'Katha', the size taken is at least 0.5 'Katha'. (2) A stable community with occupancy for a period of five years or more. In the case of Kolkata taken the occupancy period of more than ten years. (3) Ethnic or racial composition. In this context, the change of ownership and the belief system is taken into consideration to understand gentrification and the correlation with crime if any. (4) House design. In the case of Kolkata typology such as detached, semi-detached, and row housing is considered. (5) House with accessible terrace/balcony units. (6) Level of income. For the study income of the inhabitants in the selected locality is not considered to get a holistic perspective towards crime. Based on these selection criteria the mentioned sites A, B, and C are chosen which were found to fulfil the criteria.

A population survey was conducted for the selected area in reference to the geoIQ population chart showing approximately 53000 people per sq. km. for the College Street area. From which the selected site is 0.25 sq. km. with an approximate population of 13000 for site A. Similarly for Salt Lake Kolkata, FE block the approximate population is 10000 people per sq. km. From which the selected site is 0.12 sq. km. with an approximate population of 1200 for site B. Furthermore, Rahara has an approximate population of 9000 people per sq. km. From which the selected site is 0.15 sq. km. with an approximate population of 1300.

From the conducted survey 300 samples were taken. The surveys were based on willing participation from the residents. However, only one member of a family was considered for the questionnaire survey. A face-to-face survey approach was conducted with random sampling to ensure that the participants fully understood the questions and that genuine answers are received. The respondents include homeowners, workers and regular passersby. This point was important as it was important to understand the viewpoints of various people along with their sense of responsibility towards that area. The survey was conducted in the morning and evening, both between 7 am/pm to 8 am/pm for a period of five consecutive days.

4. Results and Discussions

The agenda of conducting this research was to analyse and understand the effect of CPTED principles consisting of Territoriality, Surveillance, Maintenance and Access Control, with the observation method with its base on the surrounding built fabric. In this particular research, each of the principles was assigned with five parameters, to analyse the specific head. The items under respective principles were selected based on previous research papers and guidelines. Further, the parameters were measured using a Likert scale and validation of the items was done by conducting a confirmatory factor analysis (CFA) using AMOS and SPSS software. The precedence of this research was conducted on the aspect of non-gated community in the research paper “Validating Crime Prevention through Environmental Design Using Structural Equation”. Confirmatory factor analysis (CFA) is a statistical technique used to verify the factor structure of a set of observed variables. CFA is a measurement model which is developed by the correlation between latent variables and several indicators (items) or known as variables and error manifests (M.Hedayati Marzbali, 2012). Confirmatory Factor Analysis (CFA) serves as a statistical method employed to validate the underlying factor arrangement within a given set of observable variables. CFA permits researchers to assess the proposition that a connection between observable variables and their latent constructs beneath them is present. Latent variables are those variables that can be deduced indirectly using a mathematical model, derived from other directly observable or measurable variables.

To validate and establish a confirmatory test, an appropriate number of samples have been considered for the analysis. The measurement model for each of the parameters is developed through the software as shown in the figure below.

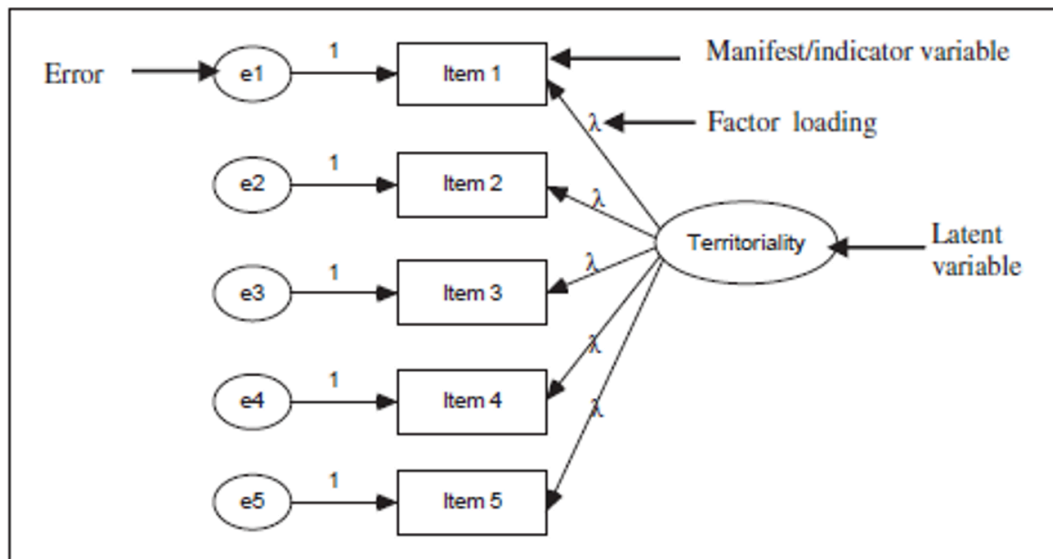


Figure 1. CFA Model for CPTED elements

Source: Validating Crime Prevention through Environmental Design by Structural Equation

The figure depicts that one latent variable, in this instance Territoriality consists of five items (observable variables) which measure its value. Factor loading value in CFA refers to the correlation between the original variables and the underlying latent variables or factors.

Fundamentally, these factor loadings indicate the extent to which each variable is connected to a specific factor. Therefore, factor loadings provide insights into the variables that exhibit the strongest connections with a given factor. In Figure 2, each of these individual items has its measurement error, and the quality of the individual items is determined by the factor loading **lambda**. Factor loading imparts information about the total number of variances contributed by each item towards the measured construct and the factor loading value of 0.3 is used as a cut-off value to determine the suitability of the item in measuring the latent variable (M.Hedayati Marzbali, 2012).

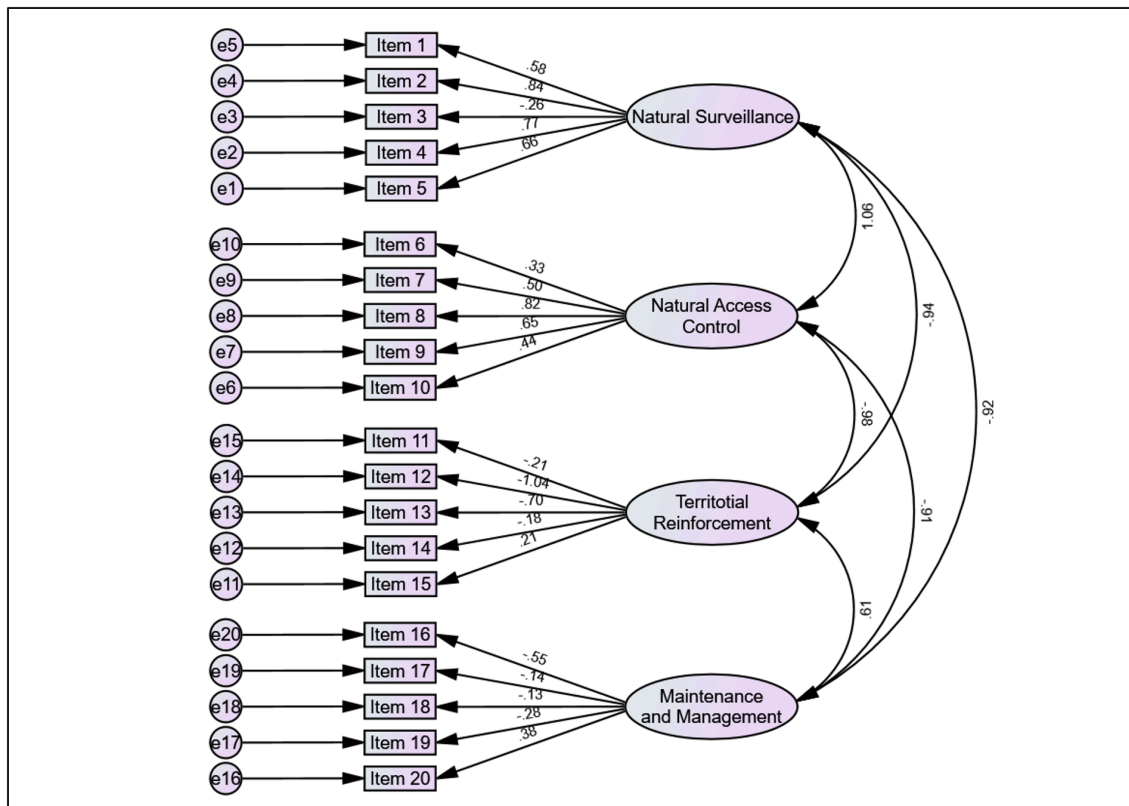


Figure 2. CFA model for all the four elements of CPTED

Moreover, the level of reliability is determined by calculating Cronbach's Alpha value as shown in table e below. The Alpha is a probability value which decides whether the data is reliable to analyze or not. The table shows that the Access Control Point has a reliability factor in negative whereas natural surveillance has a factor of 0.56 which indicates a good reliability value. Based on the model, the analysis that can be drawn is that the Natural Surveillance ($r=0.56$) represented CPTED better than the other two dimensions (Territorial reinforcement; $r=0.383$ and Maintenance and Management; $r=0.366$). As the Access control point has a reliability factor in negative, hence it will be eliminated for further consideration as it does not contribute to CPTED in the chosen localities.

CPTED Dimension	Items	Description of Items	Factor Loading	Reliability
Natural Surveillance	Item 1	Clear sight lines.	0.58	0.56
	Item 2	Adequate lighting on the street.	0.84	
	Item 3	Large windows promote casual supervision of the street.	-0.26	
	Item 4	The exterior of the building is well-illuminated.	0.77	
	Item 5	Keeping shrubs and plants below window levels.	0.66	
Access Control	Item 6	Points of entry	0.33	0.18
	Item 7	Barriers to preventing unauthorized use of private spaces.	0.5	
	Item 8	Low, open-type fencing that indicates private space, but does not prevent natural surveillance.	0.82	
	Item 9	Eliminating design features that grant access to roofs or higher windows.	0.65	
	Item 10	Defensive plants around potential points of access act as a formidable barrier.	0.44	
Territorial Reinforcement	Item 11	Presence of sidewalks	-0.21	0.383
	Item 12	Fences—when kept see-through and low to the ground—provide not only territorial reinforcement but also natural surveillance and access control, Landscaping, which shows an active presence and often provides some level of access control.	-1.04	
	Item 13	Marked boundaries of private, semi-private, and public space via signage, change of material	-0.7	

CPTED Dimension	Items	Description of Items	Factor Loading	Reliability
	Item 14	Security cameras or other security measures	-0.18	
	Item 15	Areas like Dalan segregate between public and private spaces.	0.21	
Maintenance and Management	Item 16	Pruning and upkeep of lawns, gardens, or any other landscaping elements	-0.55	0.366
	Item 17	Regulated removal of trash and other debris	-0.14	
	Item 18	Strategically placed benches to motivate residents to sit and chat or people watch	-0.13	
	Item 19	Timely repair of broken equipment and replacement of burnt-out light bulbs	-0.28	
	Item 20	Activating public spaces through community engagement activities	-0.38	

Table 1. Result of the measurement model of the CPTED elements

5. Conclusion

The research paper tried to decipher the prevalent perspective and CPTED based crime scenario across three areas in Kolkata Metropolitan Region (KMR). The research papers found were solely based on CPTED principles which needed other parameters to understand crime in historic growing cities like Kolkata. This indicates that CPTED measurement related to attitude, responsibility, action and belief systems were not taken into consideration (M.Hedayati Marzbali, 2012). Thus, the study indicates how taking the CPTED principles can be corelated with other measuring tools to obtain an accurate result.

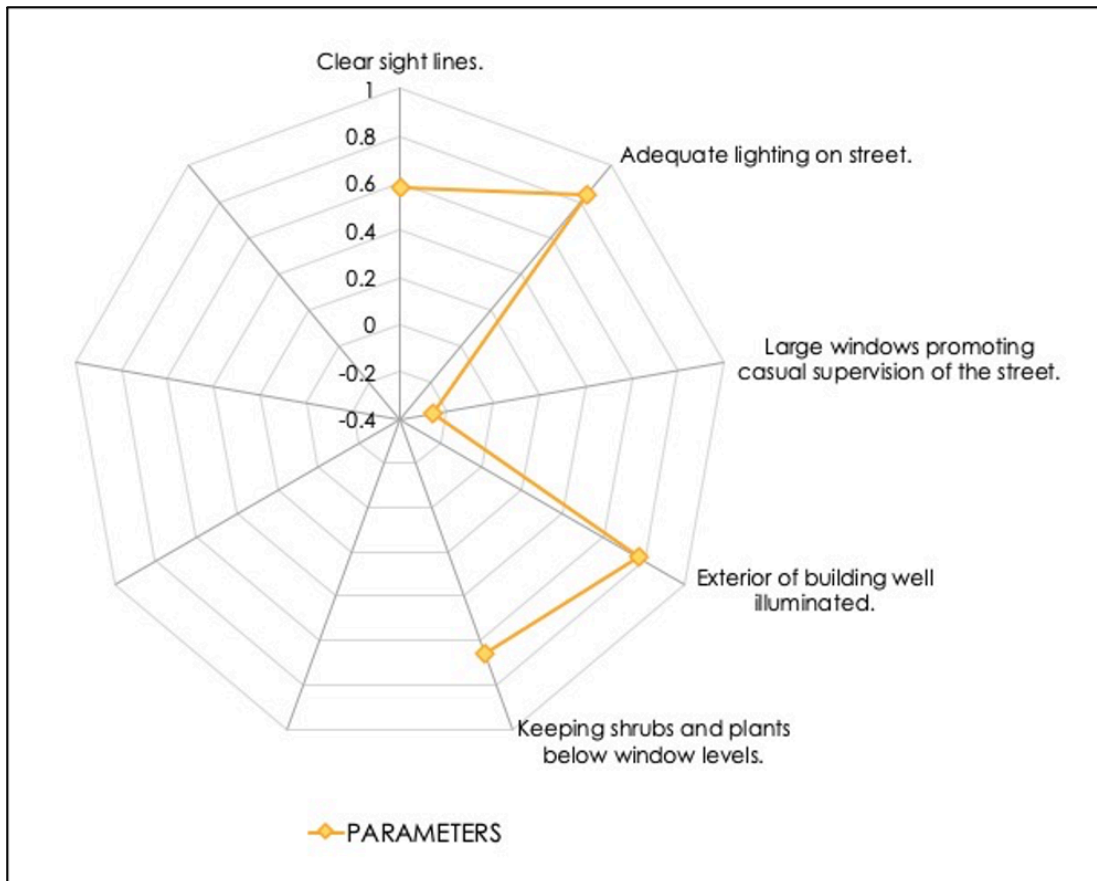


Figure 3. Radar Chart of Natural Surveillance

The radar charts of natural surveillance and access control indicate that outliers regarding eyes on street from window opening becomes a contrasting feature with central Kolkata thus the parameter is showing divergent graph. Contrastingly, access control is higher in planned areas like Salt Lake creating a deflating understanding on how the building works in correlation with the user in terms of crime.

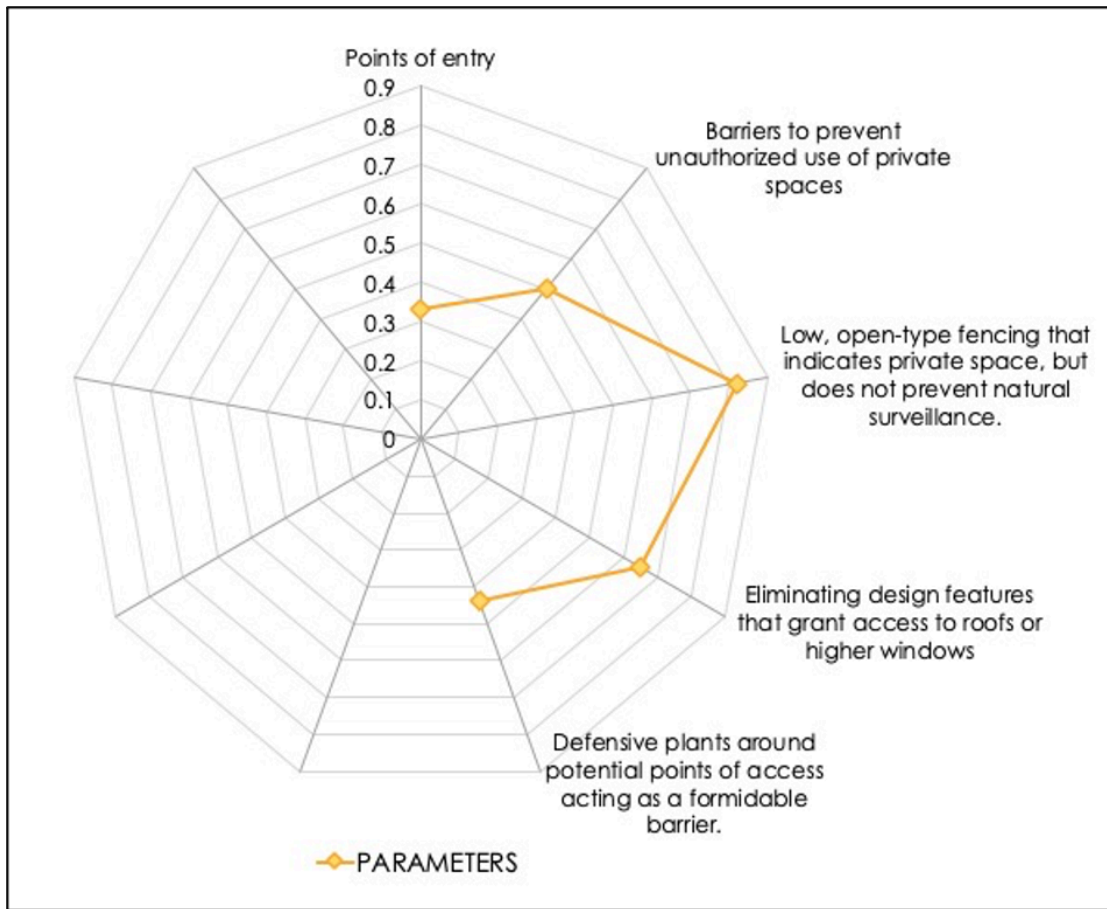


Figure 4. Radar Chart of Access Control

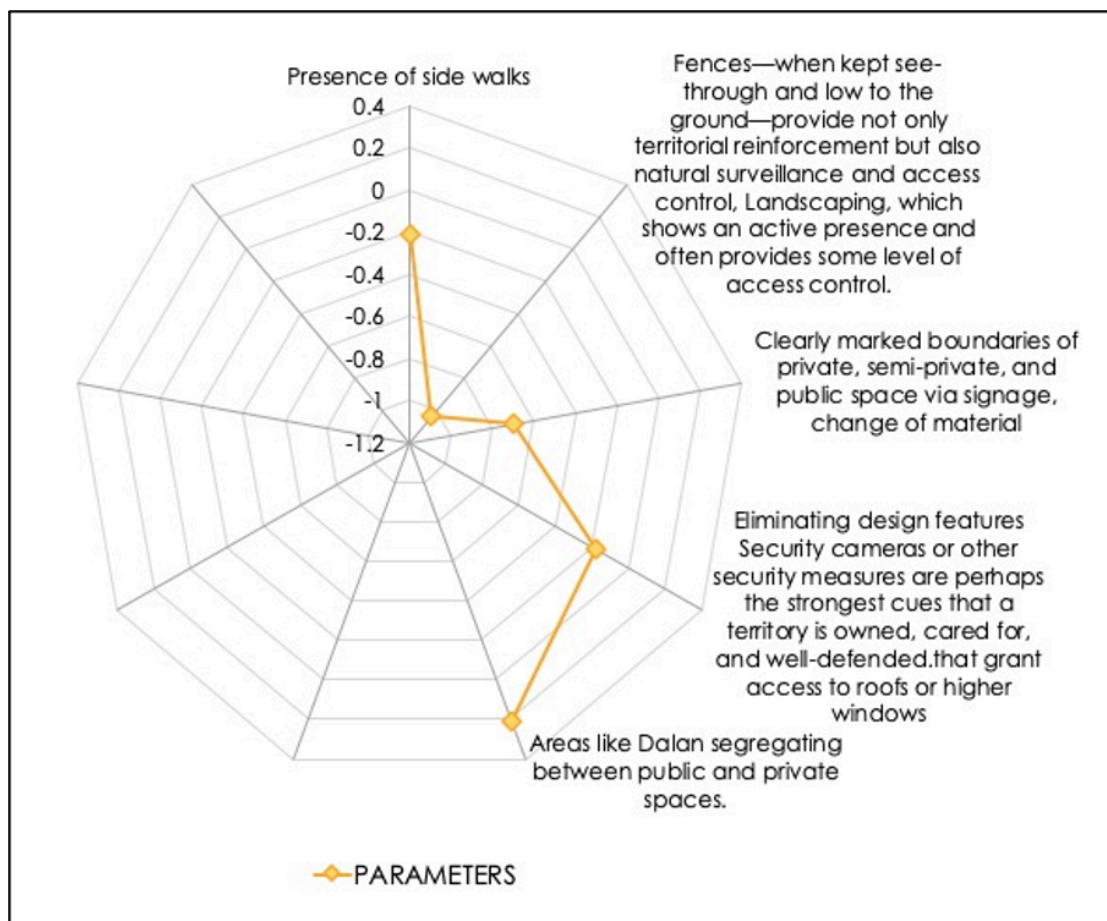


Figure 5. Radar Chart of Territorial Reinforcement

The radar chart for territorial reinforcement along with maintenance and management show that though the delineation of private, semi private and public is poor but architectural features like Dalan are being used. This is in contrast with the maintenance of public and semi-private spaces. Thus, the increasing use of informal spaces with movable street furniture.

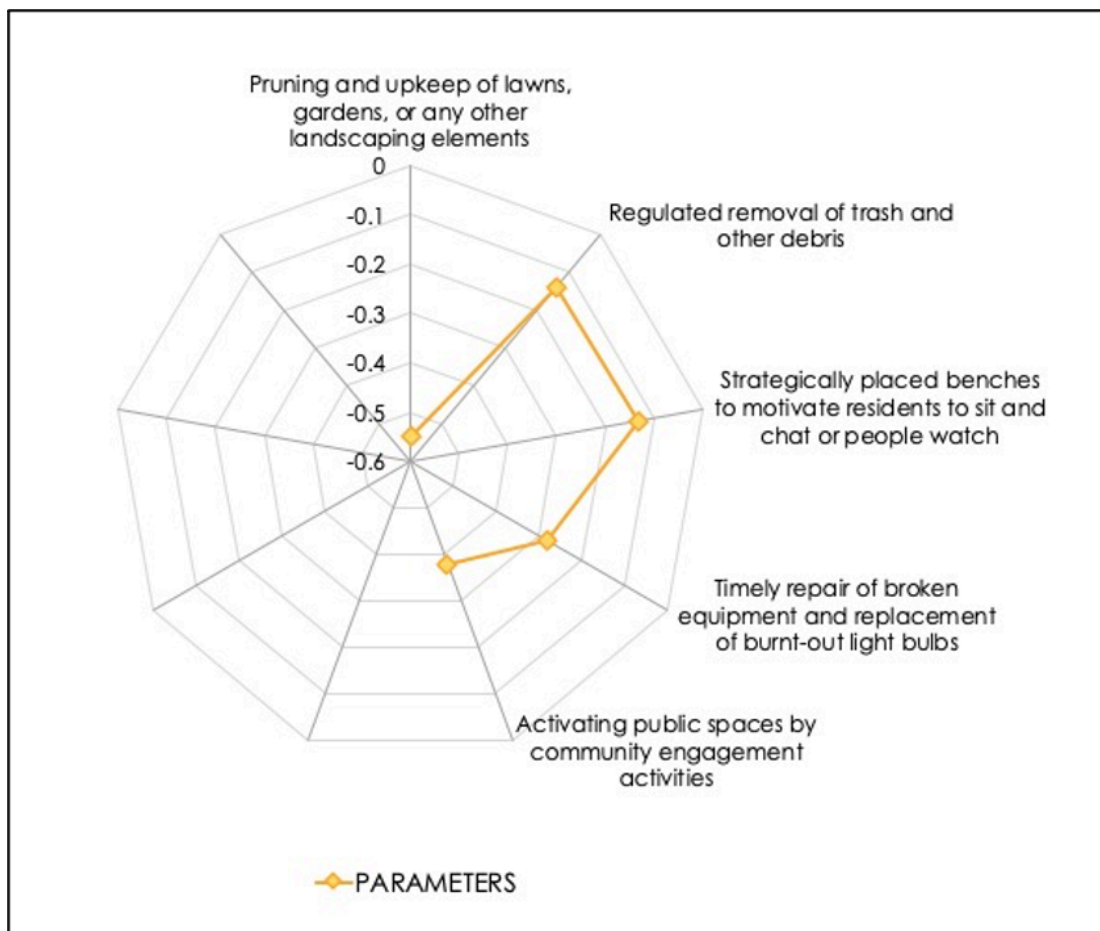


Figure 6. Radar Chart of Maintenance and Management



The findings in the study indicate that the parameters set by the CPTED can be used to measure Indian cities like Kolkata. However, certain alterations and incorporations are required to understand the crime prevention scenario for a historic growing city. The current data related to survey states that the only constructive way of surveillance is the natural surveillance. Thus contradicting the survey outcome in reference to the historic element of architecture, i.e. the concept of ‘Dalan’.

With the parameters set for the research, the most important point that was initially raised was regarding the ‘Dalan’ incorporated architecture style. The effectiveness in its present context and the change in the design of the same concept for the peripheral regions. In historic cities such architectural features become a key identity factor with important underlying use. This is a difficult factor to measure and is only based on perception. However, upon surveying it was found that this particular architectural element though extremely important and useful but have lost its relevance in terms of security. These

Dalans would now become a place where holding related to political meetings or crime initiating and nuisance making place. Thus, people are covering these Dalans with grills or sloping the surface so that it becomes unusable. Similarly in the peripheral areas, these outside spaces are being used for potted gardening spaces. This not only beautifies the house but also restricts its use.

Thus, based on the survey it can be concluded that small but effective measures can be taken to enhance natural surveillance. Measures such as bringing up wall art and colours to various pockets of the neighbourhood. This would not only create more engaging spaces but also reduce crime as it helps alter the negative mindset (Charlotte Brady, 2022).

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Conflict of Interests

We have no conflict of interest to disclose.

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