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Research Paper

# Determining the Spatial Organization of the Neighborhood based on Providing Territorial Behavior Using Space Syntax*

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## ABSTRACT

Home is the first pillar of social life and the most important space of human life, which by defining the territory and its relationship with other spaces, achieves a balanced interaction with this primary territory. The increased urban density following the changes in the contemporary lifestyle has led to the weakening of the home-based-spaces, which provided a just passing through spaces due to the disruption of the territorial behavior in the lack of residents' surveillance. The purpose of this research is to reduce the gap between theory and practice, by presenting the theoretical framework and testing the physical features using space syntax, answering the question of what spatial structure and physical features based on configuration imply territorial behavior. The research's hidden assumption is that by creating spatial hierarchies in secondary territories and dividing them into three spatial domains, plus paying attention to the effects of physical configuration characteristics and the access structure between domains, it is possible to achieve interactive secondary territories with transparent shared ownership that can be defended. The research methodology is to explain the design framework in a qualitative and naturalistic way, and from a practical point of view the controlled tests of the design results using the space syntax and the comparative analogous of the mean depth in the UCL Depthmap software to analyze the effective physical features. The results show that firstly, the creation of spatial hierarchy in secondary territories leads to the strengthening of territorial behavior in the home-based-spaces, secondly, the arrangement and physical characteristics of these central open spaces, such as form of domains, access length and width, and its number, movement barriers and corners are effective in determining the privacy of territories. Also, these cases, along with visibility, natural surveillance, and people presence requiring activity support, are targeted suggestions for future researches.

**Keywords**: Territorial Behavior, Defensible Space, Home-Based Space, Space Syntax Approach, Mean Depth.

* This paper is derived from an M.Sc dissertation by the first author titled "Residential Neighborhood Solidarity (Designing a Safe Neighborhood -Defensible and Under Surveillance- by a Social Sustainability Approach)" guided by the second author and advised by the third author at Architecture and Environmental Design School of Iran University of Science and Technology in 2022.

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## 1. INTRODUCTION

Residential buildings make up the major part of the built environment and as the first pillar of human social life, home is the most important livening space that influences and is affected by it. Humans have shaped their homes based on various methods over history, defined their territories, and protected them to make a balance in their interaction with the environment and community. Human beings have been always looking for privacy by defining his/her territories. This structure of territorial behavior and its borders have been influenced by the social, economic, and cultural structures within a geographical area and based on the lifestyle of its people through time. The considerable evolutions in recent centuries particularly after modernization and subsequently in the lifestyle and residence form of modern humans have led to change in human space. Population growth and urban density resulting from changes in economic and social structures of modern communities in addition to lack of sufficient land and area have led to the elimination or limitation of home-based-spaces and secondary territories-shared areas belonging to a group of individuals that may seem unnecessary at first phase- for increasing building density and providing demanded housing and generating more income by spending less cost and time. Weakening home-based spaces and not determining the boundary of ownership in secondary and interactive territories would directly affect the territorial behavior and result in a quantitative and qualitative decline in the expected activities done in this shared domain, imbalance in social interactions, reduction in sense of ownership and surveillance over the living environment. On the other hand, this housing brokerage would limit the role of home to a place for settlement and shelter converting the inherent value of home to an exchange value, and some factors, such as spatial quality and providing human needs-not minimum need for shelter-become unessential. The exchange value of housing leads to a quantitative approach to the home problem, and is an effective factor for many displacements through human dwelling; this short-term living in a home within the contemporary lifestyle compared to long-term life or living in a home for several generations has led to a dramatic decline in sense of belonging and surveillance over the home and neighborhood.

Ultimately, we are watching the formation of neighborhood spaces in which, the destruction of territorial behavior system and lack of sense of belonging and surveillance of occupants and their proper interaction with each other in the home-based-spaces as semiprivate and semi-public spaces, as well as non-determination of secondary territories' ownership and social integration and segregation boundaries not only cannot provide human and social needs of people in the neighborhood environment, but also they have been limited to a space just for passing through. The use allocation, street pattern, and neighborhood in the contemporary dense urban structure are designed in a way that the only available space is the primary territory and secondary and shared territories in the absence of determining certain ownership and lack of sufficient and accurate natural surveillance of users.

This study tries to review theoretical foundations in this scope using space syntax for physical analysis of neighborhood space by presenting the form and physical results affecting the territorial behavior for a better explanation of secondary territory boundaries and narrowing the gap between theory and practice. This paper aims to answer the question of what spatial structure layout and physical features can ensure territorial behavior in the secondary territories. How can one examine the consistency between qualitative studies on territorial behavior and early theoretical framework based on the space syntax method and find some results in the space configuration and form? The final goal is to provide a proper spatial pattern to determine the secondary and public territories in neighborhood space based on the comparative scale of physical characteristics of four early proposed patterns in a way to ensure social integration and segregation of its occupants in the home-based spaces. We assume that one can achieve secondary territories with relatively certain boundaries and transparent shared ownership that are defensible without creating surrounding and segregated neighborhoods without using walls and fence by creating spatial hierarchy from the primary territory as domain 0 (as personal territory of individuals and families) to the public territory as domain 4 and dividing the secondary territory between them to three spatial degrees of domain 1 (as secondary shared territory between blocks), domain 2 (as secondary shared territory between 4, 5 blocks and secondary territory in the neighborhood) and domain 3 (as the secondary shared territory of neighborhood). Moreover, the effect rate of these components can be explained based on the physical analysis of form characteristics and structure of access between domains.

## 2. METHOD

This study theoretically examines the documentary studies and reviews theories about territorial behavior in general and the secondary territory in particular in terms of two scopes of environment psychology and social sustainability in a divergent form, and then extracts the practical theories about territorial behavior (Fig. 1) then determines the primary idea based on the design theories (Fig. 2). The third view examines the causal relationship between variables, the rate of the relationship, and the terms changing the relationship that is along with empirical tests. This study examines the effect of the primary idea of this study-creating spatial hierarchy in central open spaces from the public territory (domain 4) to primary territory (domain 0) as a subset of spatial structure (Table 1 and Fig. 3)- and the results of early physical

analyses on the effect of some cases such as form and shape of domains, number of accesses, movement barriers, and corners are compared and retested under the controlled conditions. To assess these results, four proposed designs having spatial organization and hierarchy similar to different physical characteristics are compared using software simulation and the "Space Syntax" method, which is a subset of environment psychology studies.

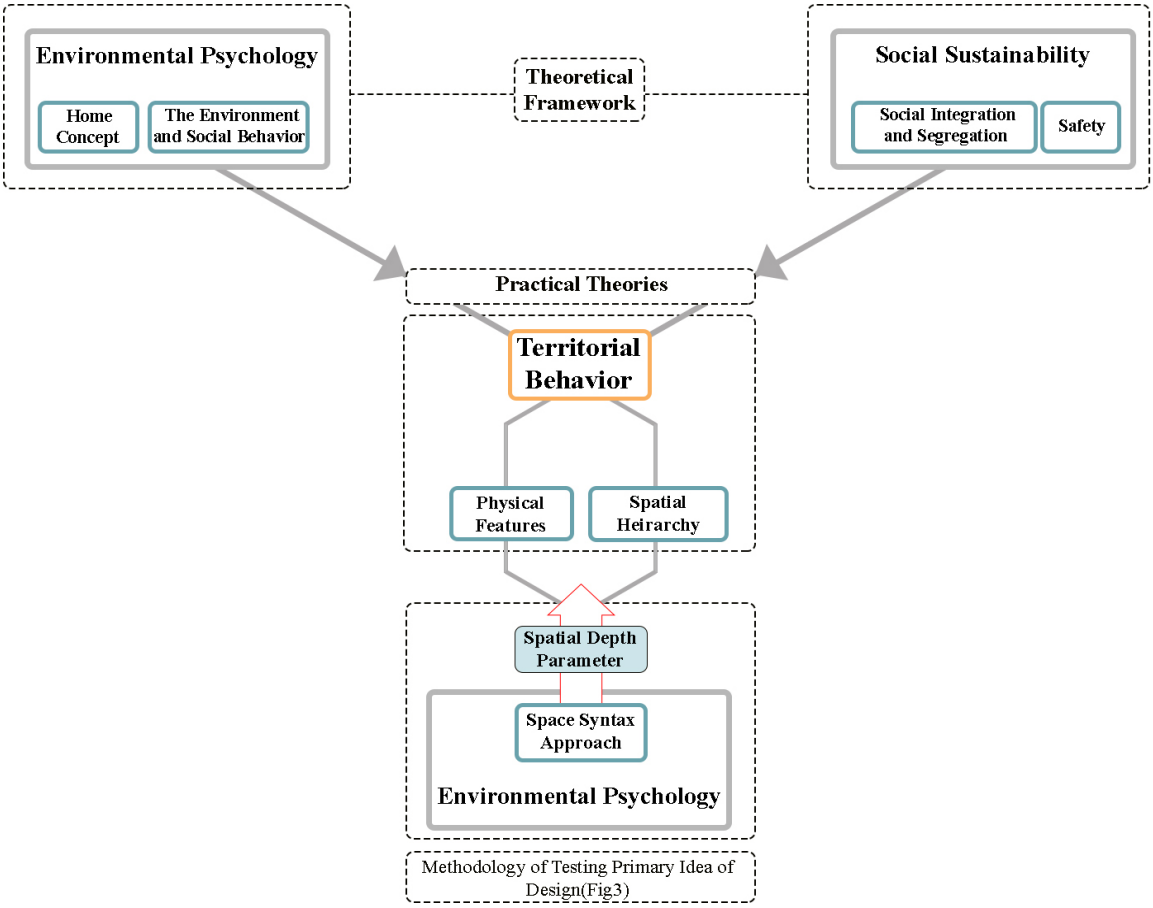



**Fig. 1. Conceptual Framework of Study; Practical Theories based on Territorial Behavior in the Secondary Territories and Testing it**

This method was introduced by Professor Bill Hillier and Julienne Hanson (1984) at the Bartlett and used for analyzing the spatial organization and internal discipline of an urban system. In the space syntax method, the layout relation between all spaces is analyzed, and space characteristics are presented as mathematical and graphical parameters and analyzed through Gama maps and point and line analyses (Hillier 2015). Therefore, space syntax is a theory that has provided a Method for analysis of the physical environment, by using various software UCL Depthmap is one of the most authenticated ones. This software is used for the proposed designs of this study to examine visual mean depth parameters and compare them with the concepts of domain and spatial hierarchy.

In an analysis of components through the considered software, there is a depth in any situation that needs passing through in-between space to go from one to another space (or axial rotations). It means that the more we need in-between spaces to have access to a space, the more the spatial depth will be. Therefore, the concept of depth indicates the space layout regarding the relation between its objects and elements not related to metric distances and distance measurement, and it corresponds to the concept of spatial hierarchy. Hierarchical changes from public territory (domain 4) to secondary territory in the block (domain 1) are considered an ascending trend in the analyses of this study. It means that Domain 1 has the highest depth, and Domain 4 has the lowest depth. The important point about the analysis of components of the most external domain is that domain 4 has been considered almost similar to each other, and to the wall of the main street is all four designs. Three other domains are indeed compared based on this method in the extant study. Ultimately, the outputs of this analysis have been collected in Table 2 within a colored range from red for the highest value to blue for the lowest rate of parameter.

## 3. THEORETICAL FRAMEWORK

Theories and discussions on the human environment were an antithesis of the pragmatic architecture of the 19th and 20th centuries that its goals were to find a strategy for housing of large population during the short term and design new patterns for social organizations and their required physical spaces could create a synthesis of environment psychology and social psychology in the man-made space field especially in the urban environment and residential environments by criticizing the modern architecture since second half of 20th century. These studies have examined and predicted human behavior in urban environments by using place-based behavioral sciences-environmental behavior- focusing on a better understanding of the relationship between humans and the physical environment and analysis of the physical environment. It means that every physical environment provides a certain range of behaviors. In other words, a significant correlation exists between physical characteristics and the environmental behavior of individuals, including movement and sitting behaviors (Eslami Mojaveri, Ansari, and Einifar 2022). The main problem of these studies is to match the environmental capability with human needs that result in the formation of a human environment. These studies are done within a range from urban planning and urban development to the architecture of single buildings. The considered area of this study is the central scale and neighborhood boundary as the most important place for the advent of secondary territories.

### 3.1. Nature of Territorial Behavior

This study reviews the theoretical frameworks in detail in terms of two perspectives (Fig. 1) of environment psychology-within two environment and social behavior scopes- and the concept of home and social sustainability- including some theories such as social integration and segregation and security- to explain how secondary territories are designed in a neighborhood (home-based-space). The third perspective is returning to environment psychology and the use of the space syntax method to assess the results of design based on the theoretical framework.

In terms of environmental psychology and studies conducted on social behavior and environment, the notion of territory is rooted in sociological analyses of urban life that began in the 1920s (Park et al., 1925; Thrasher 1927; Zorbaugh 1929; Whyte 1949; Yablonsky 1962). A geographical territory is a place that is personalized by marking and defended against violation and encroachment (R. Sommer 1969; Sommer and Becker 1969: Becker and Mayo 1971; Becker 1973). Territorial behavior is a mechanism used to control the border between self and others, which is done through privatization or marking an object or place and indicates that the place or object belongs to a person or a group of individuals. Privatization and ownership creation are used in monitoring social interactions. Defensive reactions are usually shown when territory borders are violated or trespassed. The territorial behavior is based on the core role of privacy and private space. Private space is a space or bubble around a person the invasion of others may be stressful and annoying (T. Hall 1966). Moreover, personal traits and also some variables of the location, such as the formality rate of place are factors affecting the mechanism of personal space (Altman 1975). Familiar environments evoke more willingness to make close relationships, which occurs because people may have more supervision over their relationships (Felipe and Sommer 1966). Researchers distinguish between primary, secondary, and public territories based on the surveillance rate and ownership durability of individuals in a place, and the importance of territory design is seen in detecting whether they are primary, secondary, or public (Altman 1975). It means that primary territory is owned and used inclusively by a person or certain group, such as a family under the permanent authority, and includes private and semiprivate territories of individuals with clear ownership and is equivalent to private and personal space and territory of a residential unit in other classifications. Public territory includes temporary boundaries that anybody has access to and can go there but cannot necessarily do action there and the law rules, and regulations would determine the access, method, and limited time of using these territories (Altman 1975). Secondary territory, the main problem considered in this study, is under the surveillance of its owners on the one hand and is open to the public on the other hand, and is a bridge between primary territory-with full and comprehensive supervision of the person- and public territory available to the public that can be considered as the private territory of a group of individuals. This territory can be the only shared territory between a group of people without creating a field for interaction that is assumed the shared social territory or can be not only a shared space but also provides the field for their interaction that is considered as interactive social territory (Eslami Mojaveri 2022). Semiprivate and semipublic spaces are equivalent to home-based space and territory of several residential units, respectively in the spatial divisions (Table 1).

In terms of the home concept, a review of territorial behavior in a historical trend and observing similar actions of ancestors indicate the key role of the tendency for privacy and the factor shaping such concept, so that this inner tendency has provided various manifestations in the interaction with different external conditions in terms of time and place, various social and cultural situations and available facilities. Therefore, this tendency has been a factor in forming territories related to the person, family, and different groups and communities; so that can be defensible against human, natural, and animal factors of the surrounding environment, and surveillance over it is simple, and not only prevent others' invasion but also provide a proper field for interaction. In other words,

the environmental capability of this space does not determine the range of aggressive behavior, and this takes into account risky behavior. Reflection on the historical background of territorial behavior indicates that Egyptians planted grapevine around their gardens to prevent others' invasion, Greeks defined some in-between spaces by designing porches around their houses, and wealthy English people gated their summer houses using stone walls and parks, for instance (McGinley 1959).

### 3.2. Social Sustainability and Territorial Behavior

Accurate determination of social integration and segregation boundaries is highly important in forming territories in terms of social sustainability. The reason is that segregation means the separate physical life of different groups of people (Mohammadzadeh Azari 2018) that may have appeared with demographic (age or family), ethical (nationality or culture), and socioeconomic (income or job) motivations (Gans 2008). The gated communities are surrounded and separated from the environment around them and suffer from the gap between integration and proper interactions in the community. In general, the concept of integration can be used in semantic scopes. In the first scope, places can be integrated in terms of the type of buildings, their forms, and determined uses. In another scope, places may be integrated based on the viewpoint of users and their social characteristics (e.g., income and job, type of household, age, ethnicity, etc.) (Tunstall and Fenton 2006).

In the case of security that is influenced by both social and physical factors, we find some studies on defensible space, crime prevention through environmental design (CPTED[1]), and safe growth in terms of the physical effect that all of them examine the impact of territorial behavior as one of the most important factors affecting security.

## 4. PRACTICAL THEORIES

The practical theories extracted from theoretical frameworks available in the field of territorial behavior are divided into two main categories spatial organization and demarcation. Spatial organization means the layout and arrangement of full and empty spaces, the pattern of streets, and generally the features that determine the structure of an environment that include three categories of "spatial hierarchy," "density," and "use." Demarcation means an accurate determination of domain and behavioral territories by defining their edges that can be realized based on physical, symbolic, visual, and physiological methods (Lees and Warwick 2020). Density means the number of users in a shared space, such as a neighborhood, block, courtyard, threshold, and entrance as hierarchies of secondary territories. The more non-transparent the users and ownership of spaces, the weaker the territorial behavior will be. For instance, the division of a wide neighborhood into several smaller neighborhoods and using separate access for each can increase security (Newman 1996). The use is distributed and assigned in a way to meet the needs of individuals living in the neighborhood without eliminating their interests, so this contradiction may result in undesirable intrusion of people into their territories, tension, and conflict. The main problem of this study that is spatial hierarchy means grading spaces and routes.

### 4.1. Spatial Hierarchy in Home-Based-Space

Spatial hierarchy in the nodes means grading public, semipublic, semi-private, and private spaces- or public, secondary, and primary territories-in the central spaces. Oscar Newman (1996) believes that semiprivate and semipublic spaces that do not have transparent shared ownership, such as long abandoned corridors in apartments and mass high-rise buildings cause criminal behavior. He instead suggests a kind of spatial hierarchy from public to private space (Fig. 2). The spatial hierarchy in the routes means grading the network of routes and accesses that strengthen territorial behavior (Larimian, Saeideh Zarabadi, and Sadeghi 2013; Yazdanfar and Nazari 2015).

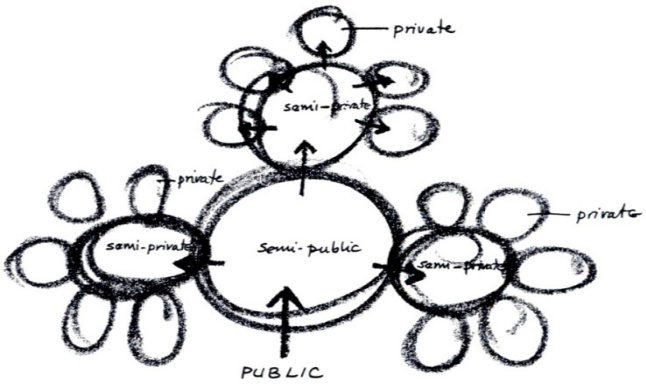



**Fig. 2. Spatial Hierarchy from Public to Private**
(Newman 1996)

Table 1 indicates the division of various types of spatial hierarchies and territories by different researchers and their overlapping areas.

**Table 1. Overlapping Comments of Various Researchers in Determining Types of Territories**

| Researcher | Classification Considered in this Research | | | | | | Year |
|---|---|---|---|---|---|---|---|
| Authors | Public Territory | | Secondary Territory | | | Primary Territory | (2023) |
| | Domain 4 | | Domain 3 | Domain 2 | Domain 1 | Domain 0 | |
| | Beyond Neighborhood | | Neighbor-hood | Middle Neigh-borhood | Middle Block | Home | |
| **Researcher** | **Types of Classifications Presented for Territory** | | | | | | **Year** |
| Alexander & Chermayeff | Public Spaces of the City | Semipublic Spaces of the City | Public Spaces of one Group | Private Spaces for one Group | Private Spaces of a Family | Private Spaces of a Family | (1971) |
| Irwin Altman | Public Territory | | Secondary Territory | | Primary Territory | | (1975) |
| Douglas Porteous | Available Space in the Home | | Home-Based-Space | | Private Space | | (1976) |
| Mahmoud Tavassoli | Territory of a Neighborhood Unit | | Territory of Several Residential Units | | Territory of a Residential Unit | | (1986) |
| Oscar Newman | Public | | Semipublic | Semiprivate | Private | | (1996) |
| Nasr Eslami Mojaveri | Beyond Neighborhood /Urban Territory | | Interactive Social Territory (Shared and Interactive Territory)<br>Shared Social Territory (Shared and Non-Interactive Territory) | | Family Territory | Semiprivate Territory | Private Territory (2022) |

(Retrieved from Aghalatifi 2012)

The creation of spatial hierarchy from the secondary territory as Domain 0 to the public territory as Domain 4 and the division of secondary territory between these two territories into three spatial degrees of Domain 1, domain 2, and Domain 3 was the idea of this study. It should be noted that in this spatial division, domain 1 of the middle block is considered as shared secondary territory for a building block, domain 2 of the middle neighborhood space is considered as shared secondary territory between 4-6 blocks, and domain 3 of neighborhood space is taken as shared secondary territory between all blocks of residential complex (Fig. 3).

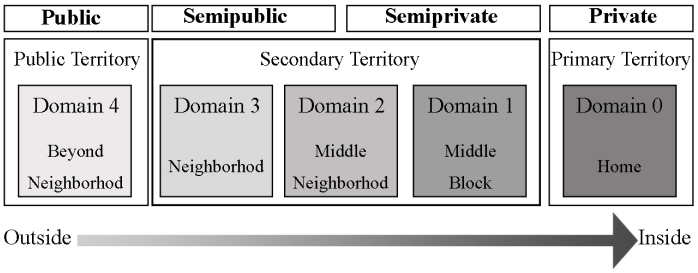



**Fig. 3. Basic Idea; Creating Spatial Hierarchy from the Domain of the beyond Neighborhood (Public Territory) to the Home (Private Territory)**

## 5. FINDINGS

Fig 4 depicts the four proposed designs in a way that all of them are placed in a fixed density between open and closed space with a hierarchical spatial organization of central open spaces from public territory to the secondary territory of the middle block (domain 1), but each has a different physical characteristic, including form structure of each domain, axial or core shape, length, width, and location of accesses.

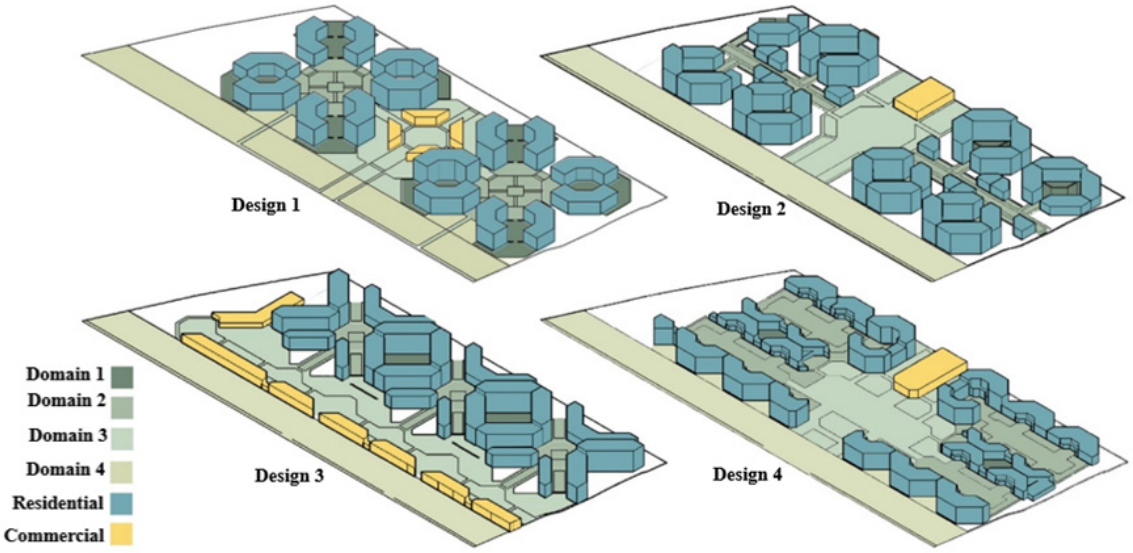



**Fig. 4. Spatial Hierarchy from Public to Private Territory and Three Spatial Degree of Secondary Territory and its Relation with Residential and Commercial Spaces in Four Proposed Designs**

In the first column of Table 2, domain 4 (public territory) connected to domain 3 (secondary territory of the neighborhood) is first analyzed for each proposed design, and then in the second column, domain 2 (secondary territory of the middle neighborhood) and in the third column, domain 1 (secondary territory of middle bock) are added to find the effect of spatial hierarchy idea from domain 4 as the public territory to the domain 1 (comprising domain 3, domain 2, and domain 1 as secondary territories) that was mentioned before (Fig. 3) in the 4 proposed designs (Fig. 4) by comparing the values of visual depth in each design. For instance, in the first design and left column ranging from domain 4 to domain 3, minimum and maximum values equal 1.17 and 2.54, respectively but these values are increased to 1.47 and 2.99 in the middle column ranging from domain 4 to domain 2. Similarly, the interval of 1.82-4.86 is seen in the right column, ranging from domain 4 to domain 1, and the same process is seen for other designs.

Moreover, different physical modes are presented for each proposed design in each column to compare them, and find the effect of various form features, including form and shape of domains, number of accesses, movement barriers, and corners, and test each design under controlled circumstances.

According to the visual mean depths reported in Table 2 indicating in left-hand column from domain 4 (public territory) to domain 3 (secondary territory of neighborhood), middle column from domain 4 to domain 2 (secondary territory of middle neighborhood), and right-hand column from domain 4 to domain 1 (secondary territory of middle block) related to each design, colors from blue to red in each image indicates the minimum and maximum values of that image that is written in front of it. It is shown that after adding hierarchies of domain 1, domain 2, and domain 3 as the secondary territory to domain 4 as the public territory, the depth values are increased, which can improve the territorial behavior. It means that we reach domain 1 which is the most private degree of secondary territories through a certain hierarchy and more spatial intermediaries. This is our expected territorial behavior in organizing secondary territories by creating depth and hierarchy of central open spaces and assigning shared ownership with transparent physical demarcations without creating complete gating (confinement) and segregation.

Also, the most optimum case of each design is shown in Table 3 to compare these four designs. In addition, the initial pattern for the formation of each design is explained in the left-hand column. For example, in comparison between value graphs through a horizontal row, the depth values are increased from left to right. The higher the depth value in moving from domain 4 to domain 1 and the more hierarchical the changes without immediate jump, the better the performance of the design will be. It is seen in the right-hand column showing the final mode of each design from domain 4 to domain 1, design 1 has the highest depth, and design 3 shows the best hierarchical changes in depth rate after domains are added.

**Table 2. Min and Max Values of Visual Depth in Different Alternatives of 4 Proposed Designs**

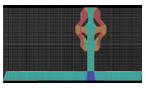
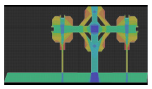
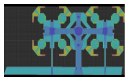
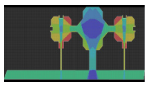
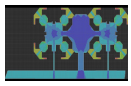
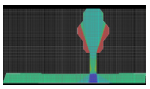
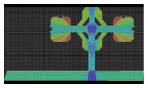
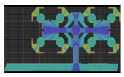
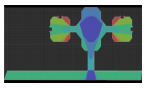
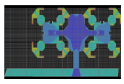
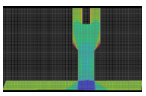
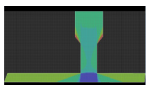
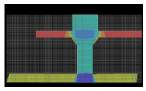
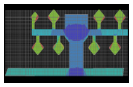
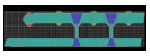
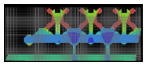
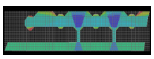
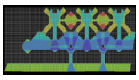
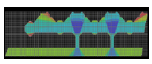
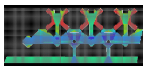
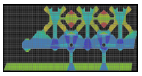
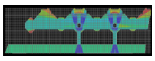
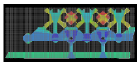
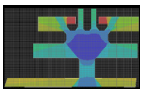
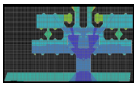
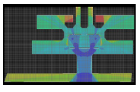
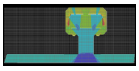
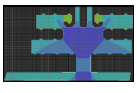
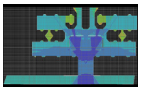
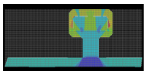
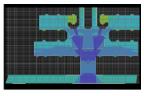
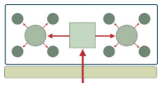
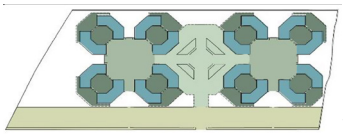
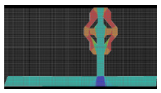
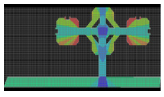
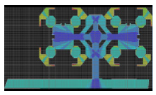
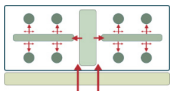
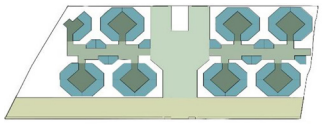
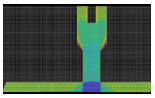
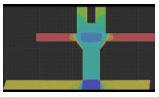
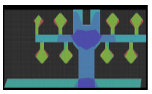
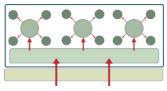
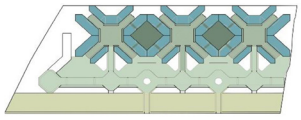
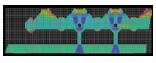
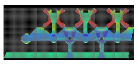
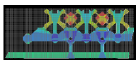
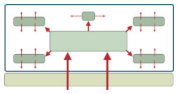
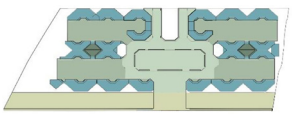
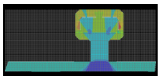
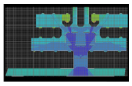
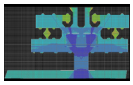
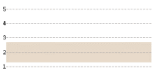
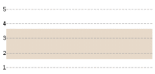
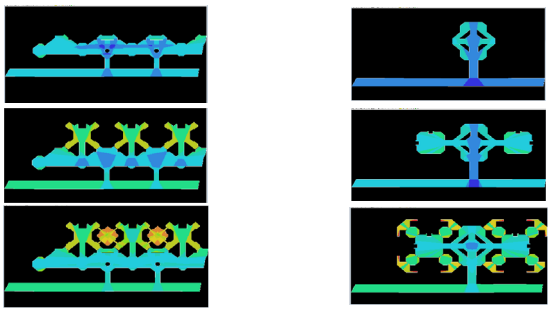
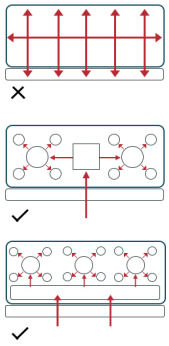
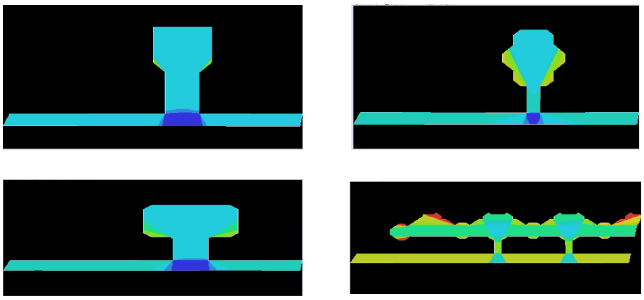
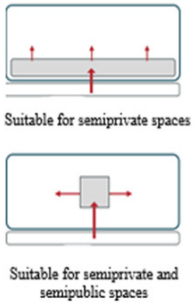
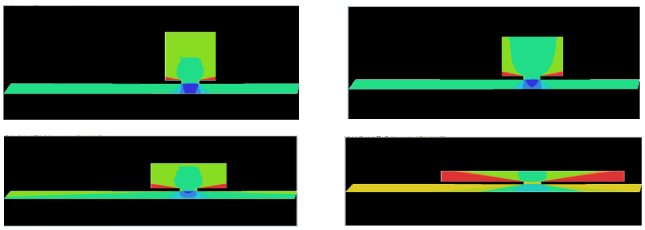
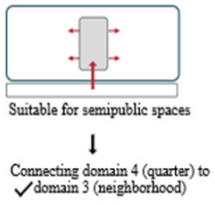
| | Number of Domains | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Domain 4 to Domain 3 | | | | Domain 2 added to the Left-Hand Column | | | | Domain 1 added to the Left-Hand Column | | | |
| | Number of Designs | Analytical Graph | Max and Min | N | Number of Designs | Analytical Graph | Max and Min | N | Number of Designs | Analytical Graph | Max and Min | N |
| Design 1 | 1 |  | Min | 1.24 | 1 |  | Min | 1.59 | 1 |  | Min | 1.86 |
| | | | Max | 2.54 | | | Max | 2.62 | | | Max | 4.61 |
| | | | | | 2 |  | Min | 1.50 | 2 |  | Min | 1.82 |
| | | | | | | | Max | 2.46 | | | Max | 4.53 |
| | 2 |  | Min | 1.17 | 3 |  | Min | 1.57 | 3 |  | Min | 1.93 |
| | | | Max | 2.12 | | | Max | 2.99 | | | Max | 4.86 |
| | | | | | 4 |  | Min | 1.47 | 4 |  | Min | 1.82 |
| | | | | | | | Max | 2.86 | | | Max | 4.78 |
| Design 2 | 1 |  | Min | 1.04 | 1 |  | Min | 1.22 | 1 |  | Min | 1.54 |
| | | | Max | 2.00 | | | Max | 2.05 | | | Max | 3.96 |
| | 2 |  | Min | 1.03 | 2 |  | Min | 1.21 | 2 |  | Min | 1.54 |
| | | | Max | 1.99 | | | Max | 2.07 | | | Max | 3.96 |
| Design 3 | 1 |  | Min | 1.48 | 1 |  | Min | 1.74 | 1 |  | Min | 1.86 |
| | | | Max | 2.87 | | | | | | | Max | 3.96 |
| | 2 |  | Min | 1.43 | | | Max | 3.74 | 2 |  | Min | 1.94 |
| | | | Max | 2.77 | | | | | | | Max | 3.95 |
| | 3 |  | Min | 1.45 | 2 |  | Min | 1.84 | 3 |  | Min | 1.94 |
| | | | Max | 2.78 | | | | | | | Max | 3.96 |
| | 4 |  | Min | 1.57 | | | Max | 3.78 | 4 |  | Min | 1.97 |
| | | | Max | 2.84 | | | | | | | Max | 4.35 |
| Design 4 | 1 |  | Min | 1.13 | 1 |  | Min | 1.37 | 1 |  | Min | 1.67 |
| | | | Max | 1.94 | | | Max | 2.50 | | | | |
| | 2 |  | Min | 1.14 | 2 |  | Min | 1.65 | | | Max | 3.73 |
| | | | Max | 2.14 | | | Max | 2.88 | | | | |
| | 3 |  | Min | 1.33 | 3 |  | Min | 1.38 | 2 |  | Min | 1.68 |
| | | | Max | 2.74 | | | Max | 3.40 | | | | |
| | 4 |  | Min | 1.33 | 4 |  | Min | 1.66 | | | Max | 3.72 |
| | | | Max | 2.75 | | | Max | 3.72 | | | | |

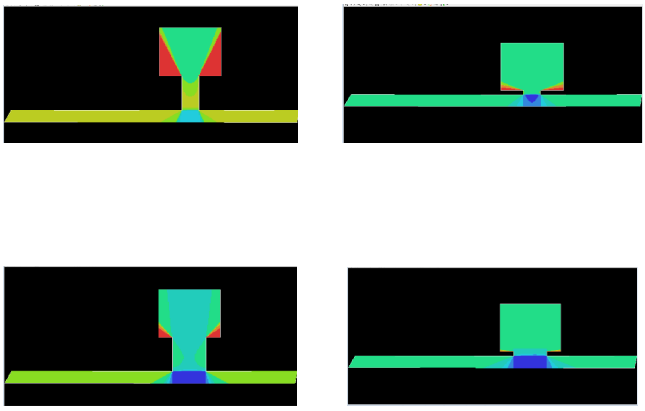
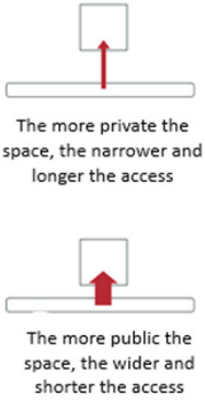
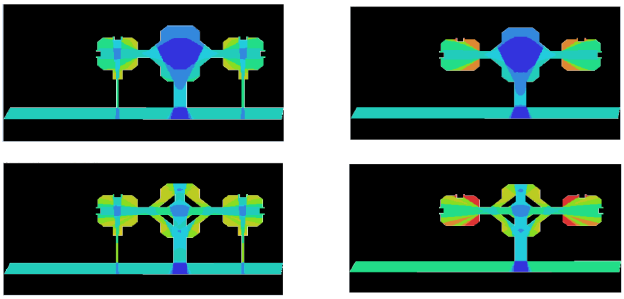
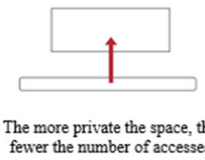
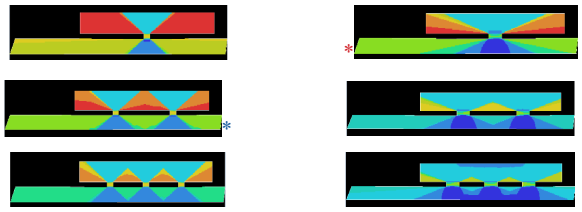
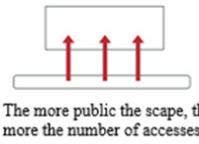
**Table 3. Analysis of Spatial Depth Values in the Optimum Mode of four Proposed Designs and Assessment of Effect Rate of Spatial Hierarchies**

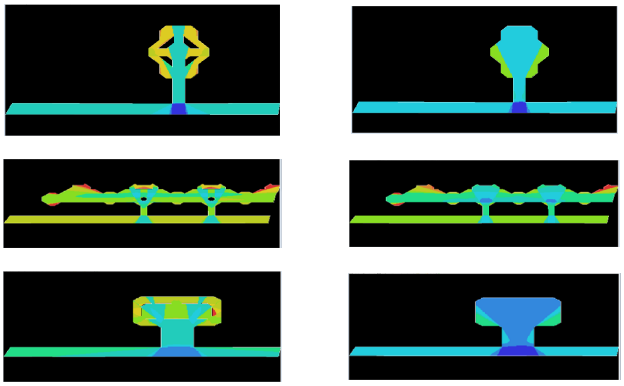
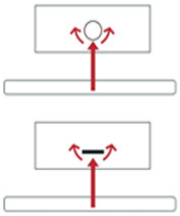
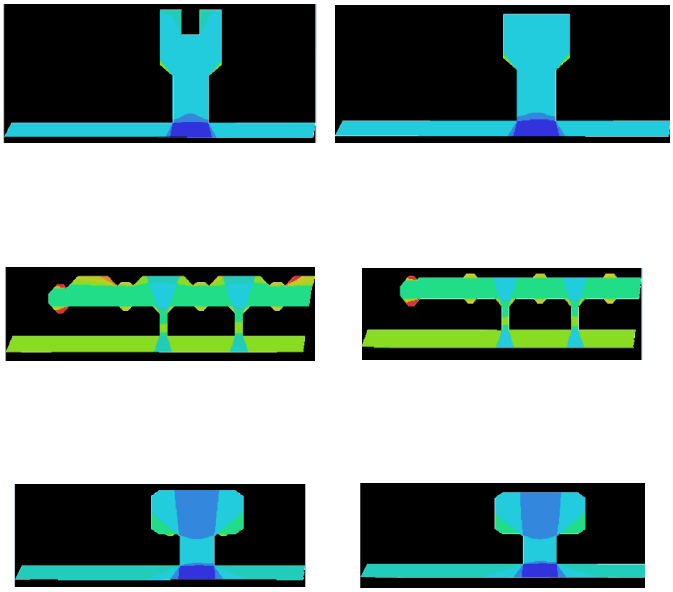
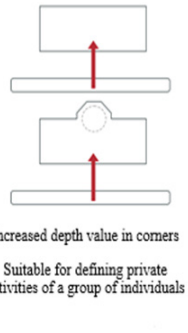
| Number of Designs | Basic Pattern | Design Plan | Parameters | Number of Domains: Domain 4 to Domain 3 | Domain 4 to Domain 2 | Domain 4 to Domain 1 |
|---|---|---|---|---|---|---|
| Design 1 |  One Main Linear Core, 2 Secondary Central Cores, 8 Central Microcores |   | Analytical Graph of Depth |  |  |  |
| | | | Numerical Values | Min 1.24 Max 2.54 | Min 1.57 Max 2.99 | Min 1.93 Max 4.86 |
| | | | Graph of Values |  |  |  |
| Design 2 |  One Main Linear Core, 2 Secondary Linear Cores, 8 Central Microcores |   | Analytical Graph of Depth |  |  |  |
| | | | Numerical Values | Min 1.04 Max 2.00 | Min 1.22 Max 2.05 | Min 1.54 Max 3.96 |
| | | | Graph of Values |  |  |  |
| Design 3 |  One Main Linear Core, 3 Secondary Central Cores, 12 Central Microcores |   | Analytical Graph of Depth |  |  |  |
| | | | Numerical Values | Min 1.57 Max 2.84 | Min 1.84 Max 3.78 | Min 1.97 Max 4.35 |
| | | | Graph of Values |  |  |  |
| Design 4 |  One Main Linear Core, 5 Secondary Linear, and Central Cores |   | Analytical Graph of Depth |  |  |  |
| | | | Numerical Values | Min 1.33 Max 2.75 | Min 1.66 Max 3.72 | Min 1.67 Max 3.73 |
| | | | Graph of Values |  |  |  |

The effect of different form characteristics can be found by comparing physical analyses of the four designs. In Table 4, six hypotheses are expressed that are the effect of the hierarchy of central open spaces, form, and shape of domain 3 (secondary territory of neighborhood) connected to domain 4 (public territory), length and width of access, number of accesses, movement barriers, and cornets under the controlled circumstances, and then these hypotheses are tested based on space syntax method and UCL Depthmap software. In Table 4, the hypothesis of each parameter is adopted from Table 2 then this hypothesis is retested under controlled circumstances. In some cases, the retest is not required because other variables in the outputs of Table 2 are fixed, such as the effect of spatial hierarchy that was examined in Table 2 or the effect of movement barriers and corners that were tested in Table 2 under fixed conditions separately in each design.

**Table 4. Testing Six Assumed Physical Features and their Effect on the Spatial Depth Parameter based on the Space Syntax Method**

| Parameter | Analytical Graphs of Spatial Depth | Diagram |
|---|---|---|
| 1<br>Hierarchy of Central Open Spaces |  | Image retrieved from Table 2<br>  |
| Interval of Values | Min: 1.24 Max: 4.86 | |
| Hypothesis | When spatial hierarchy is created for central open spaces, the spatial depth rate is also increased hierarchically. | |
| Explanation | The right column shows proposed design 1, and the left column shows the proposed design 3. The first row is accessed from domain 4 to domain 3, the second row indicates access from domain 4 to domain 2, and the third row shows access from domain 4 to domain 1. See Table 3 for information. | |
| Conclusion | Dividing central open spaces into four spatial hierarchies from domain 1 to domain 4 would increase the spatial depth (Table 2 supplement) | |
| 2<br>The Form and Shape of Domain 3 connected to Domain 4 |  | Image retrieved from Table 2<br>  <br>Suitable for semiprivate spaces<br>Suitable for semiprivate and semipublic spaces |
| Interval of Values | Min: 1.03 Max: 2.78 | |
| Hypothesis | The more elongated the form of domain 4 perpendicular to the access route to it, the higher the spatial depth will be. | |
| Testing Hypothesis |  | Controlled test<br>  <br>Suitable for semipublic spaces<br>Connecting domain 4 (quarter) to ✓domain 3 (neighborhood) |
| Interval of Values | Min: 1.03 Max: 1.97 | |
| Explanations | The area of domain 3 and the length and width of access articulation are fixed, and variations are considered only in the form of domain 3. | |
| Conclusion | Maximum depth rate is similar in all four cases and the form of domain 3 has not affected this value (and length width and the number of accesses may be the factors affecting this value) but the dispersion and points are different with maximum depth rate and the elongated form perpendicular to the access has the highest level of points with maximum depth values (red points). | |

| Parameter | Analytical Graphs of Spatial Depth | Diagram |
|---|---|---|
| 3<br>Length and Width of Access |  | Controlled Test<br>  <br>The more private the space, the narrower and longer the access<br>The more public the space, the wider and shorter the access |
| Interval of Values | Min: 1.01 Max: 2.03 | |
| Hypothesis | According to the test above, the more the openness (width) of the access and the shorter its length, the more the spatial depth will be. | |
| Explanations | The area of domain 3 is fixed, and variations are considered only in the length, width, and area of access articulation. In horizontal rows, width is fixed and length is variable, and in vertical columns, length is fixed, and width changes. | |
| Conclusion | When the length is increased and the width of the access route decreases, depth rises, and it declines when length and width are decreased and increased, respectively. | |
| 4<br>Number of Accesses |  | Image retrieved from Table 2<br>  <br>The more private the space, the fewer the number of accesses |
| Interval of Values | | |
| Hypothesis | The fewer the number of accesses, the higher the spatial depth will be. | |
| Testing Hypothesis |  | Controlled Test<br>  <br>The more public the scape, the more the number of accesses |
| Interval of Values | Min: 1.34 Max: 2.03 | |
| Explanations | In the right column, the width of access is 20m, and in the left column, this width equals 10m, and the length remains fixed. | |
| Conclusion | The fewer the number of accesses, the higher the spatial depth and the more the maximum rate will be.<br>Note: the first mode in which the right column has one access with a 20cm width (red star) and the second mode in which the left column has two accesses with a 10m width (blue star) have similar access areas and a relatively similar performance in depth but have different dispersions. Moreover, red and orange points having a mean value of 1.95 make 20% in the first model and 24% of whole points in the second model. it means that mode 2 a little outperforms the mode 1 due to its smaller width. | |

| Parameter | Analytical Graphs of Spatial Depth | Diagram |
|---|---|---|
| 5 Movement Barriers |  |  Image retrieved from Table 2  |
| Interval of Values | Min: 1.13 Max: 2.84 | |
| Hypothesis | The placement of movement barriers would increase the depth. | |
| Explanation | In the right column, the mode without barrier of each design is placed, and its case with barrier is placed in the left-hand column. | |
| Conclusion | The placement of movement barriers leads to higher depth. Also, the dispersion pattern would change the points having maximum depth. This value reaches its maximum rate on the back of movement barriers relative to its access route. Maximum rate of depth equals 20% in the first design, while experiences 2% and 40% rise in the second and third designs, respectively. Moreover, the mean depth value has had a 20%, 7.2%, and 23.5% increase in the first, second, and third designs, respectively. | |
| 6 Corners |  |  Image retrieved from Table 2  |
| Interval of Values | Min: 1.03 Max: 2.87 | |
| Hypothesis | The placement of corners and indented and convex spaces would increase depth. | |
| Explanations | The case without indentation and the mode with indentation are shown in the right and left columns, respectively. | |
| Conclusion | Depth values are a little increased in indentations. It should be noted that these corners are suitable for some spaces, such as the entrance gate of residential blocks, but cause insecurity in the public spaces that are far from visibility. | |

According to the comparison between these physical characteristics in diverse climates of Iran, it can be stated that this spatial hierarchy can be shaped in the hot and arid climate with central courtyard organization as secondary territory of middle block (domains 1) in form of central courtyard branched

from secondary territory of linear low-width middle neighborhood (domains 2) with maximum shading branched from the secondary territory of linear or core neighborhood (domains 3) open for interactions of middle neighborhood. In cold and arid climates with dense construction mass, the same branching technique can be used, and the difference is seen in considering domain 1 as south-facing courtyards of closed and compressed interconnected residential masses instead of using a central courtyard. Also, central open spaces must be avoided especially in the wind direction. In cold and humid climates that need openings towards different directions in a relatively dense mass, volumetric masses with sufficient depth can be used around domain 1 of the central courtyard with openings in different directions connected to the not-much-wide core domain 2. The numerosity of openings in different directions in the hot and humid climates that need uncompressed texture for ventilation next to the central courtyard structure is adopted from cultural structures, so can be used as volumetric masses with openings in different directions around the domain 1 of wide central courtyards that provide a large central open space. Finally, it should be considered that a more precise assessment of the role of spatial hierarchy in the physical structure of built environments is needed in different climates by considering spatial depth and territorial behaviors. Therefore, it can be a topic for further studies.

## 6. CONCLUSION

As expressed in Table 1, the basic idea of the spatial hierarchy of domain 4 as public territory and quarte, division of secondary territories of domain 3 as neighborhood, domain 2 as middle neighborhood, and domain 1 as the middle block (Fig. 3) by studying environmental design stream affected by the behavioral sciences and social sustainability related to territorial behavior in the home-based-spaces within the theoretical framework and determining the impact of spatial hierarchy parameter in the field of practical theories. In the next step, the physical aspect of the four designs proposed based on the basic idea (Fig. 4) was tested by comparing their spatial depth parameters with some components such as spatial hierarchy and territorial behavior, domain, and privacy based on the Space Syntax method and using UCL Depthmap Software. In this case, we joined many researchers around the world who tend to compare parameters of space syntax theory and various components of the architecture and use this theory as a configuration technique (Tables 2 & 3). The information provided in Table 2 helps to explain the initial hypotheses of physical effects and form features that were tested under the controlled conditions (Table 4). As mentioned in Table 4, it was concluded that the creation of spatial hierarchy in secondary territories has firstly affected the spatial depth rate and strengthened the territorial behavior in the home-based space (test 1). Secondly, the layout method and physical characteristics of these central open spaces could affect the result. The wider and shorter the access from one to another domain and the more the number of accesses, the lower the depth rate will be, which is more suitable for public spaces. When social spaces become more private, the number of accesses must be lower with a narrower width or wider length based on the circumstances (tests 3 & 4). However, domain configuration did not affect the depth but affected the dispersion of the surfaces with maximum depth. For example, more surface of domain 3 is assigned to maximum depth in the elongated rectangular form of domain 3 parallel to domain 4 with one connection point compared to the square or rectangular form perpendicular to domain 4 (test 2). Moreover, physical barriers in the route (test 5) and indented corners (test 6) would increase the depth rate. It should be noted that these variables-in addition to other parameters such as visibility, natural surveillance, and people's presence in social spaces of the neighborhood that require supporting activities based on their needs- are considerable topics in the relevant literature that can be examined in future studies.

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## CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

## MORAL APPROVAL

The authors commit to observe all the ethical principles of the publication of the scientific work based on the ethical principles of COPE. In case of any violation of the ethical principles, even after the publication of the article, they give the journal the right to delete the article and follow up on the matter.

## PARTICIPATION PERCENTAGE

The authors state that they have directly participated in the stages of conducting research and writing the article (first author: 40%, second author: 30%, third author: 30%).

## ENDNOTE

1. Crime Prevention Through Environmental Design

## REFERENCES


- Aghalatifi, Azadeh. 2012. People and Home: Recognition od Interaction between People and Home in Contemporary Era of Iran. PhD Diss of Architecture: Tehran University. https://ganj.irandoc.ac.ir/#/articles/82eabc3a4c-3ce5d144e23aacc3fc1316
- Altman, Irwin. 1975. *Privacy, Personal Space, Territory, Crowding*. United States: Brooks/Cole Publishing Company.
- Becker, Franklin D. 1973. "Study of spatial markers." *Journal of Personality and Social Psychology* 26(3): 439-455. https://doi.org/10.1037/h0034442
- Becker, Franklin D., and Clara Mayo. 1971. "Delineating personal distance and territoriality." *Environment and Behavior*: 375-381. https://www.proquest.com/docview/1292758968?sourcetype=Scholarly%20Journals
- Chermayeff, Serge, and Alexander Tzonis. 1971. *Shape of Community: Realization of Human Potential*. United Kingdom: Penguin.
- Eslami Mojaveri, Nasr. 2022. Creating a Design Model, Regarding Home based Everyday Behavior Patterns of Residents. PhD diss in Architecture: Tehran University [in Persian].
- Eslami Mojaveri, Nasr, Hamidreza Ansari, and Alireza Einifar. 2022. A study of the relationship between neighbourhood syntactic properties and walking and sitting behaviour in three urban contexts in Tehran." *The Journal of Architecture* 27(5-6): 827-857. https://doi.org/10.1080/13602365.2022.2144410
- Felipe, Nancy J., and Robert Sommer. 1966. "Invasions of personal space." *Social Problems* 14: 206-214. https://doi.org/10.1525/sp.1966.14.2.03a00080
- Gans, Herbert J. 2008. "Involuntary segregation and the ghetto: Disconnecting process and place." *City & Community* 7: 353-357. https://doi.org/10.1111/j.1540-6040.2008.00271_2.x
- Hemmati, Khatereh. 2022. Residential Neigbourhood Solidarity: Designing a Safe neighbourhood -Defensible and under Surveillance- by a Social Sustainability Approach. M.A. Diss of Sustainable Architecture: Iran University of Science and Technology. https://ganj.irandoc.ac.ir/#/articles/f08c7fa455b055e3933b521c9fdca57d. [in Persian]
- Hillier, Bill. 2015. *Space is the machine: A configurational theory of architecture*. Space Syntax. https://discovery.ucl.ac.uk/id/eprint/3881/1/SITM.pdf
- Hillier, Bill, and Julienne Hanson. 1984. *The Social Logic of Space*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511597237
- Larimian, Taimaz, Zahra Sadat Saeideh Zarabadi, and Arash Sadeghi. 2013. "Developing a fuzzy AHP model to evaluate environmental sustainability from the perspective of Secured by Design scheme—A case study." *Sustainable Cities and Society* (7): 25-36. https://doi.org/10.1016/j.scs.2012.10.001
- Lees, Loretta, and Elanor Warwick. 2020. *Defensible Space on the Move: Mobilisation in English Housing Policy and Practice*. United States: John Wiley & Sons.
- McGinley, Phyllis. 1959. *Province of the heart*. The Viking Press.
- Mohammadzadeh Azari, Nima. 2018. ''Analysis of Urban form's Effect on Social Sustainabitty of Tehran Neighborhoods'' Case Studies : Neighborhoods of Chizar, Shahrak Qarb,Madaa'en, and Imamzadeh Yahya. M.A. Diss of Urban Planning: Tehran University. https://ganj.irandoc.ac.ir/#/articles/aaa188575d9ba849b924ed4974c8cf02. [in Persian]
- Newman, Oscar. 1996. *Creating Defensible Space*. United States: U.S. department of housing and urban development office of policy development and research. https://www.huduser.gov/publications/pdf/def.pdf
- Park, Robert Ezra, Ernest Watson Burgess, Roderick Duncan McKenzie, and Louis Wirth. 1925. *The city, chicago*. chicago: University of Chicago Press.
- Porteous, J. Douglas. 1976. "Home: The Territorial Core." *Geographical Review* 66(4): 383-390. https://doi.org/10.2307/213649.
- Sommer, Robert. 1969. *Personal space*. United Kingdom: Prentice-Hall.
- Sommer, Robert, and Franklin D. Becker. 1969. "Territorial defense and the good neighbor." *Journal of Personality and Social Psychology* 11(2): 85-92. https://doi.org/10.1037/h0027046
- T. Hall, Edward. 1966. *The Hidden Dimension*. United Kingdom: Knopf Doubleday Publishing Group.
- Tavassoli, Mahmoud. 1986. *Principles and techniques of urban design in Iran*. Tehran: Ministry of Road, Urban Development. [in Persian]
- Thrasher, Frederic Milton. 1927. *The gang: A Study of 1,313 Gangs in Chicago*. chicago: University of Chicago Press.
- Tunstall, Rebecca, and Alex Fenton. 2006. In the Mix: A Review of Research on Mixed Income, Mixed Tenure and Mixed Communities. What Do We Know? York: Joseph Rowntree Foundation. https://urbanrim.org.uk/cache/Tunstall&Fenton_In-the-mix.pdf

- Whyte, William Foote. 1949. *Street corner society*. Chicago: University of Chicago Press.
- Yablonsky, Lewis Yablonsky. 1962. *The violent gang*. New York: Macmillan.
- Yazdanfar, Seyed Abas Agha, and Nassim Nazari. 2015. "Proposed Physical-Environmental Factors Influencing Personal and Social Security in Residential Areas." *Procedia - Social and Behavioral Sciences* (201): 224-233. https://doi.org/10.1016/j.sbspro.2015.08.171
- Zorbaugh, Harvey Warren. 1929. *The Gold Coast and the slums*. Chicago: University of Chicago Press.

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