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Neighborhood Connection Density-Neighborhood Morphology Connection: The Case of Antalya Kaleiçi

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Abstract

Can neighborhood boundaries be defined in terms of morphological and functional characteristics in cities that have developed different formations due to various influences in the historical process? While neighborhood units in planned settlements are pre-planned with an integrative approach, in unplanned traditional settlements, residences come together as pieces and ultimately form the settlement. In this study, which was carried out in Antalya-Kaleiçi, qualitative and quantitative research methods were used. In the study, the neighborhood formation system was discussed based on the hierarchical structure. A set of buildings including residences that are next to and opposite a residence and directly open into a shared urban space is defined as the neighborhood cell of that residence. The functional relationships among residential elements were defined as neighborhood connections, and a method to determine neighborhood connection density was developed. In morphological development, an arrangement involving religious buildings accepted as focal points, neighborhood cells of different degrees forming around them, neighborhood blocks of different degrees belonging to neighborhood cells of different degrees, and neighborhood units formed out of neighborhood blocks was observed. It is understood that the density of neighborhood connections is influenced by the number of residences defining neighborhood cells, the number of connection points between residences such as building doors and gates, and the spatial sizes of neighborhood spaces in which neighborhood connections take place. In other words, the tendency for dense neighborhood connections emerges in areas with more residences and connections but low square footage area. This situation was considered a reflection of the relationship between the morphological and functional structures. It was concluded that unplanned traditional neighborhood units were formed in a way that did not show the self-sustaining and enclosed character of planned residential units, and this structure was a characteristic that should be taken as an example and maintained in terms of settlement culture.

Keywords: *Antalya- Kaleiçi, Neighborhood connection density, Neighborhood morphology, Neighborhood unit, Traditional settlements.*

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INTRODUCTION

As the smallest areas of buildings that are parts of cities, towns, or villages (Keleş, 1998, 96), neighborhoods are defined by the proximity of their residential buildings to each other, their shared spaces, social interactions, and connections (Pacifico & Truex, 2019, 12). With their unique personality, they are seen as a part of the polyphonic choir of the city (Petruccioli, 2008, 17). The words people, place, and harmony are three keywords that describe a neighborhood (Park & Rogers, 2015, 19). The fact that neighborhoods, which are defined as small communities in Anatolia (Cerasi, 1999, 71), contain homes and clusters of homes at their center shows that homes are the most fundamental component of a neighborhood.

Neighborhoods are formed by the gathering and spread of residential buildings. This way, residential buildings, which gather around urban spaces such as streets, dead-ends, and cul-de-sacs near or across each other, become neighbors of each other. Units that share a border are defined as neighbors, while their relationships are defined as neighborhood relationships (TDK, 2023). Neighborhood relationships take place via the visual, auditory, and actual connections between residences. These relationships are defined as relationships in daily life that are not official (Ruonavaara, 2021, 1), where those inside a neighborhood area with known boundaries share the atmosphere of common life (Aru, 1998, 13). Spatial neighborhood relationships are formed between units that are connected by spatial transitions, and proximity in relationships is considered more meaningful than sharing borders without relationships (Erman, 2017, 166). In establishing neighborhood relations, It is important for people to know each other and trust each other. It is thought that chance encounters resulting from using and sharing the same urban space are effective in achieving this. In this context, by establishing relationships between people who use the same street or the same square and are in each other's field of vision, such as becoming aware of each other, becoming familiar with each other, getting to know each other, and chatting, the way for people to know and trust each other is paved, and healthy neighborly relations can be established.

In 1913, Drummond developed the concept of “Neighborhood Units” with an approach that covered transportation, commerce, parks, leisure areas, industry, trade, and residences and divided the larger city into smaller cities (Johnson, 2002, 232-238; Brody, 2016, 331). While McKenzie argues that a neighborhood unit has two main components as physical proximity and sincerity between people, Unwin defines neighborhood units as self-sustaining suburbs (Johnson, 2002, 239-241). A neighborhood unit is a defined area enabling families to reach essential destinations like schools, playgrounds, and shops without crossing a highway (Perry, 1929, 99). This settlement unit includes a central primary school, parks and playgrounds covering 10% of the area, perimeter commercial units, compatible building groups, inner

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streets, and large roads marking the neighborhood boundaries (Dahir, 1947, 16). The neighborhood community is said to have around 5,000-6,000 residents, including 800-1,000 primary school-age children, covering 160 acres with one side extending half a mile for single-family plots (Perry, 1929, 98). This morphological and functional structure is important for social relationships. This structure is said to bring together individuals with similar lifestyles, foster face-to-face relationships, and support a sense of community (Perry, 1929, 99-100; Bauer, 1945, 109; Isaacs, 1948, 15). Regardless of planned order or social amenities, the neighborhood is a social reality that exists in one form or another (Mumford, 1954, 169). When talking about a neighborhood, one refers to a distinct urban scale, a certain function and a defined structure (Kallus and Law-Yone, 1997, 109). Jacobs considers neighborhood units devastating due to their introverted structure and systems of functional segregation (Silver, 1985, 170), while Hillier et al. criticize these units based on the idea that they disrupt the universal dynamics in the relationships between isolated islands of residences and cities (Mehaffy et al., 2015, 203, 206). It is stated that neighborhoods should be organized in the form of clusters of 8-12 residences gathering in a shared area, away from main roads, for 400-500 users, and in an area of at least 300 yards (275 m) in width (Alexander et al., 1977, 81-85, 202).

It is seen that the traditional Anatolian settlement system bears the characteristics of a 3000-5000-year-old settlement model and related lifestyles (Koca, 2015, 37), and in this model, neighborhoods usually develop around religious centers (Özbek Eren, 2012, 1550). These center points are marked with elements such as fountains or plane trees. There is an inward-looking structure in settlements where there are no examples of planned squares or squares. Social life takes place in residential courtyards, dead-end streets, mosque courtyards, and unplanned squares. Housing elements develop and grow around religious centers. This growth is far from geometric rules. Aru defines this situation as a rhythmic system (Aru, 1998, 11). In fact, it is said that the positions and distribution of mosque minarets in the settlement silhouettes are a reflection of this rhythmic structure. It is seen that a formation system dominated by streets is common. Smooth, non-geometric street systems pave the way for the formation of urban spaces with surprises and rich perspectives. Thus, it is seen that urban spaces are formed that are not the same, do not repeat, but are compatible with each other and speak the same language.

One could argue that planned residential units are shaped by a holistic approach. In unplanned traditional settlements, residential units come together to reach a larger area or the entire area, and this growth continues up to the borders of other neighborhoods. In this study, the functional connections in neighborhood cells that are formed as a result of the gathering of residences and residential units are discussed as neighborhood relationships, whereas their morphological connections

are discussed as the system of neighborhood formation. Thus, it is aimed to analyze the unique structure of traditional neighborhood configurations in Anatolia based on their morphological-functional building relationships. The area of study is the Antalya-Kaleiçi area, which was selected because it hosts different systems of urban texture and has preserved its local architectural identity and settlement characteristics. In the first stage, the building morphology in the area and the urban texture characteristics of the settlement are analyzed. In the study area, which is categorized in terms of organic and geometric urban textures, analyses of the functional structure are carried out by examining neighborhood cells formed in relation to residential units selected systematically in the area and making neighborhood relationship density assessments. Analyses of the morphological structure of the area aim to describe the neighborhood units with focal points, consisting of religious buildings selected as focal points, in the context of neighborhood blocks and neighborhood units. It is seen that neighborhood relationships are influenced by neighborhood spaces, neighboring buildings, and the number of street-facing doors, and there are differences in neighborhood morphologies between organic and geometric settlement areas depending on neighborhood cells.

It is believed that the Antalya-Kaleiçi area is important because it hosts two different characters of settlement that are shaped based on its traditional organization of settlements. In this sense, more irregular developments constitute organic settlements, and more regular/grid-shaped developments constitute geometric settlements. In the study, the functional and formal structure of the neighborhood, neighborhood connection density, neighborhood cells, neighborhood units, and neighborhood morphology are discussed and and the maintenance of elements belonging to this unique settlement culture is recommended.

CONCEPTS AND DEFINITIONS

Morphological Structure in the Neighborhood: Neighborhood Cell with Focal Points, Neighborhood Blocks, Neighborhood Unit

In his urban morphology analyses, Muratori lists four classification scales: interior decoration, building, town plan, and region, while he also divides their forms of gathering into two categories, where those that gather based on adjacency are serial groups, and those that gather based on association are organic groups (Cataldi, 2003, 26; Mosharraf, 2023, 401). It is asserted that this way, all scales can be organically intertwined, and volumes, morphologies, and materials can be combined based on emotion (Maretto, 2013, 94). In urban morphology, it is stated that while neighborhood units in planned settlements are pre-planned with an integrative approach, in unplanned traditional settlements, residences come together as pieces and ultimately form the settlement as a whole. The textural characteristics of settlements that are categorized into unplanned and planned classes (Kostof, 1991) are formed based on the connections of city blocks and roads. In this

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system, clusters of buildings are classified as linear, tributary, parallel, grid, or irregular (Zhang, 2013). The positions of buildings in city blocks determine the residences to which they are connected and the neighborhood areas to which they extend together with other residences. In city blocks, buildings can be located along the street, at inside corners, and at outside corners. Depending on streets and street intersections, neighborhood connection areas can be seen in the form of linear, L, Y, T, X, and multiple intersections.

In Anatolia, neighborhoods are units consisting of 100-200 residences where multiple streets are connected to each other, buildings of worship are not far from each other, and the boundaries are complex (Cerasi, 1999). There is a process of gradual transition and diversity from the neighborhood unit, religious buildings, drinking fountains, trees, and coffee houses to shared spaces on the scale of streets and squares (Başman & Akın, 2018). The center of the neighborhood is formed around mosques, shops, coffee houses, libraries, and buildings such as madrasahs and soup kitchens (Aru, 1998).

As neighborhoods grow around religious structures, religious buildings are considered “focal points”, while clusters of buildings surrounding these focal points are considered “neighborhood cells with focal points”. Neighboring buildings that have a border with the focal point are defined as “first-degree neighborhood cells with focal points”, and those that have borders with “first-degree neighborhood cells with focal points” are defined as “second-degree neighborhood cells with focal points”. Thus, depending on the number of building units they contain, neighborhood cells with focal points result in the formation of new neighborhood cells with focal points. When the farthest expansion points of neighborhood cells of the same degree with a focal point from the focal point are connected, “neighborhood blocks” are obtained. The expansion of neighborhood blocks stops when neighborhood blocks around different focal points intersect, and here, “neighborhood units” are completed. In this sense, neighborhood units are formations that expand around a focal point and can maintain this expansion until they reach another neighborhood unit. Thus, it is understood that the hierarchy of “focal point-neighborhood cells with focal points-residential units-neighborhood” is shaped with an inductive development (Figure 1).

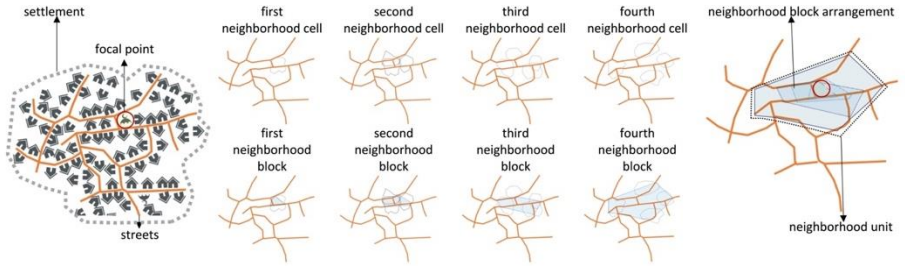

Figure 1. Formation of neighborhood cells with a focal point -neighborhood blocks-neighborhood units around a focal point

Functional Structure in a Neighborhood: Neighborhood Cell, Neighborhood Connections, and Neighborhood Connection Density Values

Urban interfaces are defined horizontally based on building positions and vertically based on the façade features of buildings, and they provide a transition between the city and buildings and between private and public spaces (Eren & Cengiz Taşlı, 2020). Doors are considered "threshold points" that allow transition from interior-private spaces to exterior-public spaces. The ratio of the number of outfacing doors to the total façade length is known as the door opening ratio, and building-street connections are considered depending on the density of thresholds along the total façade length (Palaiologou & Vaughan, 2014). Street-facing doors also have functions as semi-public interfaces through which visual or auditory communication takes place between private spaces and public ones (Gehl, 2011). Semi-public spaces allow people to maintain interactions by keeping them out of public or private spaces for a longer duration (Wilkerson, et al., 2012).

It is seen that the positioning of buildings, the shared neighborhood spaces they open into, and windows and doors along building interfaces are important in neighborhood connections. Doors and gates along building interfaces can facilitate the transformation of neighborhood connections into physical acts. While the word "density", which is also used to refer to crowdedness, is defined as the ratio of the mass of an object to its volume in physics (Kızılcık & Damlı, 2019), it is defined as the number of vehicles along a unit length of road at any time point in the field of traffic management (Taş & Sezen, 2020). From a similar perspective, density in neighborhood connections is evaluated to include the neighborhood relationships among neighboring buildings in shared neighborhood spaces.

It is argued that neighborhood cells can be defined in association with 'building entry-neighborhood space-building entry' network connections. As opposed to neighborhood cells with focal points, sole neighborhood cells take a single residential unit as the center/starting point, and they are accepted as sets of buildings that neighbor this central residential unit and directly open into shared neighborhood spaces. The neighborhood cell of the central residential unit is named a first-degree neighborhood cell. Each set of buildings that takes one of the other residential units in the first-degree neighborhood cell as the center/starting point and covers buildings that neighbor that central unit is defined as a second-degree neighborhood cell (Figure 2). Therefore, if there are three residential units within a first-degree neighborhood cell, this system creates three separate second-degree neighborhood cells. As seen in Figure 2, each residential unit has its own neighborhood cell, and this system expands outward from the center as first-degree, second-degree, third-degree, and further degrees of neighborhood cells.

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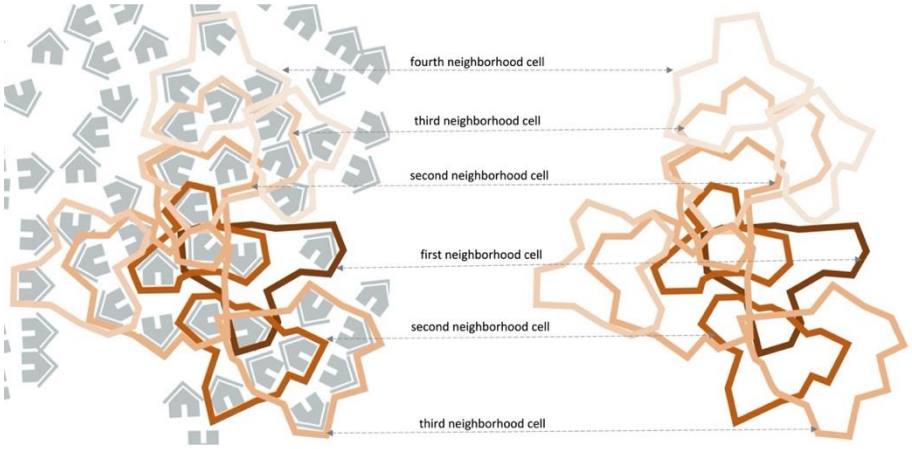

Figure 2. Neighborhood cells

Neighborhood units are defined as urban spaces (e.g., streets, squares) that are shaped based on the boundaries (the farthermost boundary such as the boundary of a building or garden/yard) of residences that are neighbors to a residence that is taken as the center/starting point, are shared by residents, and constitute gathering points. In this context, it is thought that neighborhood connections occur depending on departures/arrivals that are assumed to take place via the doors and gates of buildings that directly open into shared neighborhood spaces. These departures/arrivals constitute the number of neighborhood connections. Neighborhood connection density can be calculated using the number of connections in neighborhood units. In the calculation of the neighborhood connection density value, the total number of connections from all doors of each building opening to the exterior space to all doors of neighboring buildings opening to the same space is determined. The neighborhood connection density value can also be expressed as the number of links within a 1 m^2 neighborhood space that depends on the ratio between the number of neighborhood connections and the size of the neighborhood space. Figure 3 displays a neighborhood cell with three residences. It is seen here that the residence for which the neighborhood connection density value is calculated has a total of two entries opening to the neighborhood space, a building entry and a garden entry, while each of the two neighboring buildings has one building entry opening to the same space. It is observed that the residence for which the neighborhood connection density value is calculated has four neighborhood connections, including two connections to each building via the building and garden entries. Each of the two non-central buildings has three connections to the other two, one connection via the building entry of the other non-central building and two connections via the building and garden entries of the central residence. Thus, there can be a total of ten neighborhood connections in the entire neighborhood cell (Figure 3). If the number of neighborhood connections in a unit area ($1m^2$) is high, this indicates a higher neighborhood connection density, while it is accepted that the neighborhood connection density value is low if the number of connections per unit area is low.

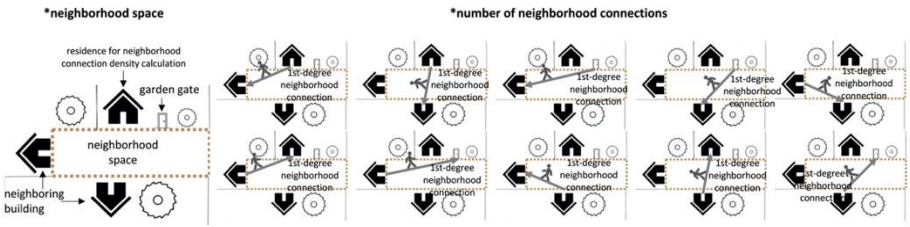

Figure 3. Neighborhood Connection Density calculation

The neighborhood connection density value expresses the number of links within a 1 m² neighborhood space that depends on the ratio between the number of neighborhood connections and the size of the neighborhood space:

- **number of neighborhood connections=** [(number of neighborhood cells–number of entrance points for own residence) x number of entrance points for own residence] + [(number of neighborhood cells– number of entrance points for own residence) x number of entrance points for own residence] +…….. n
- **neighborhood connection density (number of connections / 1m²) =** number of neighborhood connections / neighborhood space

A dense network of neighborhood connections refers to the high number of connections per area of the neighborhood space, while a loose network refers to the low number of such connections.

METHOD

Study Area

The Antalya and Kaleiçi Region has been and is an important settlement area. In the Hellenistic period, the east of the city had a grid-type settlement, an acropolis, and an agora. In the Roman period, with some additions, outer neighborhoods with an organic texture were formed in the southwest of the city. Moreover, in the Ottoman period, Turkish neighborhoods formed in a region with an organic texture, while Greek neighborhoods formed in a region with a grid-type structure (Kılıç, 2022; Canan, et al., 2020; Yağcı, 2009). This region is divided into sixteen neighborhoods with large streets extending from interior and exterior doors to the center, as well as smaller streets extending from large streets into neighborhoods (Dayar, 2020, 62). The city walls of the Kaleiçi area had been preserved until the 1930s, the protective border was updated as Atatürk Street with the large-scale destruction of the walls in the 1940s, and the area was affected negatively by developments related to migration and tourism in the 1970s (Canan, et al., 2020). In the Kaleiçi area, it is seen that the Kılıçarslan and Barbaros neighborhoods display the grid texture belonging to the Roman period, while the Selçuklu and Tuzcular neighborhoods display the organic texture belonging to the Turkish period (Türk, 2014). The main components of morphology were taken as building units. In the examinations about the building stock of the

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Antalya Kaleiçi Region, Development Plans aiming a preservation were taken as a basis, and building traces, garden traces, plot outlines, building entrances, and garden entrances were identified based on sources in the literature and information obtained from satellite images (Figure 4).

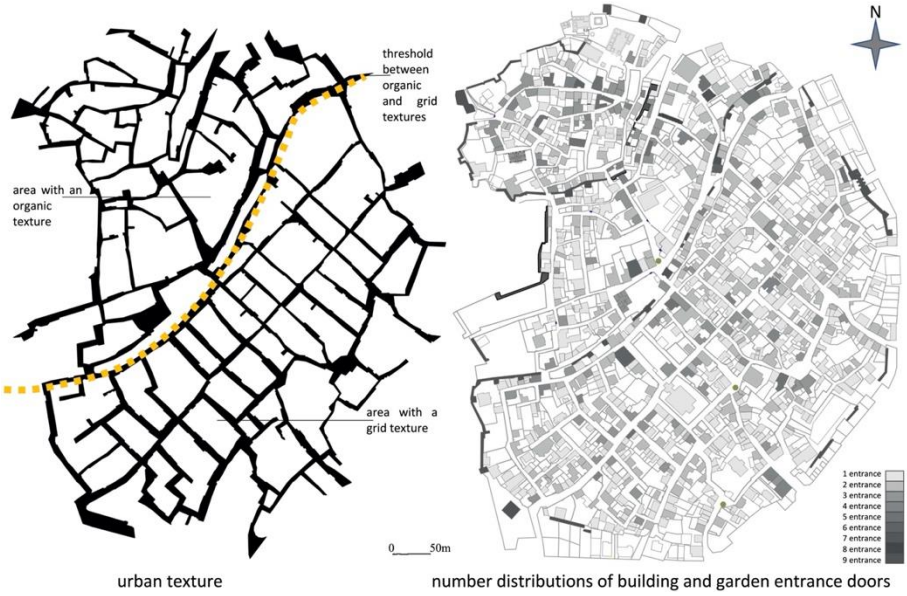

Figure 4. Analyses of the urban texture and numbers of building doors and garden gates in the study area

Antalya-Kaleiçi: Functional Structure

Neighborhood Cells

The Kaleiçi Region, which has been preserved as a protected site since 1973 (Mansuroğlu, 2021, 222) is considered in the context of its urban texture, street system, and historical buildings that have reached our time. Building and garden entrances such as single doors, double doors, and gates opening from buildings into urban spaces such as streets, dead-end streets, and cul-de-sacs are shown on the plan. The building and garden entrances of some buildings, a part of which had been demolished, were identified based on the remaining rubble and development plans aimed at preservation, and it was aimed to have a picture of the original structure. As a result of the preliminary assessments, it was determined that 621 of the 741 buildings were residential units. The study area was divided into 50 m x 50 m zones, selected residences (single residential units) that could preserve its unique architectural identity were identified in each zone, and the first- and second-degree neighborhood cells of these residential units were defined. Among the 621 residential units in the area (excluding apartment buildings), 123 (20%) (45 in the areas with organic texture and 78 in the areas with geometric texture) were examined (Figure 5).

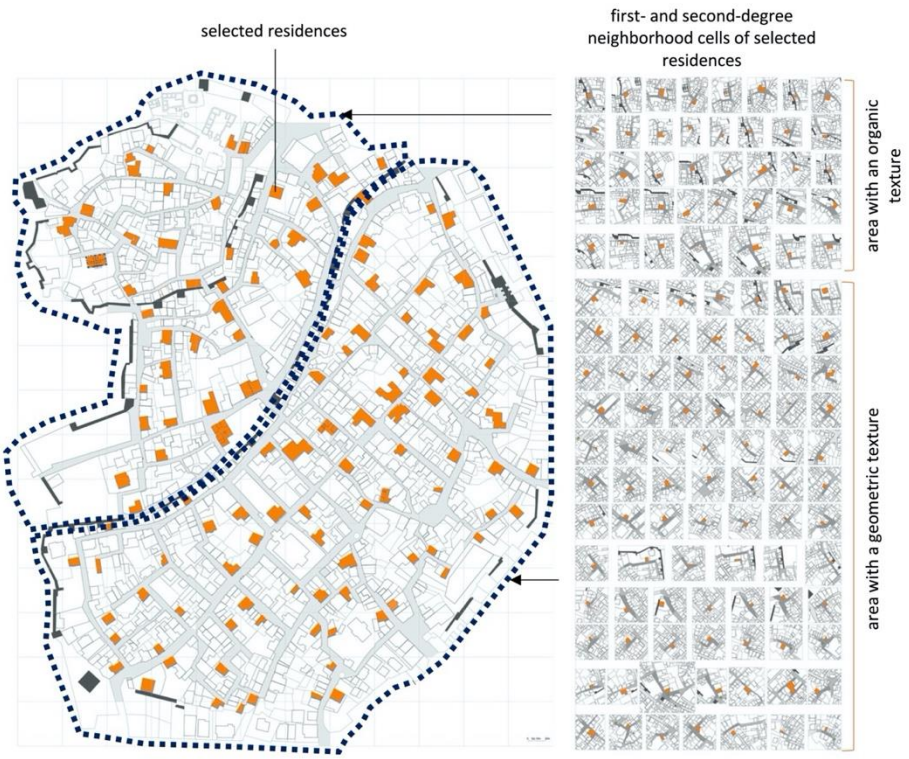

Figure 5. Locations of the selected residences for which units of neighborhood and neighborhood connections were calculated

Neighborhood Connection Density Value

Neighborhood connection density values were calculated for the first-degree neighborhood cells of the 123 residences in the sample. The Neighborhood Connection Density value refers to the number of connections passing through a 1 m^2 neighborhood area. The neighborhood connection density map created based on the density values calculated for the selected residential units in the settlement is presented in Figure 6.

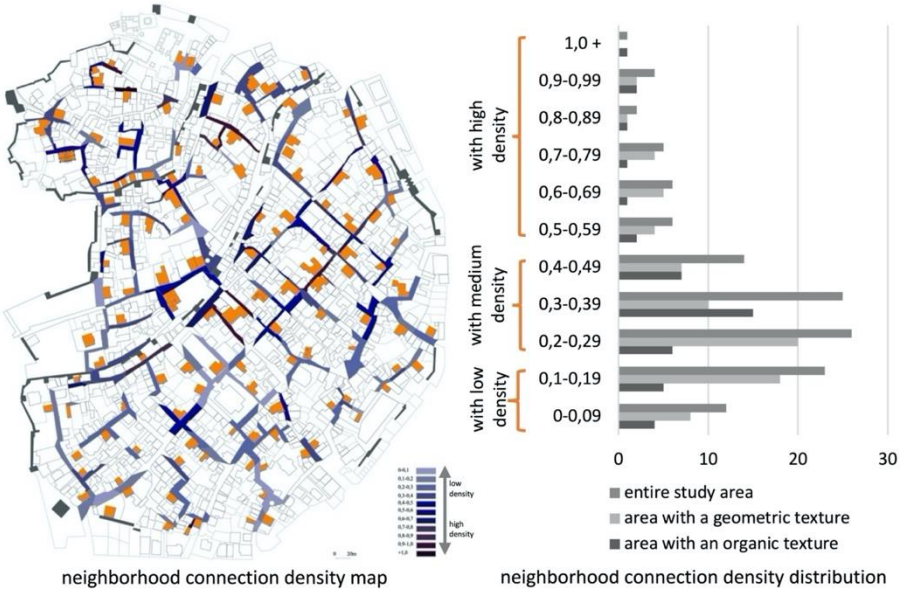

Figure 6. The neighborhood connection density map and density values

Most of the neighborhood connection density values calculated in the organic settlement areas were in the range of 0.3-0.39, whereas most of

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those calculated in the geometric settlement areas were in the range of 0.2-0.29. This result showed that the organic settlement areas had a morphological arrangement that supported neighborhood connections more compared to the grid settlement areas. In the entire examined area, the neighborhood connection density values were in the ranges of 0.2-0.29 and 0.3-0.39.

The mean neighborhood connection density value for the 123 neighborhood cells in the examined area was 0.34 connections/m^2, this value was considered to be within the range of 0.3-0.39 in the ranking of density categories, and when the ranges of 0.2-0.29 under this range and 0.4-0.49 over this range were included, the range of 0.2-0.39 was defined as the range of medium neighborhood connection density. The ranges below this range (0-0.09 and 0.1-0.19) were defined as the ranges of low neighborhood connection density, and those above this range (0.5-0.59, 0.6-0.69, 0.7-0.79, 0.8-0.89, 0.9-0.99, and 1.0+) were defined as the ranges of high neighborhood connection density.

Antalya-Kaleiçi: Morphological Structure

Neighborhood Cells with Focal Points and Neighborhood Blocks

The Kaleiçi Region can be discussed based on its historical buildings that were built in different years and have remained intact so far (e.g., residences, religious buildings, hammams). It is aimed to determine the boundaries of its neighborhoods based on its current structure that has remained intact. Hence, neighborhood cells with focal points centered around religious buildings and neighborhood blocks connected to these cells are defined. Eight religious buildings in the study area (one outside the area was excluded from the analyses) were accepted as focal points, and the neighborhood cells with focal points around these focal points are presented in different colors based on their degree ranking (Figure 7). The farthest distances from the focal point to the neighborhood cells with focal points around the same focal point and of the same degree (first, second, …) were defined as “expansion distances”. “Neighborhood blocks” were formed by connecting the expansion points of the neighborhood cells with focal points of the same degree, and the neighborhood blocks of the same degree around different focal points are shown in the same colors. When the expansion distances of the neighborhood cells with focal points were combined, “movement series of neighborhood cells” were obtained, and these are shown in Figure 7. It is seen that in addition to the main movements centered around the focal point, there were also lower-level movement series caused by the partition of streets toward two or three directions.

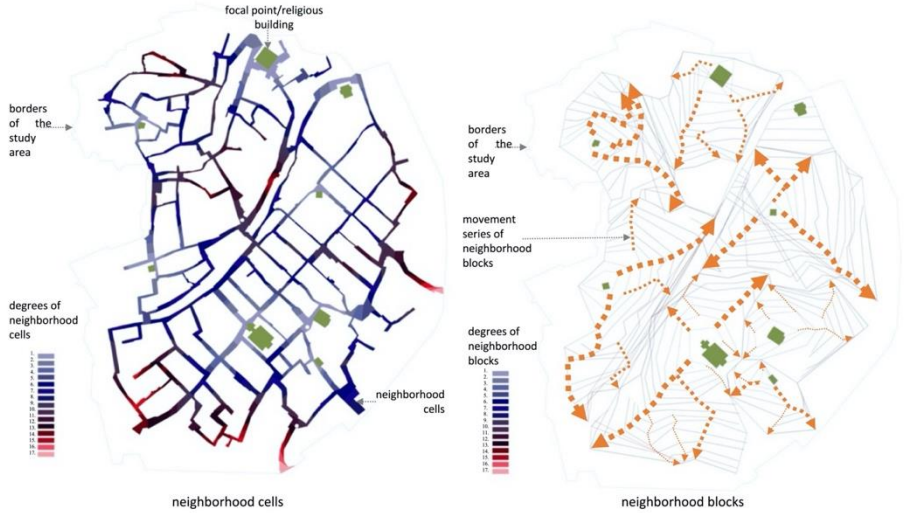

Figure 7. Neighborhood Blocks and Movement Series

Neighborhood Units

The neighborhood cells with focal points surrounding each religious building expanded up to their intersection with the neighborhood cells with focal points surrounding other religious buildings, and these intersection points constituted the boundaries of these cells with each other (Figure 8). It is seen that three of the neighborhood units in the study area (units numbered 1, 2, and 5) were in the organic settlement areas, while five units (units numbered 3, 4, 6, 7, and 8) were in the grid settlement areas.

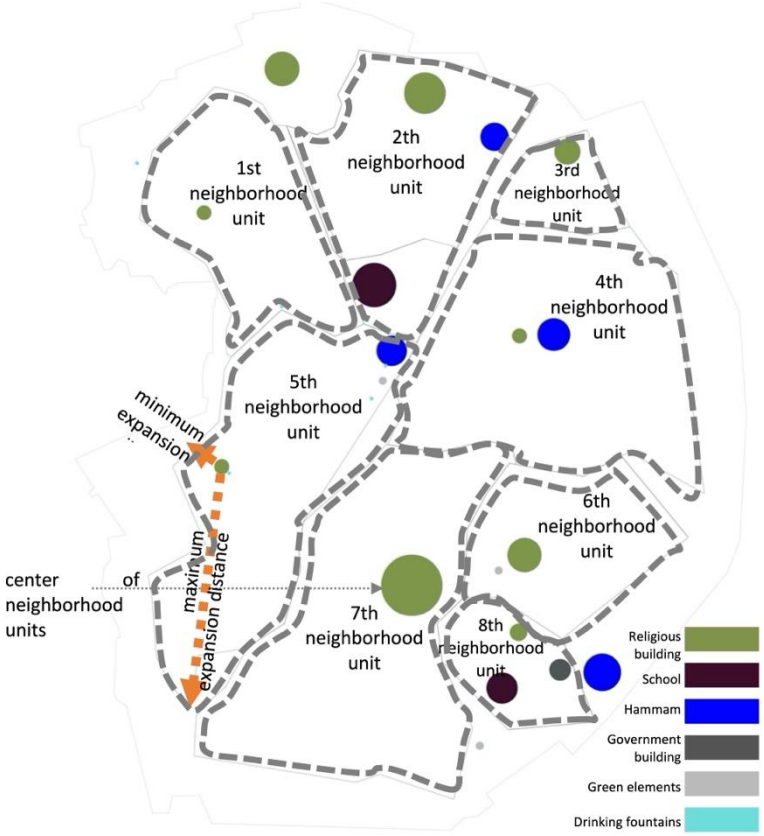

Figure 8. Neighborhood units linked with neighborhood connections

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The data on the morphological structure of the neighborhood units in the study area are presented in Table 1.

Table 1. Morphological structure of neighborhood units

		lowest expansion (m)	highest expansion (m)	lowest number of neighborhood cells	highest number of neighborhood cells	circumference of neighborhood unit (m)	area of neighborhood unit (m^2)
organic settlement areas	Unit 1	36	173	first	tenth	714	25722
	Unit 2	35	222	first	ninth	771	31796
	Unit 5	30	217	second	thirteenth	986	37959
grid settlement areas	Unit 3	13	91	first	sixth	349	7231
	Unit 4	77	217	twelfth	thirteenth	927	47480
	Unit 6	44	147	fourth	ninth	574	20527
	Unit 7	35	257	fifth	fifteenth	1052	50829
	Unit 8	16	104	third	seventh	408	10745

Four neighborhood units had hammams, two had schools (non-historical), one had a government building, two had both schools and hammams, and trees and drinking fountains were usually found at the intersection points of the streets. The neighborhood units had an amorphous morphology, they expanded at distances of 13 m to 247 m from the focal point, there was a hierarchical gradation from the first neighborhood cell to the fifteenth neighborhood cell within this expansion area, the circumferences of the neighborhood units varied between 349 m and 1052 m, and their areas varied between 7231 m^2 and 50829 m^2. The sizes of the neighborhood units were similar in the organic settlement areas and variable in the grid settlement areas. In the geometric settlement areas, the seventh neighborhood unit had the highest degree of expansion, whereas the eighth neighborhood unit had the lowest degree of expansion, which demonstrated this difference.

FINDINGS

While tributary and deviating streets and amorphous city block formations differing from each other were common in the organic settlement areas, the grid settlement areas mostly contained a grid street system, as well as rectangular and square-shaped city blocks. Among the 741 buildings in the area, 83.8% (621) were residential units (function changes for tourism purposes were neglected), 5.6% (42) were apartment buildings, 8.4% (62) were commercial buildings, 1.3% (9) were religious buildings, and 1% consisted of schools (2), hammams (4), and a government building (1). Similar distributions of functions were observed in the settlement areas with organic and grid textures. While 9.2% (69) of the buildings were positioned at the inside corners of the city blocks, 30.7% (229) were positioned at the outside corners, 60.1% (449) were positioned along the streets, and 6 were positioned at

both the inside and outside corners of the blocs. In the entire area, the door opening ratio was 1.55, and the garden gate opening ratio was 1.1 (Table 2).

Table 2. Findings on building morphologies in the study area

		organic texture	grid texture	entire study area
function distribution function distribution	residence	205-%80,3	416-%85,6	621-%83,8
	apartment building	8-%3,2	34-%7	42-%5,6
	school	1-%0,4	1-%0,2	2-%0,3
	hammam	2-%0,8	2-%0,4	4-%0,5
	commercial building	35-%13,7	27-%5,5	62-%8,4
	government building	-	1-%0,2	1-%0,1
	religious building	4-%1,6	5-%1,1	9-%1,3
	total	255-%100	486-%100	741-%100

		organic texture	grid texture	entire study area
position	inside corner	29-%11,2	40-%8,2	69-%9,2
	outside corner	86-%33,2	143-%29,3	229-%30,7
	street	144-%55,6	305-%62,5	449-%60,1
	total	259-%100	488-%100	747-%100
entrance points	building door	1,7	1,4	1,55
	garden gate	1,1	1,1	1,1

Findings on the Functional Structure

It was aimed to identify the characteristics of the neighborhood cells that affected the neighborhood connection density values and how these factors affected these values. The neighborhood connection density values of the first-degree neighborhood cells belonging to the 123 residences in the study area were evaluated based on building numbers, neighborhood area values, morphological structures of neighborhood areas, building arrangements, the position of the buildings in the city block, and the numbers of door openings to the neighborhood areas (Table 3).

Table 3. Characteristics of first-degree neighborhood cells based on neighborhood connection density values

density	neighborhood connection density	number of units	size	type of urban space	building arrangement	building position	mean number of doors
low	0-0,09	4,08	437m^2	linear	linear	street	6,3
	0,1-0,19	5,31	391,4 m^2	linear	intermittent	street	8,5
medium	0,2-0,29	6,53	413,3m^2	linear	irregular	street	10,84
	0,3-0,39	6,6	443,8m^2	linear	irregular	outside corner	13,48
	0,4-0,49	7,71	465,21m^2	t street	grid	outside corner	14,64
high	0,5-0,59	7	311,66m^2	linear	linear, tributary	street	14,33
	0,6-0,69	8	420 m^2	linear and t	grid	outside corner, street	17,66
	0,7-0,79	7,6	245,4 m^2	linear	linear	street	14,8
	0,8-0,89	7	297 m^2	y street	irregular	outside corner, street	17,5
	0,9-1,99	8,25	352 m^2	linear	linear	street	19,75
	+1,0	5	154 m^2	linear	linear	street	15

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The quantitative structures of the low-, medium-, and high-density neighborhood cells were interpreted based on the arithmetic mean values shown in Table 3. In general, for the areas with low neighborhood connection density values, there were 4.7 buildings on average, the mean block area was 414.2 m^2, and there were 7.4 doors on average; in the medium-density areas, there were 6.9 buildings on average, the mean block area was 661.1 m^2, and there were 12.9 doors on average, and in the high-density areas, there were 7.14 buildings on average, the mean block area was 296.6 m^2, and there were 16.5 doors on average. It is seen that the relationships between the number of buildings defining the neighborhood cells, the areas of the neighborhood spaces, and the numbers of door or gate entries affected the calculated neighborhood connection density values. In other words, a small area of neighborhood spaces, higher numbers of neighboring buildings, and higher numbers of entry doors were associated with higher neighborhood connection density values.

The neighborhood connection density values belonging to the selected residences positioned along the streets were generally more favorable compared to those positioned at the inside or outside corners (Table 4).

Table 4. Neighborhood connection density values based on the positions of the selected residences

building position	Neighborhood connection density values											
	0-0,9	0,1-0,19	0,2-0,29	0,3-0,39	0,4-0,49	0,5-0,59	0,6-0,69	0,7-0,79	0,8-0,89	0,9-0,99	1,0-	total
inside corner	3-%21,5	4-%29	3-%21,5	2-%14	2-%14							14-%100
outside corner	3-%7	4-%9	10-%22	12-%26	8-%17	2-%4	3-%7	2-%4	1-%2	1-%2		46-%100
street	6-%9	14-%22	13-%21	11-%17	4-%6	4-%6	3-%5	3-%5	1-%2	3-%5	1-%2	63-%100
total	12-%10	22-%18	26-%21	25-%20	14-%11	6-%5	6-%5	5-%4	2-%2	4-%3	1-%1	123-%100

Most neighborhood connection density values calculated for buildings in neighborhood cells positioned along the streets were in the range of 0.3-0.39 in the organic settlement areas and 0.1-0.19 in the grid settlement areas, most of those calculated for buildings positioned at the outside corners were in the range of 0.3-0.39 in the organic settlement areas and 0.2-0.29 in the geometric settlement areas, and most of those calculated for buildings positioned at the inside corners were in the range of 0.1-0.19 in the organic settlement areas and 0.2-0.29 in the grid settlement areas (Table 5) (Figure 9).

The buildings positioned along the streets and at the outside corners in the neighborhood cells had higher neighborhood connection density values in the organic settlement areas, while those positioned at the inside corners had higher density values in the grid settlement areas.

Table 5. Neighborhood connection density values prominent in neighborhood cells based on their location

	street		outside corner		inside corner	
	prominent neighborhood connection density value	total number of cells	prominent neighborhood connection density value	total number of cells	prominent neighborhood connection density value	total number of cells
organic	0,3-0,39	14	0,3-0,39	22	0,1-0,19	9
grid	0,1-0,19	49	0,2-0,29	24	0,2-0,29	5
entire study area	0,1-0,19	63	0,3-0,39	46	0,1-0,19	14

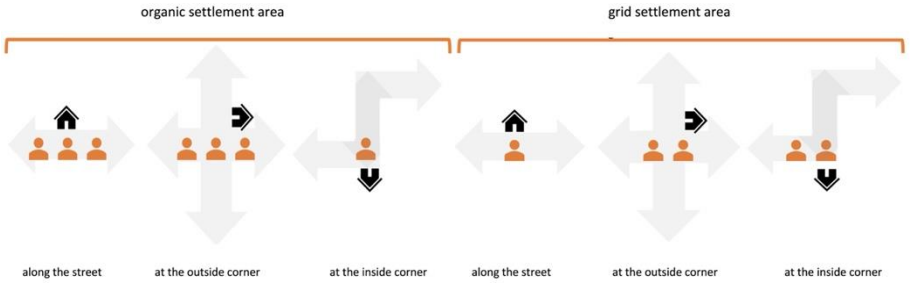

Figure 9. Neighborhood connection density values based on building positions

In general, in the organic settlement areas, 33% of the neighborhood cells had neighborhood connection density values in the range of 0.3-0.39, 15% had density values in the range of 0.4-0.49, and 11% had density values in the range of 0.1-0.19. In the grid settlement areas, 25% of the neighborhood cells had neighborhood connection density values in the range of 0.2-0.29, 21% had density values in the range of 0.1-0.19, and 12% had density values in the range of 0.3-0.39. The neighborhood cells in the organic settlement areas were found to have higher neighborhood connection density values than those in the grid settlement areas.

Findings on the Morphological Structure

Findings on neighborhood cells

The function distributions, positions, building entrance numbers, and numbers of buildings in the first- and second-degree neighborhood cells of a total of 123 residential units are presented in Table 6.

Among the 3174 buildings constituting a total of 123 neighborhood cells, 2708 (85.32%) were residences, 148 (4.67%) were apartment buildings, 16 (0.5%) were schools, 24 (0.75%) were hammams, 216 (6.8%) were commercial buildings, 2 (0.06%) were government buildings, and 60 (1.9%) were religious buildings. The buildings constituting the neighborhood cells were positioned along the street (53.96%), at the outside corner (38.4%), and at the inside corner (7.64%). The mean number of building doors in these buildings was 1.33, while the mean number of garden gates was 0.55. The distributions of the numbers of buildings constituting first- and second-degree neighborhood cells in the organic and grid settlement areas are shown in Figure 10.

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Table 6. Morphological structure of neighborhood cells

		organic first-degree	grid first-degree	total/mean first-degree	organic second-degree	grid second-degree	total/mean second-degree	total/mean entire area of the sample
distribution of functions	residential	208-%81	472-%88	680-%85,7	186-%76	488-%89	674%84,88	2708%85,32
	apartment building	14 –%5	24 –%4	38-%4,8	13-%5	23-%4,2	36-%4,53	148-%4,67
	school	2 – %1	1-%0,2	3-%0,4	2-%0,8	3-%0,54	5-%0,67	16-%0,5
	hammam	2 –%1	2-%0,4	4-%0,6	6-%2,4	2-%0,36	8-%1	24-%0,75
	commercial	25 –%10	28-%5	53-%6,6	33-%13,4	22-%4,1	55-%6,92	216-%6,8
	government	-	1-%0,4	1-%0,1	-	-	-	2-%0,06
	religious	6 –%2	8-%2	14-%1,7	6-%2,4	10-%1,8	16-%2	60-%1,9
	entire area	257-%100	536-%100	793-%100	246-%100	548-%100	794-%100	3174-%100
position	inside corner	36-%13,58	34-%6,31	70-%8,7	19-%7,6	35-%6,15	54-%6,59	124-%7,64
	outside corner	116%43,77	186%34,57	302-%37,6	105-%42	216%37,96	321%39,19	623-%38,4
	street	113%42,65	318%59,12	431%53,67	126-%50,4	318%55,89	444%54,22	875-%53,94
	total	265-%100	538-%100	803-%100	250-%100	569-%100	819-%100	1622-%100
number of buildings	1 building	-	-	-	1-%2,2	-	1-%0,8	1-%0,4
	2 buildings	1-%2,2	-	1-%0,8	4-%8,9	1-%1,3	5-%4	6-%2,4
	3 buildings	3-%6,7	3-%3,8	6-%4,9	6-%13,4	7-%9	13-%10,5	19-%7,7
	4 buildings	10-%22,2	7-%9	17-%13,9	14-%31,1	7-%9	21-%17	38-%15,4
	5 buildings	10-%22,2	10-%12,8	20-%16,3	2-%4,4	15-%19,3	17-%13,9	37-%15
	6 buildings	7-%15,6	21-%27	28-%22,8	7-%15,6	11-%14,2	18-%14,6	46-%18,7
	7 buildings	5-%11,1	10-%12,8	15-%12,1	4-%8,9	8-%10,2	12-%9,9	27-%11
	8 buildings	3-%6,7	11-%14,1	14-%11,3	2-%4,4	8-%10,2	10-%8,1	24-%9,8
	9 buildings	5-%11,1	7-%9	12-%9,9	1-%2,2	8-%10,2	9-%7,3	21-%8,6
	10 buildings	1-%2,2	4-%5,1	5-%4	-	5-%6,4	5-%4	10-%4
	10+ buildings	-	5-%6,4	5-%4	4-%8,9	8-%10,2	12-%9,9	17-%7
	Total	45-%100	78-%100	123-%100	45-%100	78-%100	123-%100	246-%100

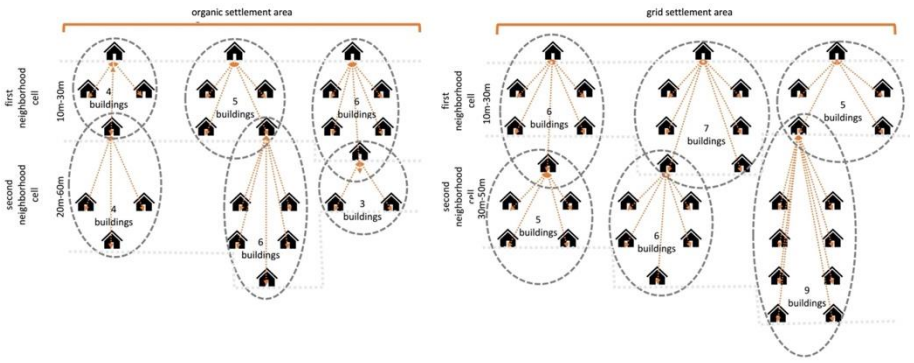

Figure 10. Numbers of buildings constituting neighborhood cells and their expansion distances

In the organic and grid settlement areas and the entirety of the study area, the first-degree neighborhood cells expanded by at least 10-19 m and at most 20-29 m. The second-degree neighborhood cells expanded by at least 20-29 m and at most 50-59 m in the organic settlement areas, at least 30-39 m and at most 40-49 m in the geometric settlement areas, and at least 30-39 m and at most 40-49 m in the entire study area (Figure 10) (Table 7).

Table 7. Distributions of the expansion distances of neighborhood cells

	organic				grid				entire study area			
	first-degree neighborhood connection		second-degree neighborhood connection		first-degree neighborhood connection		second-degree neighborhood connection		first-degree neighborhood connection		second-degree neighborhood connection	
	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
10m-19m	22-%48,9	4-%8,9	4-%8,9		38-%48,8	7-%8,9	2-%2,5		60-%48,8	11-%8,9	6-%4,8	
20m-29m	20-%44,4	18-%40,1	20-%44,4	1-%2,2	34-%43,5	28-%35,8	21-%26,9	1-%1,2	54-%43,9	46-%37,3	41-%33,3	2-%1,7
30m-39m	3-%6,7	15-%33,3	14-%31,2	13-%28,8	6-%7,7	26-%33,3	39-%50	15-%19,2	9-%7,3	41-%33,3	53-%43,1	28-%22,8
40m-49m		3-%6,7	6-%13,3	9-%20		14-%17,9	15-%19,2	27-%34,6		17-%13,9	21-%17,1	36-%29,2
50m-59m		2-%4,4	1-%2,2	14-%31,2		2-%2,5	1-%1,2	17-%21,7		4-%3,3	2-%1,7	31-%25,2
60m-69m		2-%4,4		2-%4,4		1-%1,2		12-%15,3		3-%2,4		14-%11,3
70m-79m		1-%2,2		3-%6,7				4-%5,1		1-%0,9		7-%5,7
80m-89m				3-%6,7				2-%2,5				5-%4,1
toplam	45-%100	45-%100	45-%100	45-%100	78-%100	78-%100	78-%100	78-%100	123-%100	123-%100	123-%100	123-%100

The neighborhood spaces of the first-degree neighborhood cells had areas in the range of 100-199 m^2 (20%) in the organic settlement areas, 200-299 m^2 (30.7%) in the grid settlement areas, and 200-299 m^2 (26.1%) in the entire study area. It was determined that the first-degree neighborhood cells in the entire study area formed in neighborhood

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spaces with linear (39%), Y (19.6%), and X (15.4%) street arrangements. The buildings constituting the first-degree neighborhood cells were positioned irregularly (37.4%), linearly (18.7%), or intermittently (17%) (Table 8).

Table 8. Neighborhood areas, spatial morphologies, and building arrangement structures in first-degree neighborhood cells

	neighborhood unit area (m^2)											
	0-99	100-199	200-299	300-399	400-499	500-599	600-699	700-799	800-899	900-999	1000 üstü	total
organic	2-%4,4	9-%20	8-%17,8	7-%15,6	6-%13,3	8-%17,8	-	1-%2,2	1-%2,2	-	3-%6,7	45-%100
grid	2-%2,6	9-%11,5	24-%30,7	11-%14,1	10-%12,9	8-%10,2	2-%2,6	7-%8,9	3-%3,9	-	2-%2,6	78-%100
entire study area	4-%3,2	18-%14,7	32-%26,1	18-%14,7	16-%13	16-%13	2-%1,6	8-%6,5	4-%3,2	-	5-%4	123-%100
	spatial morphology						
	linear	linear	linear	linear	linear	linear	total
organic	13-%28,9	8-%17,8	2-%4,4	13-%28,9	7-%15,6	2-%4,4	45-%100
grid	35-%44,9	10-%12,9	9-%11,6	11-%14,1	12-%15,3	1-%1,2	78-%100
entire study area	48-%39	18-%14,7	11-%8,9	24-%19,6	19-%15,4	3-%2,4	123-%100
	building arrangement type					
	linear	linear	linear	linear	linear	linear
organic	5-%11,1	7-%15,6	7-%15,6	1-%2,2	25-%55,5	45-%100
grid	18-%23	11-%14,1	14-%18	14-%18	21-%26,9	78-%100
entire study area	23-%18,7	18-%14,7	21-%17	15-%12,2	46-%37,4	123-%100

Findings on Neighborhood Cells with Focal Points, Neighborhood Units, and Neighborhood Morphology

It is thought that neighborhood blocks carry some codes regarding the arrangement structures of neighborhood cells with focal points and their styles of formation. It was observed in this study that the movement lines in the organic and grid settlement areas differed from each other, there were more tributary lines within the neighborhoods in the organic settlement areas, which did not expand much outward, and the grid settlement areas had more straight lines and movements growing by a uniform course of expansion (Figure 11). In general, the formation of the hierarchy of focal point-arrangements of neighborhood cells with focal points-residential units can be observed. It is acknowledged that this structure, which constitutes the neighborhood in the traditional settlement system that is not pre-planned, differs from planned neighborhood units in the literature in terms of scope and content, and this is believed to be a characteristic that is unique to the culture of the settlement.

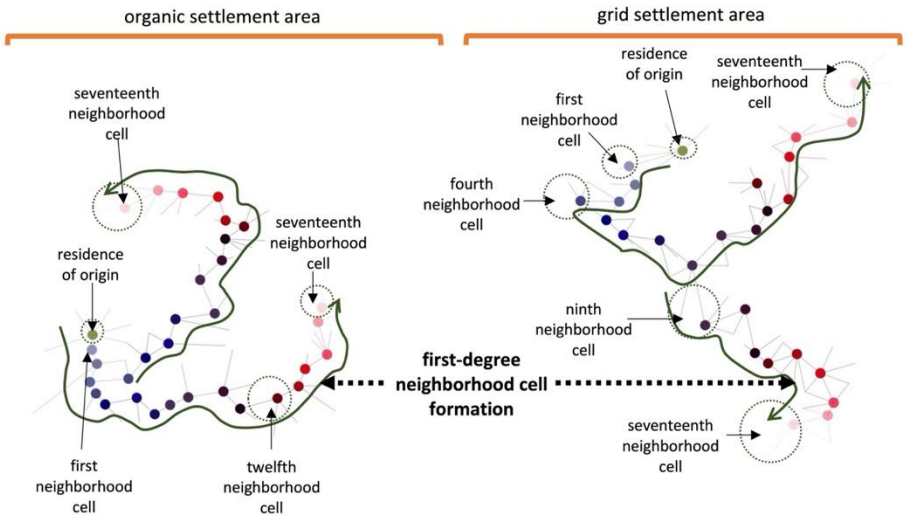

Figure 11. Morphological differences in neighborhood units in settlement areas with different textures

DISCUSSION AND RESULTS

In the study; the relationship between the formal and functional structures of neighborhoods formation with an traditional approach is questioned. Neighborhood systems with organic and grid textures reveal the formal structure, and neighborhood relationships between housing elements in the neighborhoods reveal the functional structure. First of all, the issues of where or at what point the neighborhood formation begins and how it develops and grows come to the fore. In this context, it is accepted that religious buildings representing the center of the neighborhood constitute the starting points or focal points in the formation of the neighborhood. It is acknowledged that this approach is compatible with the study conducted by E. Dayar in which the approximate centers of the sixteen neighborhoods of Kaleiçi in the early 19th century are presented. In the aforementioned study, it is observed that there are mostly religious buildings in the centers of neighborhoods, and the neighborhoods are shaped around these buildings (Dayar, 2020, 63). It is believed that the results of this study in agreement with Dayar's study in terms of the religious buildings reported as central points of neighborhoods (some, including Paşa Mosque, Balbey Mosque, and Makbule Mosque) are important in that they show consistency with and contribute to the literature. It is seen that neighborhood cells are formed when residential elements come together around religious buildings, and neighborhood units are formed when neighborhood cells come together.

Neighborhood relations are thought to represent the functional structure of neighborhoods. It is envisaged that neighborhood relations take place in common neighborhood areas, with residential elements coming and going from building and garden entrances. In this context, it is important that housing elements are arranged side by side or opposite each other and open to a common urban space. Neighborhood Connection Density value is determined depending on the relations between the house and garden entrances, which enable the housing

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elements to open directly to the neighborhood area, and the neighborhood areas where neighborhood relations take place.

Although the buildings belonging to each neighborhood cell had similar morphological structures, there were variations between the organic and grid settlement areas in terms of the number of buildings in neighborhood cells, the arrangements of these buildings, their positions on city blocks, and their expansion distances and areas. It is believed that this situation affected neighborhood blocks, their movement series, and their Neighborhood Connection Density values.

The distances of outward expansion from focal points varied between organic and grid settlement areas. The degree of similarity between the shortest and longest expansion distance values provides information about whether there is a uniform process of expansion from the focal point outwards. In this sense, while the expansion distance difference in the residential units in the settlement areas with an organic texture was 170 m, this difference was 126 m in the settlement areas with a geometric texture. This showed that the residential units in the grid settlement areas grew in a more centralized manner. The results on the differences between the lowest and highest numbers of neighborhood cells in the neighborhood units supported this finding. This difference was 9.3 neighborhood cells in the organic settlement areas and 5 neighborhood cells in the grid settlement areas. That is, while there was an asymmetrical process of expansion in reference to the focal point in the organic settlement areas, there was a more symmetrical process of expansion in the grid settlement areas. This situation was considered to affect the neighborhood connection density values in the organic and grid settlement areas. The neighborhood connection density values in most areas with an organic texture were in the range of 0.3-0.39, while the values in most areas with a grid texture were in the range of 0.2-0.29.

It is understood that neighborhood units that are defined based on neighborhood cells with focal points have their own unique structures other than their meaning in the literature. In particular, it is seen that with their amorphous and geometrically irregular structures, these units did not expand uniformly in every direction, and this situation led to the formation of a rhythmic connection deviating from a geometric order between centers of residential units. It was concluded that this situation was indicative of the identity and uniqueness of the settlement, and it should be maintained in terms of settlement culture.

This study is thought to be important in that it aims to determine the ideal service boundaries of neighborhoods that develop organically with a traditional approach. In this context, it aims to reveal the unique structures of concepts such as neighborhood cells, neighborhood connections, Neighborhood Connection Density values and hierarchical formation of focal points- neighborhood cells- neighborhood units and emphasizes the importance of the protection and sustainability of these unique concepts.

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Resume

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