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Chapter

Toward Practical Criteria for Analyzing and Designing Urban Blocks

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Abstract

The streets, blocks, lots, and buildings are the main elements of cities' texture. Surrounded by streets and surrounding the buildings, urban blocks invariably interact with these components dialectically, in that it can connect the network of streets and buildings, hence its significance in urban design. However, affected by unsound formal and spatial changes of urban forms in modern and postmodern eras, space coherence reduction led to a loss of blocks' identity. Therefore, we can barely find a comprehensive functional tool structured on a solid understanding to design this very component of the urban morphology. In this regard, this study seeks to define a practical tool for analyzing and designing this crucial element developing an operational, yet expandable, checklist for urban blocks including various factors, from concepts to indices. All these factors are classified under three main concepts: spatial balance, spatial continuity and integration, and durability. In fact, as a primitive step, this research can enable urban designers to understand urban blocks more effectively and use the framework to assess the current situation and design the future.

Keywords: urban morphology, blocks, urban design evaluation criteria

1. Introduction

Urban morphology is one of the most important physical approaches to urban form. The term morphology refers to the study of form and deals with shape, form, external structure, or order [1]. Understanding the importance of urban morphology, which involves the design and composition of the urban form and the processes effective in its formation, helps urban designers to recognize the local patterns of development and transformation processes [2]. Referring to the approaches taken by three schools of England, Italy, and France in relation to urban morphology, Moudon states that the typological elements from the perspectives of these three schools of urban morphology focus on three main elements, i.e., street and block, lot, and building [3, p. 7]. Urban block as one of these elements has received little attention compared to other morphological elements.

The formation of this important element took new dimensions after modern times, so that the cities lost their spatial integration due to the construction of single buildings in urban spaces, and as a result, urban context became a collection of amorphous spaces with dispersed neighborhoods and streets and isolated

applications with disrupted forms, without interconnected urban masses and blocks that could be representative of space [2].

It can be said that urban blocks have the potential to define and create the balance between lots and streets, so that buildings and streets are considered simultaneously and in parallel with each other. Therefore, attempts were made to define factors required for analyzing this element by examining the views and theories related to blocks. To this end, first, the concepts were extracted and then were clustered by examining their interrelationships. Finally, a categorized list of effective factors in design of urban blocks was developed that can be used as a guideline for the design of this essential element.

2. Urban blocks

The city block is the fundamental element of physical structure of urban areas [4]. The block is primarily a plot of land defined all around by a multitude of planned and unplanned road and streets [5] and defined by an edge and an interior where the edge is directly connected with the street and is understood as the public realm and the interior is a private zone.

Regarding urban form, Moudon indicates four levels of resolution are commonly recognized, corresponding to the "building/lot," the "street/block," the "city," and the "region" [3].

In a parallel way, it was Conzen who recognized the tripartite division of the townscape, the town plan, or ground plan, comprising street, plots, and block plans of buildings [6].

3. The role of blocks in the urban spaces

The urban block must be identified as the most important typological element in the composition of urban spaces [7] because as part of the urban continuum, an urban block is that singular element that is spatially and functionally optimized to support different circumstances of everyday life [7]. Where the urban block is the tool for urban design, the pattern of streets and squares become the result of positioning of the blocks [7]. Also, the size and shape of urban blocks contribute effectively to the formation of the character of the environment [2]. The formation and scope of urban blocks are also effective in determining traffic patterns and visual growth parameters [2].

Additionally, the block faces respond to buildings (the internal load of blocks) and street structure (the external load of blocks). In fact block faces participate in defining the edges and character of the street network; they act as the interface between architectural form and urban form [8].

In fact, the city block facilitates close integration into the surrounding urban structure. It is linked to the network of city streets and building lines, which define it spatially and geometrically. The city block is a continuous closed urban space, accessible from all sides, that ensures the continuity of surrounding structures and exterior urban areas [9].

Therefore, the city block is a spatial system that is extremely complex and flexible and lends itself particularly well to integrating diverse, differentiated modes of behavior, activities, and forms of appropriation [9, p. 22].

4. Thoughts on urban blocks

Urban blocks can be traced in a variety of thoughts, and the concepts and factors derived from ideas of this research about the block can be divided into three

categories: size, dimensions (2D, 3D), and shape; position; and function and meaning. It should be said that each of these categories can have effects on each other, mutually. In the following, spatial qualities which are created by these factors are also discussed. All the factors relate to the urban blocks could be considered in the three categories:

- size, dimensions, and shape;

- position; and

- function and meaning.

4.1 Size, dimensions, and shape

4.1.1 Two-dimensional space

Many studies have focused on the formal aspects of blocks, especially the size and dimensions of urban blocks, often to achieve optimal sizes for them. Krier [7] who compared and studied different sizes of urban blocks suggested that the sizes of blocks should contribute to integration in the context [2]. Vialard [8] states that such ideas seek to restore a human-scale environment where in buildings and blocks interact closely. In general, in this view, large urban blocks tend to get smaller to achieve the optimum size. One of the effective factors in this regard is the determination of the level of privacy and frontage of buildings, which supports concentrated urban centers [4]. This also induces a sense of transition and transfer between public, semipublic, and private spaces [10].

Conzen [11], Bentley [12], and Jacobs [13] advocate small-sized blocks, because they believe that these blocks enhance physical and visual permeability and enhance public awareness of use options. Siksna [4] supports the sustainability and durability of small urban blocks and in research on the desired size of blocks and the design of blocks in four American cities and also considers the durability and sustainability of "small-block cities" as high.

Talen [10] refers to factors such as the internal connection of blocks and their connectivity, which relates to the relationship between the blocks and the street network. It can be said that very large urban blocks affect connectivity [14]. As Scheer and Petkov [15] state that although these large urban blocks, especially those that include large shopping malls, strengthen the external connection of the blocks with their surrounding environment, they are isolated locally from the environment and have weak internal connections. Maitland [16] considers these major shopping centers as the main factor effective in the separation of blocks and streets. In his opinion, those blocks that contain large shopping centers create privacy in the inner space of the block, rather than at the edges, and though they create footpaths, they limit the connection of these paths to the internal space and weaken or interrupt the pedestrian access to the surrounding area. A similar point can be seen in introverted blocks with cul-de-sacs as a type of POD development, because the cul-de-sacs create autonomous and car-dependent spaces that grow apart from other units in the context and are detached socially and physically from the outside world [2]. Song and Knapp [14] also consider the street intersections, the length of cul-de-sacs, the block perimeter, and the residential density of blocks as effective on connectivity between neighborhoods.

It is noteworthy that in the close relationship between the street and the block, these patterns require sustainability to evolve so that initial patterns can survive under conditions of change, so one of the factors affecting sustainability is the block

size. According to Siksna [4] blocks of different sizes can achieve sustainability in block patterns and access networks, but large blocks, although can be largely stable, significantly change the composition of blocks and streets, as if they tend to be disintegrated. Thus, taking into account the corresponding relationship between factors such as the block size, the level and pattern of the access network, and the relationship between them is effective in achieving the desired size. Owens and Southworth [17] state that the street patterns (gridiron, fragmented parallel, wrapped parallel, loops, and cul-de-sac) are effective in creating a variety of urban networks (open and interconnected to closed and discontinuous ones) and believe that changing open and interconnected street patterns into closed and discontinuous ones will separate neighborhoods from their surroundings and thus reduce pedestrian access. According to their study on urban-edge communities, street patterns are related to block sizes (the number of blocks), the degree of connectivity (the number of intersections), and accessibility (the number of access points).

In terms of shape, blocks can take a wide variety of geometric shapes such as triangular, rectangular, square, polygon, ellipse, semicircular, or even circular. However, their main geometric shapes are based on different architectural and urban design frames, design and quality of interior space, and lighting conditions in apartments [9]. Also, "the corners of city blocks can be designed with gaps so that the corner buildings receive adequate light. They can also be completely removed or 'beveled'. Another possibility is creating especially wide or narrow corner buildings" [9, p. 21]. Generally, the geometric shapes of blocks and their corner forms are factors that shape urban block configuration (**Figure 1**).

4.1.2 Three-dimensional space

Talen [10] suggests a minimum distance between the inner space of the block and the street for creating enclosure. In general, enclosure depends on two factors, i.e., the distance between the blocks and the ratio of the block height to the width of the passage. Changes in these proportions and distances resulting from changes in street width, the amount of block setbacks from the edge of the street, and the height of the blocks affect the enclosure of spaces and, in turn, their human scale.
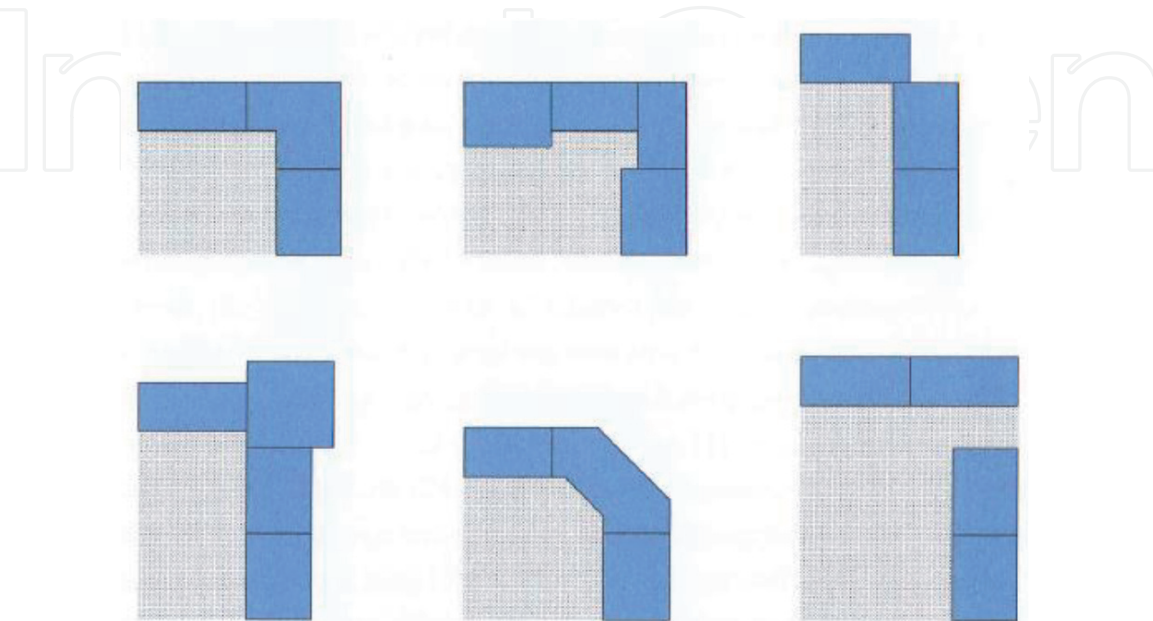
Figure 1.
Samples of block's corner design [9].

Martin and March [18] studied the typology of different physical layouts and systematically compared land occupation by building density and its consequences for land occupation, adequate access, create open spaces, and the possibility to enjoy daylight. Therefore, configuration is important, because you can create different configurations with the same density on the land. On the other hand, segregation of urban blocks also affects their layout.

Berghauser Pont and Haupt [19] developed a matrix called "Spacemate," in which a variety of building layouts fit into a block based on various types of densities. This matrix correlates the area of the block, the area of the open space, the ground floor area, and total floor area with different types of development. In general, as Krier [5] suggests, there must be equilibrium between the open space and the building density.

4.2 Position

Some scholars believe that the layout of the blocks are defined based on internal arrangement of block components, such as Moudon [20] who defines the layout of the blocks according to the location of the buildings and alleys, based on the observations of progressive evolution of block patterns, land plots, and construction patterns in a residential neighborhood around Alamo Square in San Francisco. Also, according to Conzen, plots in blocks can be taken into three forms: [2] back to back, one front to the main street and the front to the alley and two fronts with a common border on the main street. In fact, the location of plots in blocks and the location of blocks relative to each other represent the relative location of each of these elements relative to other elements and how this affects the spatial configuration and layout of blocks.

In the same way, Boffet and Serra [21] investigated the three principles of proximity, similarity, and good continuation of Gestalt theory and used indicators such as the distance between the gravity centers of buildings, and the geometric indices of buildings including orientation, surface, and elongation, to identify spatial structures within urban blocks. Their study can be used to follow Gestalt theory in the study of the spatial structure between blocks or in a super block. On this scale, Gestalt principles such as proximity, similarity, good continuation, symmetry, and enclosure can be used to understand the alignment of blocks in a superblock as a whole, the location of buildings in block, and spatial configuration of urban blocks and also to evaluate indicators such as distance between gravity centers of blocks, geometric shape influenced by orientation, surface, and elongation.

On the other hand, the other scholars examined the block size based on the location and position of blocks. Talen [10] in her book, *City Rules*, and Krier [5] in studies on European cities with organic growth state that often central blocks close to the urban core are smaller, more fine-grained, and more complex, but as we move toward areas with lower population densities and with rural behavior, urban blocks gradually become simpler, larger, and longer, changing ultimately to single units with isolated forms in context [2].

4.3 Function and meaning

Rossi [22] suggests factors such as continuity of the city reinforced by continuity in time, the underlying structure of the city as a basis for development and adaptation to new uses, and consideration of the city as a repository of collective memory that can be achieved through physical continuity of urban form (via layering of buildings and their deployment in larger and existing urban structures) [8].
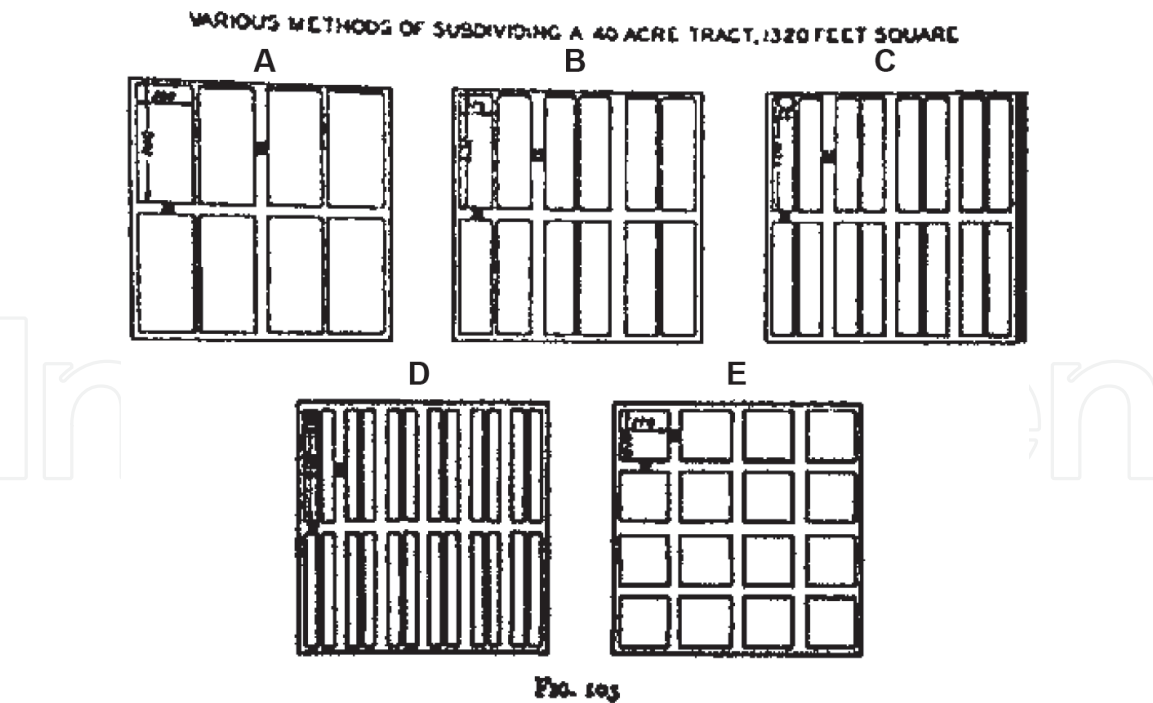
VARIOUS METHODS OF SUBDIVIDING A 40 ACRE TRACT, 1320 FEET SQUARE

A   B   C

D   E

FIG. 103

Figure 2.
Some possible block arrangements for 40 acre tracts. According to Hoyt's analysis (1933, 431), "A" made sense (i.e., would yield the most aggregate value) where "each square foot is of equal importance." "C" the most common arrangement made sense for residential or apartment use; "1" made sense for commercial use since it has the most street frontage, but it is unrealistic because no subdivision would be composed entirely of commercial lots (Hoyt did not comment on the value of arrangements "B" and "E") [10].
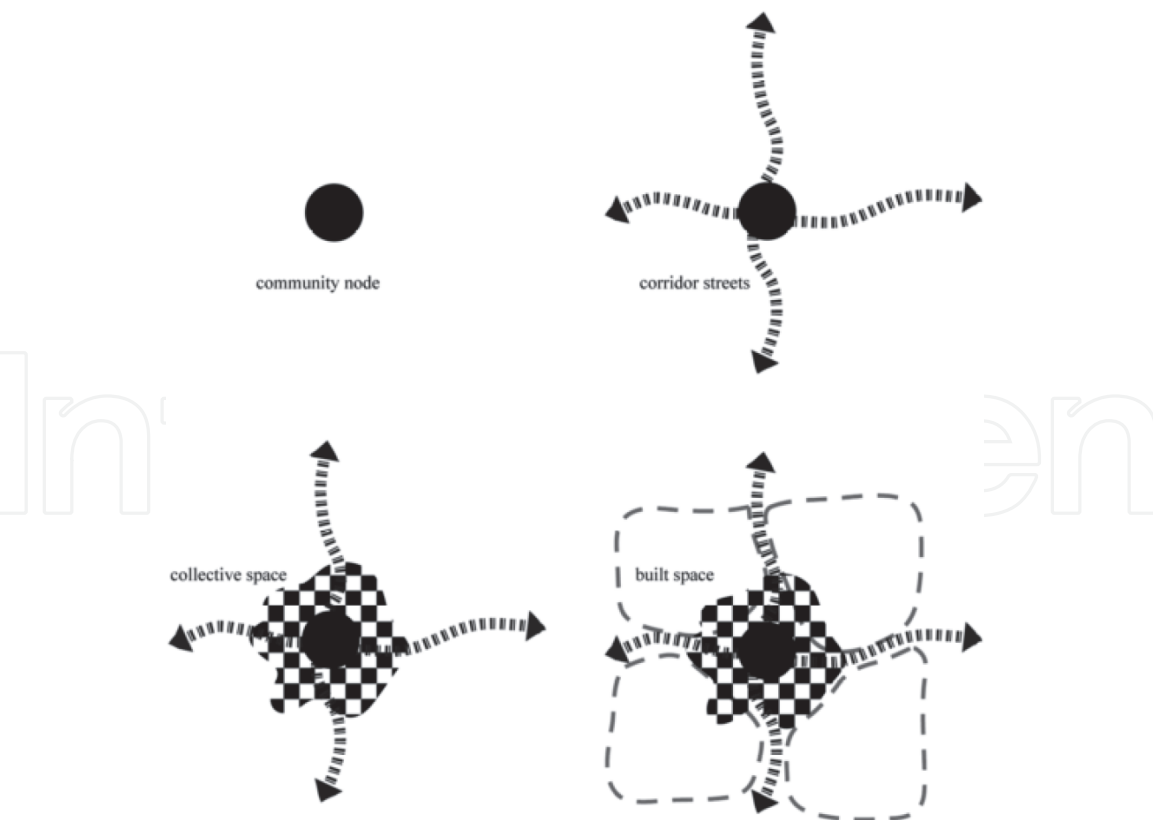

community node   corridor streets

collective space   built space

Figure 3.
The urban process of the community block [23, p. 71].

Regarding visual permeability, Bentley [12] stresses the need for front and rear sides for blocks. The front side faces public spaces for more public functions, and the rear side includes activities that have the highest degree of privacy. In this

regard, a perimeter block type of construction is proposed for blocks that place the private open spaces at the back of the buildings and the public ones in front, distinguishing the internal and external spaces [12].

Hoyt (1933) also refers to a variety of form-based division patterns for urban blocks based on their type of use [10] (**Figure 2**).

Oikonomou [23], in a research, focuses on the design process of urban blocks to create a community block based on environmental sustainability goals (mobility and accessibility, land use, natural environment, resource management, and economic aspects). Investigating layers of an urban block (street, plot, buildings, and open space) is done taking into account factors such as function; ownership; mixed land use; diversity of buildings; types of open spaces and public facilities; spatial domains and observance of hierarchies in private, semiprivate/semipublic, and public spaces; income and social mixing orientation of buildings based on sunlight; and so on (**Figure 3**).

Examining and summarizing different perspectives on each of these variables resulted in determining the effects of each block-based variable on spatial qualities (**Table 1**).

Categories		Variable	Impact
Dimension and size of blocks and shape	2D	Size of blocks	Spatial integration, human scale, enclosure, physical and visual permeability, durability
		Geometric shape of the blocks and their corners	Climate, spatial configuration
		Street pattern	Connectivity, permeability
		The amount of privacy and frontage	Spatial hierarchies, continuity, spatial integration
	3D	Density	Spatial configuration, layout, spatial balance
		Enclosure	Human scale, spatial layout
Position		Arrangement of buildings in the block, the location of the buildings, and alleys	Spatial configuration and layout
		Proximity, similarity, and good continuation	Spatial continuity and integration
Function and meaning		Block subdivision patterns	Configuration
		Land use	Adaptability, durability, variety
		Access	Spatial layout, configuration, connectivity, permeability
		Meaning	Memorability, sustainability, durability

Sources: Adapted from Krier [5, 7]; Talen [10]; Siksna [4]; Conzen [11]; Jacobs [13]; Maitland [16]; Owens and Southworth [17]; Bürklin and Peterek [9]; Rossi [22]; Moudon [20]; Berghauser Pont and Haupt [19, 25].

Table 1.
The spatial qualities affected by the block-based variables.

5. Sorting practical concepts: from macro-concepts to indicators

5.1 Procedure

In this section, the findings of the previous section are used to develop a practical checklist of the most important aspects required for the assessment of urban

blocks. Efforts have been made to extract all these findings in the form of factors without prejudgment and valuation. Since these factors do not have the same semantic and scale levels, the checklist is developed in two main steps:

- first step: the first step is conceptual classification, which is done by connecting factors with similar meanings (**Figure 4**). Here, similar factors are identified and semantically classified into three groups, distinguished from one another by color (**Figure 5**); and

- second step: the second step is the scale classification, which is done by defining the hierarchical relationships among the factors of each category in each of the three conceptual groups (**Figure 6**). Finally, the factors of these groups are placed in three classes, i.e., macro-concepts, concepts, and criteria (**Figure 7**). In addition, to make the assessment checklist more practical, definitions of indicators are included in the agenda. These indicators have been defined according to different views in the literature (**Table 2**).
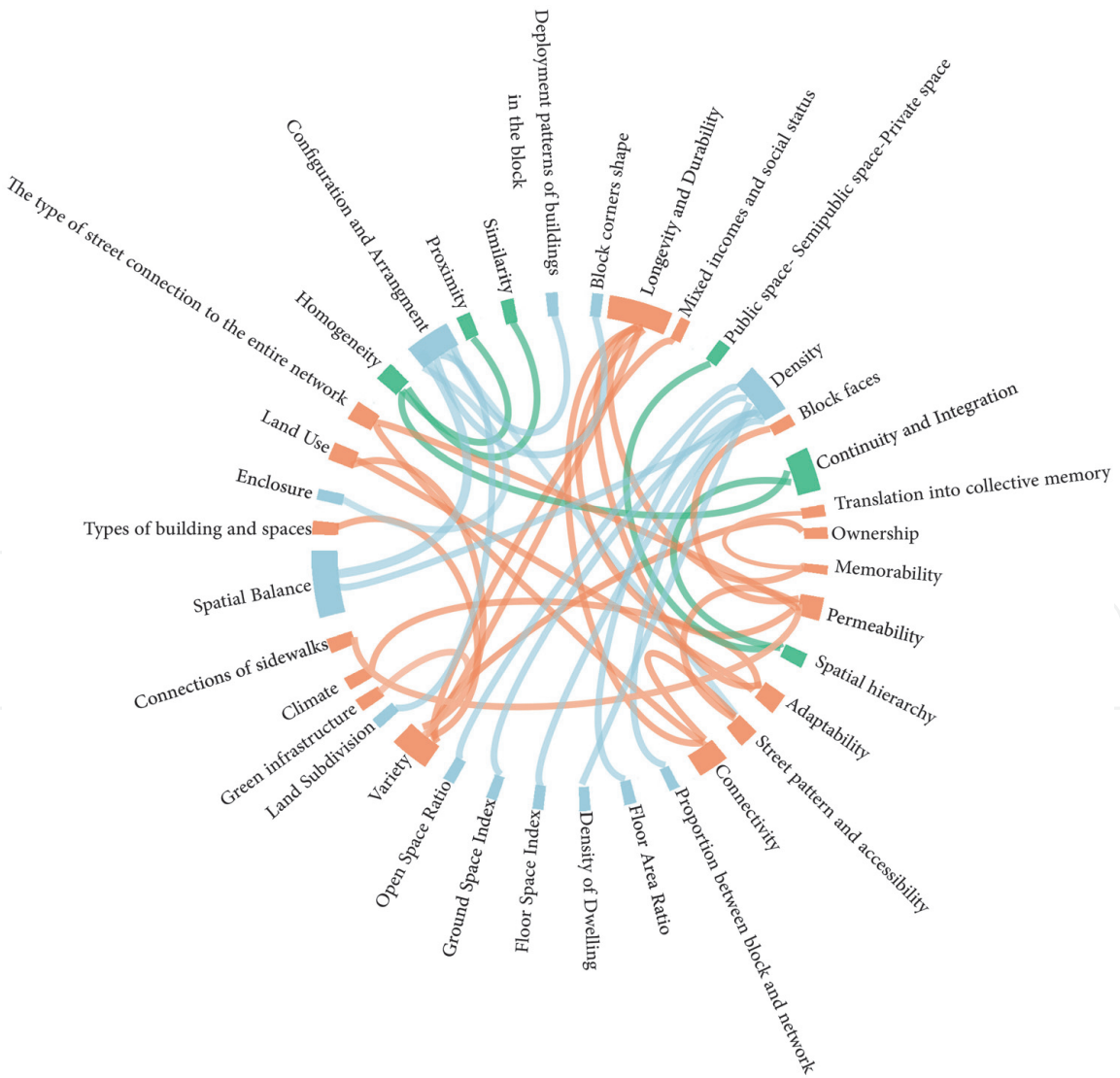

Figure 4.
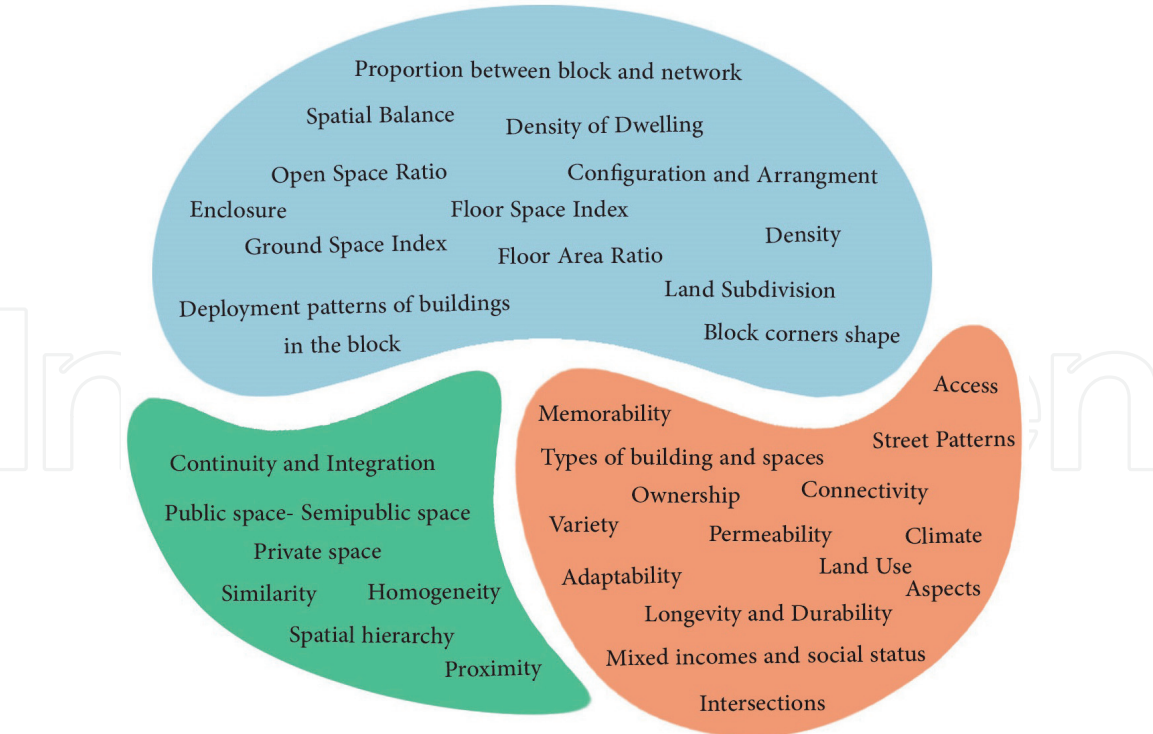*The first step: identifying similar factors and their interconnections.*

Figure 5.
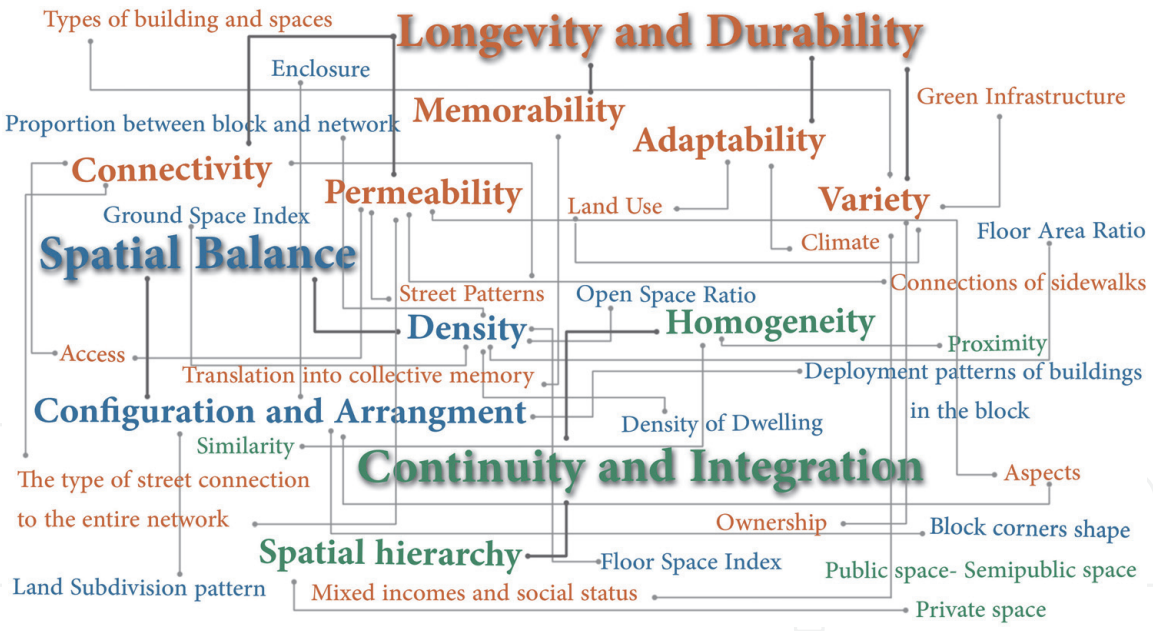*The first step: classifying similar factors into three groups.*

Figure 6.
The second step: hierarchical relationships among the factors of each category in each of the three conceptual groups.

5.2 Definition of concepts

5.2.1 Spatial balance

According to Rowe and Koetter and Krier, spatial balance can be considered as a lasting interaction between mass and space, in which there is a balance between open space and the density of buildings [5].
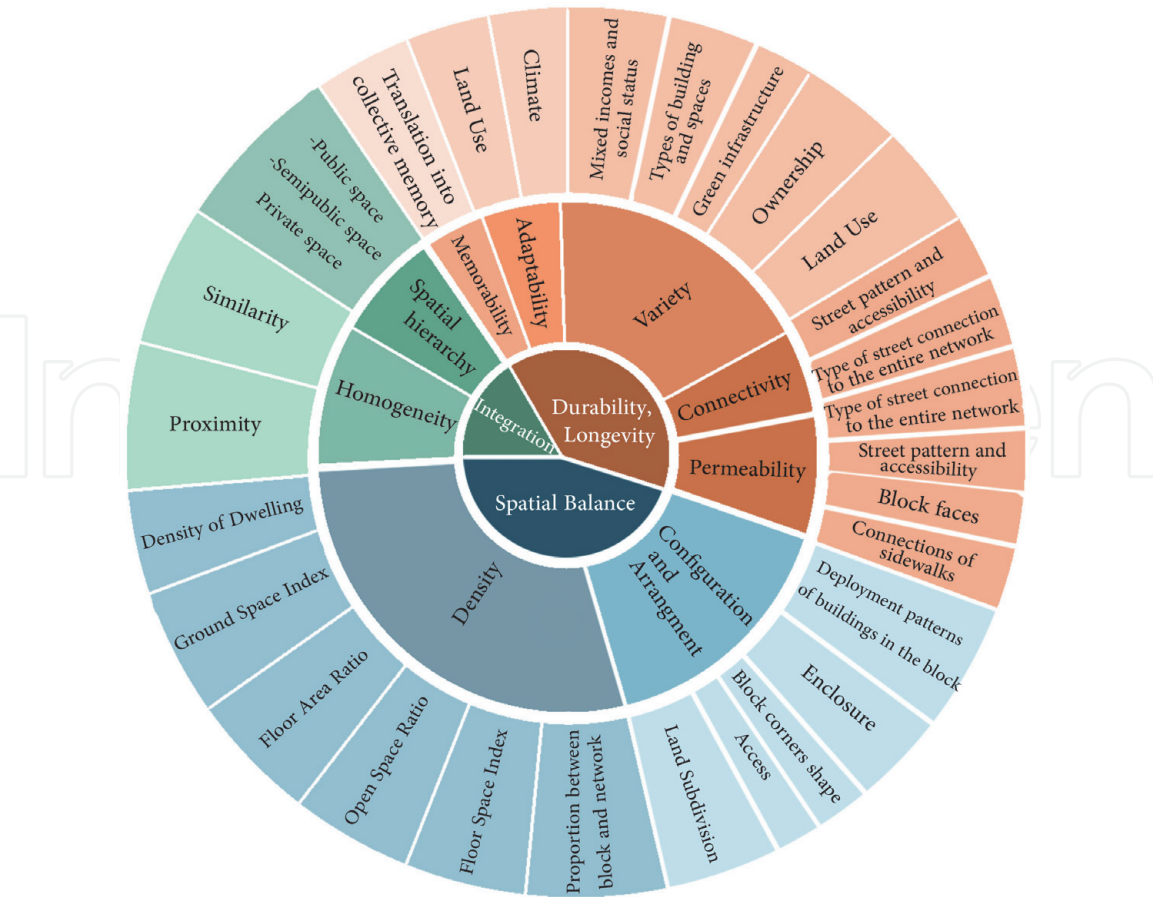
Figure 7.
The second step: grouping factors into three categories and the classification of the factors of each category.

5.2.1.1 Configuration and spatial arrangement

Spatial configuration in architectural and urban studies investigates the relationships among properties of spaces regardless of the assessment of these properties in isolation [24]. Arrangements deal with "where" [10] and are closely related to factors such as dimension and the size of the block and the functions of the buildings in the block [25]. In fact, spatial configuration deals with the way the blocks are arranged next to each other, the configuration of the edge of the blocks [10], and the resulting spatial effects.

5.2.1.2 Density

Martin and March [18] and Berghauser Pont and Haupt [19] define density as land occupation, which is related to the dimensions of the block and the resulting pattern [10] and affects the spatial configuration, though different configurations can be created with the same density. Density has different types including residential density, floor area density, open space density, ground space density, and floor space density.

5.2.2 Continuity and integration

Continuity and integration are manifested in the form and the network. Continuity in form can result from observing the principles of Gestalt theory, such as

Concept	Items	Criteria	Indicators
Spatial balance	Configuration and arrangement	Land subdivision patterns	Geometric shapes of blocks (regular, nonregular)
			Block edge size
		Deployment patterns of buildings in the block	Back to back
			One side to the street
			Two sides to the street
		The form of block corners	Simple, beveled, setback, projected
		Enclosure	The distance among buildings inside the block
			The distance between inside the block and the street
			The distance between the blocks
			The ratio of block height to path width
		Access	The number of access points
	Density	Floor space index	The ratio of total floor area of all stories to the total area of the block
		Open space ratio	The ratio of unbuilt area to the total area of floors (the amount of open space in the block)
		Ground space index	The ratio of plot area (build areas) to the total block area
		Floor area ratio	The ratio of total floor area of stories to the area of the plot
		Density of dwelling	The ratio of the block's population to its residential area
		Block and access network ratio	The ratio of block area to total surface of surrounding streets
Spatial continuity and integration	Spatial hierarchy	Public, semipublic, and private spheres	The amount of frontage of buildings
			Buildings setback distances (distance from the street border and the first line of the plot)
			Definition of block sides (back and front)
	Homogeneity	Similarity	Block orientation
			Block elongation
			Block area
		Proximity	The distances among the blocks' centers of gravity
Longevity and durability	Memorability	Translation into collective memory	The existence of buildings with special semantic dimensions and functions
	Adaptability	Land uses	Investigating the matrix of adaptability of different land uses with each other in a block
			Adaptability between the building and new land uses overtime
		Climate	Deployment and orientation of the blocks based on the sunlight angle
			The distance between the blocks based on the amount of shading

Concept	Items	Criteria	Indicators
	Variety	Mixing of land uses and activities in the block	Checking the activity buffer of kindergartens, schools, libraries, government services, etc.
		The variety of spaces	The amount of squares, recreational and leisure spaces, play grounds, parks, etc.
		The variety of buildings in the block	Different types of buildings, diversity in architectural details
		Income and social status mixing	Combination of independent villas, semi-independent dwellings, apartment buildings, and residential complexes
		Green infrastructure	Green corridors among blocks, vegetation along the streets, green roofs of buildings
		Mixing of ownership	Public and private
	Connectivity	Street pattern and accessibility	The block's area
			The number of intersection
			The number of blocks
			The number of access points
		The type of street connection to the entire network	The number of connections at an intersection
	Permeability	Patterns of streets and accessibility	The blocks' faces
			The length of cul-de-sacs
			The number of blocks
			The number of access points
		The type of street connection to the entire network	The angle of intersection
			The type of street hierarchy (arterial, local, collector, and distributor)
		Connections of sidewalks	Intersection distance
			Intersection density
		Block faces	Back and front

Source: Adapted from: Boffet and Serra [21]; Krier [5, 7]; Carmona [2]; Siksna [4]; Talen [10]; Conzen [11]; Jacobs [13]; Maitland [16]; Song and Knapp [14]; Owens and Southworth [17]; Bürklin and Peterek [9]; Rossi [22]; Moudon [20]; Berghauser Pont and Haupt [19]; Oikonomou [23].

Table 2.
Practical checklist to analyze and design urban blocks.

proximity and similarity, as well as spatial hierarchy in urban spaces. Continuity in the access network is also related to the way pathways are connected to each other [2].

5.2.2.1 Spatial hierarchy

The spatial hierarchy deals with community and privacy. In the transition from public space to private space, at the level of block, frontage of buildings, and in the space between blocks, the block edge plays an important role [10, 26].

5.2.2.2 Homogeneity

The concept of homogeneity here is the same as "the whole" in Gestalt's theory, which belongs to a psychology school dealing with perceptual processes [27]. That is, components in an urban block and the blocks themselves should be put alongside each other in such a way that preserves the nature of blocks and superblocks as a homogeneous whole.

5.2.3 Longevity and durability

Durability of urban blocks can be considered as continuity in time, which, of course, requires understanding the underlying structure of the city [22]. Durability can be achieved formally and functionally. Siksna [5] deems the realization of this aspect as dependent on the durability of the formal pattern of blocks that can survive in the conditions of change.

5.2.3.1 Memorability

Memorability refers to the role of urban blocks in shaping the collective memory [22]. According to Moudon [20], this aspect can be seen in the presence of buildings in a block that have specific semantic dimensions by themselves; examples are public and religious buildings. Sometimes, this is also true for the block itself as a whole, because of the social and functional roles it might have. Memorability is one of the factors that cause durability of the block during the time.

5.2.3.2 Adaptability

Sustainable development in relation to urban form is evaluated by the ability to adapt to changes over time [28]. In the late 1970s, architects and urban designers focused on improving the compatibility of the city's form via various uses and functions [8]. What is considered in this chapter is block adaptability resulting from various functions, as well as attention to the adaptability of uses in new developments as stressed by [22]. Also, there is the issue of climate adaptability, which is related to the arrangement of forms of blocks and factors such as sunlight and shading.

5.2.3.3 Variety

Variety refers to the diversity of functions, forms, individuals, and social groups in urban spaces [12]. The existence of this spatial quality in urban blocks and superblocks transforms them into more flexible urban spaces, resulting in higher durability over time.

5.2.3.4 Connectivity and permeability

The concepts of permeability and connectivity are derived from the relationship between the block and the street. The correct definition of this relationship can add to the durability of these two urban elements (blocks and streets) over time. These concepts primarily refer to how the environment is blocked.

In fact, the distinction between permeability and connectivity becomes clearer in practice. Connectivity refers only to the number of connections between blocks (the number of intersections) and is a quantitative concept, while permeability is defined as the way streets interconnect and depends on criteria such as width of
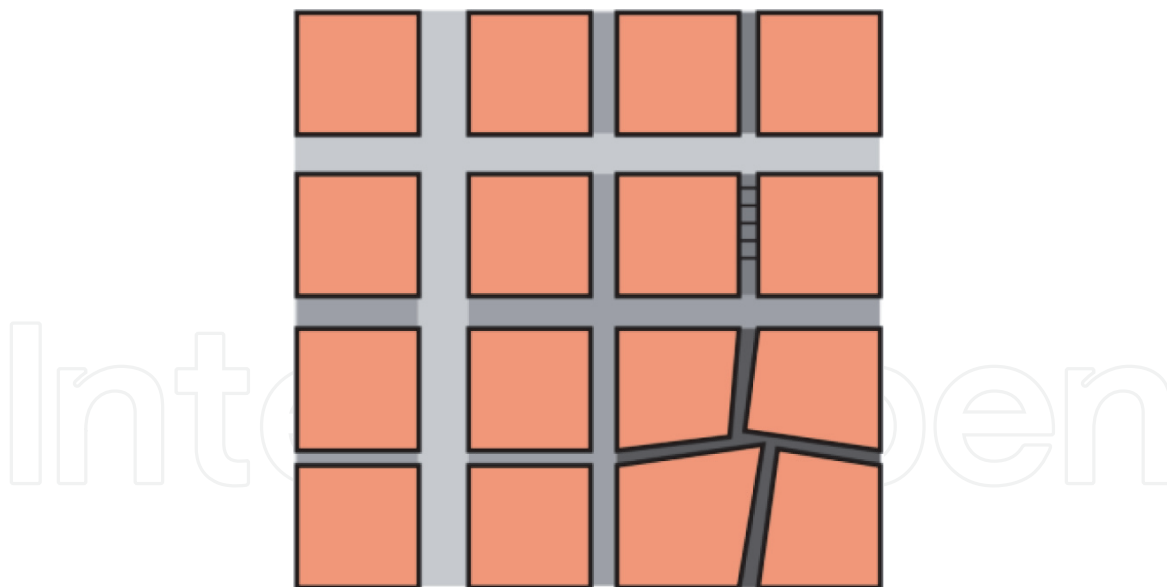
Figure 8.
Distinction between connectivity and permeability: from light gray to dark, streets become less but connectivity remains identical. (source: [29]).

the paths, the access hierarchy, as well as the visual and physical factors that induce a sense of movement (**Figure 8**).

6. Discussion

The checklist is the result of this study, as the first step in this area can be a basis for urban designers to look at urban blocks from a novel viewpoint and provide a suitable basis for the effectiveness of this element in urban design studies. Although this study is the initiator of this endeavor, in future studies it will be possible to develop and complete other factors related to the blocks.

The results show the breadth of the concept of block, hence the complexity of understanding and application of this element in the design of urban spaces, and can develop a comprehensive look at design. Finally, the mediating role of this element can balance other elements of the city.

Spatial balance, continuity and integration, and longevity and durability are macro-concepts of the list that are conceptually and functionally related to other factors and are divided into three categories of concepts, criteria, and indicators. Spatial balance is the relationship between mass and space; therefore, it can include as its subcategories "configuration and arrangement" and density, which are defined in terms of the arrangements of masses in space and the manner in which the space is occupied by masses, respectively. Subsequently, each of these factors subdivides to other factors at a smaller level. If continuity and integration are defined as the existence of the rhythm and order in the form of blocks (at the levels of superblocks, neighborhoods), and the connection in the access network, then it can include the spatial hierarchy (semiprivate, semipublic, and public) and the privacy and homogeneity among the blocks that can be used to create and inter-connect such factors.

We have defined durability as capability to last over time, which can be achieved via qualities such as memorability, adaptability (of land uses and climate), diver-sity, permeability, and connectivity, because memorability transforms the block into collective memory and adaptability helps accepting new or varied land uses for the blocks in their lifetime or adapting to changes made over time, and thus, both

are in the direction of reaching durability. The third quality, i.e., diversity, is a quality of space that changes urban blocks and superblocks into more flexible spaces via the presence of various social groups, mixed uses, and diverse spaces that in turn help them survive over time.

The concepts of permeability and connectivity represent the relationship between the block and the street. These concepts are primarily related to the arrangement of blocks in the environment, so they can be affected by the size of the block, which, in turn, affects the block's durability [4]. Therefore, it can be concluded that the rate of permeability and connectivity affects the longevity and durability of urban blocks.

7. Conclusions

Designing contemporary urban spaces requires form patterns that can be adapted to different aspects and at the same time address social interactions and encounters. This study was carried based on the concern about the status of blocks in the context of urban design and looked for a way to place the block as a focal point in urban design studies. Different concepts derived from different theories and approaches were clustered, and the interconnections among them were reviewed and defined and ultimately formulated in the form of an evaluation checklist. The checklist includes various form relationships that have a bearing on the social aspects of urban space. It has the potential to be used in the future as a framework for analyzing existing urban blocks and finding their problems in future studies, as well as for structuring new designs, taking into account context characteristics.

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