

Spatial Organization Characteristics and Their Impact on Determining the Strategies for the Reconstruction of the Old City of Mosul (Legibility in the District of al-Jami' al-Nuri al-Kabir as a Model)



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ABSTRACT

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Nowadays, the old city of Mosul is witnessing large urban movements aiming at reconstructing the traditional city after the destruction it suffered during the war against ISIS. So to come up with suitable suggestions and solutions for the urban renewal of the city of Mosul in a way that maintains the morphology of the old city, and hence, preserving its urban and cultural legacy, This paper investigated the organizational aspects of Mosul's old city, " al-Jami' al-Nuri al-Kabir " area in particular. As, the degree of legibility, area of integration, segregation and degrees of connectivity were determined using space syntax. The practical part of the study included the spatial system of the area, which was analyzed using ArcView 3.3 software. As a result, the research determined high integration, segregation, connectivity, weak control, degree of legibility of the city in general, and the factors affecting it. The research came out with a set of conclusions and recommendations that are recommended to be taken in the rehabilitation of the archaeological buildings and their neighborhood in the region. Where the research came out with a set of conclusions and recommendations that are recommended to be taken in the rehabilitation of the archaeological buildings and their neighborhood in the region. the research recommends studying the overall spatial structure of the city in order to give way for sound design judgments that help maintain the original physical aspects of the city and stop morphological alterations to the city.

1. INTRODUCTION

The interest in rebuilding the old city of Mosul has increased, especially after the destruction it suffered in recent years as a result of the war against ISIS. As a result, there have been many trends regarding the reconstruction of the old area. Some called for the city's restoration as it was, while others focused on historical monuments, and opinions were calling for renewal and change. Due to the importance of such historic areas, studies are being conducted to renovate the elementary part of the city, including old houses, mosques, churches, inns, cabins, archways, ornaments, among others. Given the importance of the Great Mosque area, especially after the competition put forward by UNESCO for the reconstruction of the Great Mosque and the surrounding area, the research tried to focus on the spatial structure of this area.

To be able to study the systemic characteristics of the city, a study of the degree of legibility of the old city must be conducted to be able to put forward strategies that enable us to deal with the morphology of the old city, so as to enable us to preserve its spatial foundations, enhance the strong points and treating weak points. As such, looking closely into the most legible areas, most connected or most segregated areas help determine future plans to preserve the characteristics of the old city and turn it into a place of central attraction, especially that the design planning of the old city has proven to be sustainable on the general planning level and the building design level.

A study of the legibility degrees and areas of high

integration, segregation, control and connectivity will be conducted in the current paper to determine and establish for further accurate studies contributing to the city's development while maintaining its historic elements at the same time. Therefore, the concept of legibility, factors affecting it, and application of this concept will be described first in this paper.

2. LEGIBILITY

Lynch defines legibility as the understanding of the parts of the city and the organization of the mental image based upon a cohesive model. A legible environment is understood visually as a series of interrelated symbols [1]. According to Lynch, imageability is the physical aspects of the environment that give a high probability for the receiver to bring about an excellent mental image. These aspects could be related to (shape, colour, organization), and thus give a vital and active definition to the five basic elements of a city (paths, nodes, districts, landmarks and edges) and shape it as a highly legible image in the mind of the receiver [1]. Lynch has also defined pathfinding as the perceptual process that represents the environmental image individuals form to envisage the outside physical world, as a clear environmental image enables individuals to move easily and quickly through it [2]. On his part, Bently defined legibility as the degree of choice that a place offers. This legibility depends on the perception of the individuals and their understanding of the borders of this

particular place. According to him, legibility is one of the aspects of a good environment [3]. On the other hand, Hillier defines legibility in spatial organization as "what is seen through spaces shaping the system" (the number of spaces connected with it). A clear system is one where all the spaces with good connectivity are also appropriately integrated. While an unclear system is the one where spaces with good connectivity are badly integrated, what is seen through a non-integrated space disrupts the state of that particular space and the system as a whole [4]. Woodcock sees that legibility can be achieved through coherence, where a clear environment can be accessed through well-structured and integrated points [5]. In contrast, Mashed defines legibility as a logically connected structure of important visual urban elements. He adds that interaction between landmarks and the way paths are formed is one of the main elements determining an urban environment's legibility [6].

3. FACTORS AFFECTING LEGIBILITY

3.1 Spatial direction

It can be defined as the ability of the individual to pinpoint his location in a physical surrounding by way of an image formed in his mind and the means needed to reach the desired location successfully. The directional ability is the process that enables an individual to connect the mental maps with the spatial environment [7].

3.2 Concepts related to the direction

Direction is usually defined as the individual's discovery or knowledge of his whereabouts in time and space [7], and Individuals are able to find their way through an environment by using information connected with the definition of the location, as the usage of this information affects the way it is organized, thus wayfinding represents the ability of the individual to reach a place inside an environment by using a piece of information and neglecting any other information that is not needed.

3.3 Mental representation

It is divided into two types:

(1) Internal representation: It constitutes sensing information from an environment, and inputting this information to the mind to be mentally processed, stored, labelled and classified Through two processes, Sensibility and perception. where Sensibility is the process of getting information from an environment within a set limit of time. although individuals are equal in their sensitivity objects, differences occur after the sensibility process; as individuals sense relationships connected with the objects more than the objects themselves. On the other hand, perception is the process of gaining, storing and organization of information in a way that ensures ease of access and forming specific concepts related to said information [8]. The concept of perception is usually used to describe how people perceive, structure and learn their environment. Perception is affected by several factors in the environment such as experience, noticeable differences, and movement [9], in addition to other factors specific to the user like social factors [5].

(2) External Mental Representation: It is the formation of

the mental map, which goes through two stages. the first stage calls Environmental image, Lynch defines an environmental image as the product of a two-way process between the beholder and the environment; an environment introduces relationships and differences, whereas a beholder chooses, organizes and gives meaning to what he is seeing. The second stage is Mental schemata, it represents the linking point between sensitivity and perceptions and the direction of sensual processes, responses and interactions. as individuals use it to organized behaviour, past and present experiences, and predict future behavior [10]. While Mental maps help individuals utilize the environment, sketch maps represent the stage in which map is converted into schemes. The study of these schemes is vital to determining individuals' understanding of the environment surrounding them.

4. ASPECTS OF SPACE ELEMENTS AFFECTING LEGIBILITY

4.1 Characteristics of a space

Bently indicates that apparent differences of spaces significantly affect the explanation individuals form towards places, as individuals determine places by giving them specific associations, and when these associations support behavioural responses of these individuals, perceived places achieve visual feasibility. The most important differences are:

(1) Space shape and proportion: The shape of the spatial area is one of the variables affecting sensual and visual perception, as variation in space shape and the ratio of its profile in subsequent visuals help balance sensual information. The utilization of this variation as a visual indicator contributes to the directional process. The shape is the collection of the aspects of (size, direction, measurement), so variation in their aspects may form important attraction points.

(2) Enclosure (closeness, openness): Inclusion on the vertical and horizontal levels is one of the aspects of shape that may achieve legibility. The height determines the inclusion of dynamic pathways to width ratio, determining the closeness or openness space [11].

4.2 Connection with other spaces

(1) Generality: It is the social location of space with a general context. There are two types of social spaces: Saciopetal and Sacifugal [12]. According to Bently, if all places had direct physical accessibility or even visual accessibly, then privacy cannot be achieved for any space. Therefore, accessibility should separate public and private, since it is an important source of contention and choice [2].

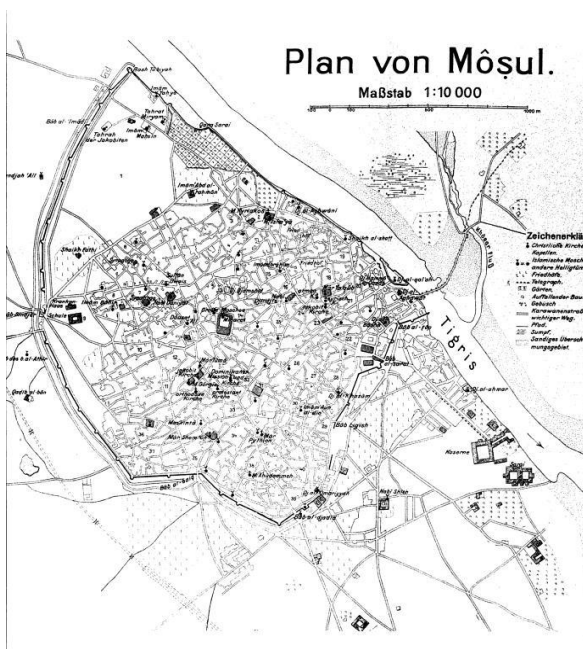
(2) Systems of global movement: They can be understood as the perceived pathways connecting spaces. These systems include direction of pathways, sequence of spaces, pathway relationships, edges, intersections, nodes, pathway endings, and the shape of dynamic space. Pathway intersections always represent the points in which individuals must make decision-making during their movements. The scale of any pathway in any intersection determines the importance of the space that leads that to it. When all pathways are equal at the intersection point, enough space must be made so that individuals can stop and direct themselves, as the difference between pathways and organizations may be used as a visual indication [11].

(3) Alternative paths: Rapoport dealt with the effects of alternate paths in the comprehension of the environment by adopting two hypotheses: The first one confirmed that good accessibility is gained through practical discovery by knowledge of the system based upon vital focal points which reduce alternative paths. while the second explained the possibility of Utilization of all main and possible paths, with the best path chosen according to the time is taken, which means that explorative behaviour is done later on. Explorative behaviour is a constant factor that is based upon several possible paths where People change their paths with time or according to the meaning and aspects of these paths.

(4) Accessibility: Ankerl indicated two evaluations for accessibility: Relational and Powerful. He also distinguished between direct arrival (where an individual moves from one space to another without passing through other spaces, which would require a physical overpass), and indirect arrival [13]. Furthermore, Bently asserts that place evaluation affects choices made by individuals concerning places they go to and places that they are able to go to, which is called "infiltration", i.e. the number of possible paths leading to all parts of an environment [3].

5. OLD MOSUL CITY

The city of Mosul is one of the greatest and oldest cities of Iraq, which has undergone constant development since pre Islamic time, the Assyrian times and Islamic time. Mosul was strategically established in 612 B.C. as a small fortress on "Al-Klea'at" Hill on the right-side bank of the Tigris River. This location was the epicenter of commerce and military affairs as it was the focal center of ancient civilization. the scheme of Mosul has undergone numerous changes according to the city's environmental, managerial, social and military conditions, with mosques being the center point of these changes [14]. Mosul is usually nicknamed "Al-Hadba'a" (the Curved) due to curviness of the Tigris River and the curviness of the Hadba'a Minaret of the Great al-Nuri Mosque Figure 1.

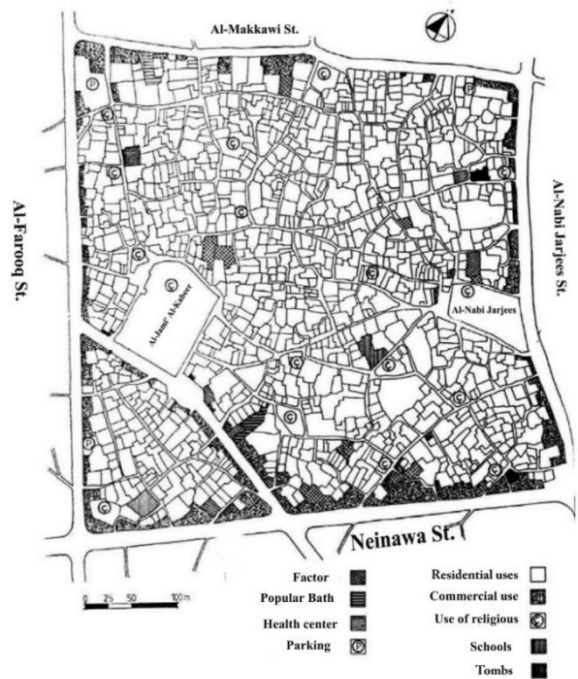


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Figure 1. City of old Mosul

5.1 Al-Jami' al-Nuri al-Kabir area

It is an urban area surrounded by four main streets; Al-Makkawi St. from the north, Al-Nabi Jarjees St. from the east, Al-Farooq St. from the west and Nineveh St. from the south, including 12 residential blocks. The Great Mosque of al-Nuri, locally known as 'Al-Jami' Al-Kabir', is the second largest mosque of the old Mosul, which was built by Noor Al-Din Zenki in (566 A.H.-1170 A.D.), with a length of (65 meters) and a width of (17 meters) Figure 2. Al Nuri Mosque lies in the center of Mosul's old city. The " al-Jami' al-Nuri al-Kabir " area is 25 hectares overall, including 1130 neighborhoods.



General Directorate of Urban Planning-Mosul

Figure 2. Map of Al-Jami' al-Nuri al-Kabir area

6. METHOD

The most recent studies have started to focus on renovation and renewal of Mosul's old city while preserving its historic characteristics and maintaining its formal architectural aspects. Accordingly, the current study will focus on investigating the systemic aspects of part of the old city (al-Jami' al-Nuri al-Kabir) "The Great Mosque" in order to determine the legibility of the area and to put forward a complete study on how to renovate the city while preserving its systemic aspects, as well as determining places most suitable for the addition of new activities, such as turning old houses into museums, in addition to increasing the legibility of other areas depending on treatment of optical characteristics, such as adding landmarks or dependence on depth diversification - an aspect of old alleyways.

6.1 Description and analysis of space system of an area

Hillier asserts that to understand a city one must understand its material shape, or rather its spatial shape. The material shape can only be understood after understanding imbedded basis of that shape. As for Islamic cities, their spatial structures

have basic rules that put together the final shape of the city. By examining space syntax studies, the relationship between aspects of two types of organization; urban organization and visual organization, will be determined.

6.1.1 Basic measurement maps

Earlier studies of principles of space structure mainly depended on axial map as main schemes to conduct structural measurements, as central schemes represent the organization of urban spaces as visual dynamic steps which in turn depend on a basic unit, the axial line, which in turn represent the maximum visibility value, and the direct motion of any point within the urban space in one dimension [15].

6.1.2 Measurement of structural characteristics of space syntax

Studies of space syntax define a number of organizational aspects of relations between elements of spatial organization according to two structural characteristics:

(1) symmetry- asymmetry: it is a basic structural characteristic that a space gains when there is a direct relation with other spaces. As such, a space is symmetrical when there is a direct relationship, otherwise the space will be asymmetrical.

(2) Distributedness - non Distributedness: a structural characteristic of spatial organization, which is expressed through relationships between spaces; a space is Distributedness when there is more than one path connecting it with other spaces, while a space is not Distributedness when there is only one path leading to this space.

6.1.3 Local & global measurement

Studies of space syntax often produce an approach of structural analysis of relationships between elements of a spatial organization on two levels (local, global). Structural aspects of an element within dynamic organization are measured according to the following standards:

(1) Local Measurement

The connectivity of a space within a visual organization or dynamic organization map is measured from the total spaces connected or intercepted with that particular space, i.e. spaces that are one step away from it. Connectivity represents the range of available choices to move directly from one space to other neighbouring spaces.

b- Local Control: is represented by the range of alternative paths provided by a space to reach it from other neighbouring spaces. Local control is measured within the visual or dynamic map from the total reverse connections with neighbouring spaces [15].

(2) global Measurement

A- Integration: integration of a space expresses its relative asymmetry within the spatial system. Relative asymmetry is achieved through deep relationships of a spatial system with other spatial systems. Degree of space integration indicates the range of accessibility from other spaces to this particular space [16].

6.2 Determination of structural and legible cores

(1) Integration core: it expresses the distribution of the highest integration values for (10-25%) of total number of spaces of a system (lowest asymmetry values RRA).

(2) Segregation core: expresses the distribution of the lowest integration values for (10-25%) of total number of spaces of a system (highest asymmetry values),

6.3 Measurement of legibility

Expresses the relationship between connective local values with inclusive integration values of spaces within a system. Thus, legibility is measured using Pearson coefficient for reciprocal relationship. Theoretically, value of legibility ranges between (+1, -1), with the highest values indicating high degree of legibility. The application of this standard indicates the ability to predict the importance of integration of a space to direct a motion depending on simultaneous sensitivity of visually available information with that space.

7. PRACTICAL PART

Space syntax principle was used to determine the systemic aspects and legibility of the area under study. For this end, an axial scheme of the area Figure 3 maps and ArcView 3.3 software, which is one of the software associated with GIS system providing high capability in obtaining spatial data of urban areas, were used.

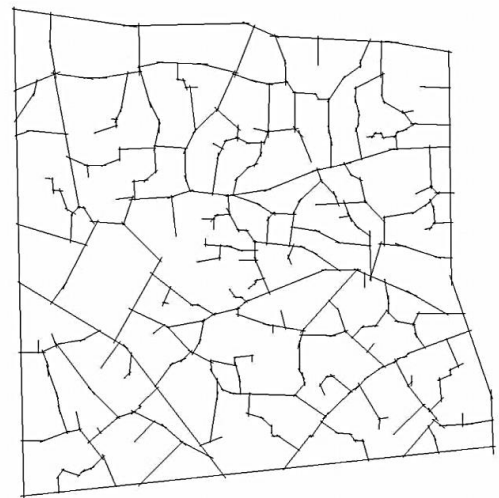


Figure 3. Axial scheme of the study area

7.1 Results

Firstly, the following results have been found:

(1) Values of connectivity ranged between 1-10 with a normative deviation of 1.95634 and values of 2,3,4 were the most frequent. See Figure 4.

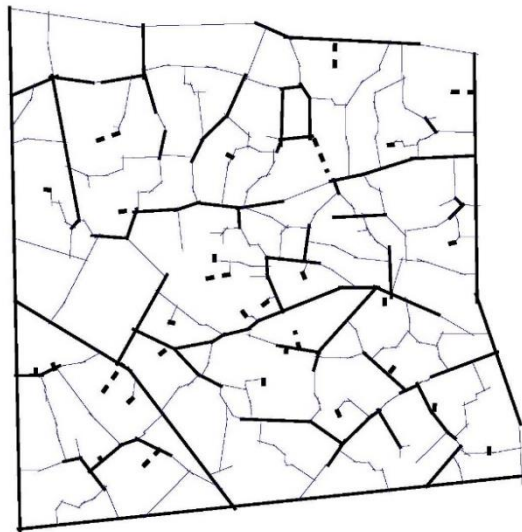
(2) Values of local control ranged between 0.125-3.50397 with a normative deviation of 0.5333 Figure 5.

(3) Values of integration of system spaces ranged between 0.45250-1.173460, with a normative deviation of 0.126308 Figure 6.

(4) The value of integration-3 ranged between 0.210930-3.869150, with a normative deviation of 0.590061 Figure 7.

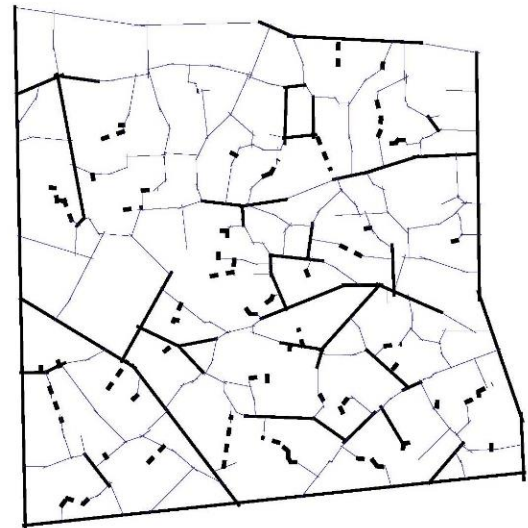
(5) Spatial depth values ranged between 2240-5223, with a normative deviation of 505.55.

(6) Degree of legibility of area amounted to 0.422402 with a significant level of 0.01.



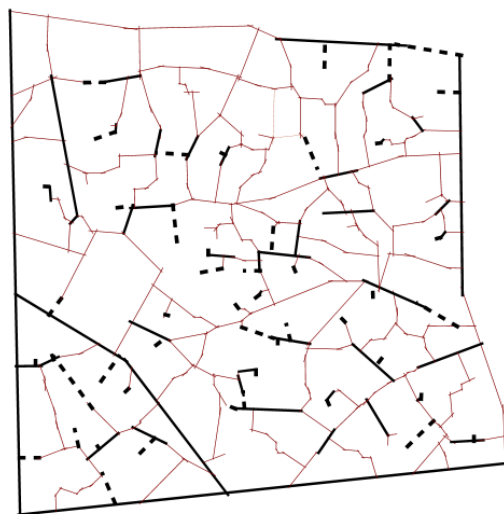
— Connectivity Strong core
 - - - - Connectivity Weak core

Figure 4. Values of connectivity



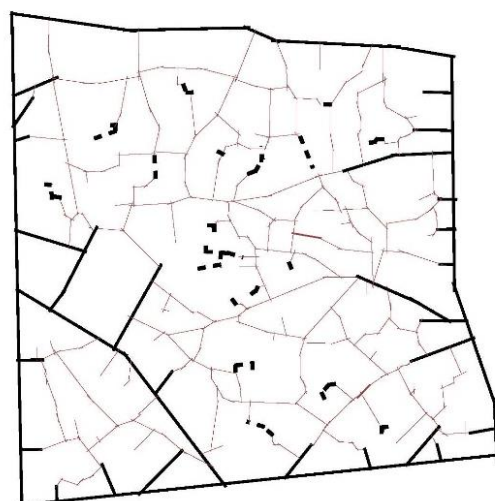
— Strong integration-3 core
 - - - - Weak integration-3 core

Figure 7. Values of integration-3 core



— Strong control core
 - - - - Weak control core

Figure 5. Values of local control



— Strong integration core
 - - - - Weak integration core

Figure 6. Values of integration core

Through the aforementioned results, the following have been concluded:

- Spaces with high connectivity were concentrated in spaces with high activities, which included mosques such as al-Jami' al-Nuri al-Kabir, public baths, schools and stores; while spaces with low connectivity mostly included residential areas. Figure 4 shows areas with high and low connectivity.

- Strong control core was concentrated around the area, in space of high activity such as mosques and baths, while low control core mostly consisted of inner residential areas, endings of alleyways. Figure 5 shows areas of strong and weak control core.

- High integration levels were concentrated in the outskirts of the area, with the center representing a deep and hardly-accessible segregated core, save for some gaps. Areas such as in al-Jami' al-Nuri al-Kabir contain high integration levels. Figure 6 shows areas of high integration and segregation.

8. CONCLUSIONS

(1) Results show that the existence of landmarks in spaces with high control and connectivity, such as the area of al-Jami' al-Nuri al-Kabir, gives such areas a high degree of legibility, which leads to the comprehension of the universal structure of the system. So, it is necessary to focus on the addition of landmarks in the process of developing the old parts of the city because such landmarks give its areas distinct identity (such as Al-Hadba' Minaret, archways) and make distinction among old areas, which, in turn, makes the areas more legible.

(2) Spaces with high connectivity give buildings within its premise a great significance due to the high degree of choice provided by these spaces. Therefore, attention should be focused on the areas lying within spaces with high connectivity by adding social activities in these areas while catering for the historic aspect (such as turning old houses into museums or restaurants with a historic nature, etc.).

(3) Areas with high degree of integration give high degree of significance for a landmark. So, when suggesting

design schemes, areas with high integration should be the main focus, and they should also be turned into a touristic attraction area (by adding architectural elements such as archways and cabins, with which the identity of an area can be expressed). It is preferred that areas with low degree of integration remain as residential areas while preserving their traditional nature, thus avoiding design schemes that change the morphology of the old city.

(4) Spaces with strong structural cores are highly public areas within the spatial system. Conversely, spaces with weak structural cores are more private. As such, it is preferred that residential buildings are contained in spaces with weak structural core due to their high degree of segregation. On the other hand, areas with strong structural cores should have more social activities.

(5) Since spaces with high degree of integration within the old city are less inclusive spaces, then focus should be on transforming these areas into public places and touristic attraction spots while keeping more inclusive strictly to residential areas, as wide areas help attract users and make an area more public.

(6) If there is need to focus on a particular area or building, landmarks and diversity in the area's alleyways could be utilized to increase legibility of the target area or buildings. In other words, optical aspects of an area are used without tampering with the morphological structure of the city.

(7) Keeping the old part of the city a pedestrian area only. Only streets that were opened in past years should be kept, and car parks should be built outside the old area to preserve its historic beauty and structure, as any breach could negatively impact the traditional structure of the city, which may cause the city to lose its traditional aesthetic and design features.

(8) In addition to giving increased degree of legibility, tightness and extension of alleyways also play significant role in creating a healthy environment as sheds protect pedestrians from sun heat. In addition, gradation in the width of alleyways generates refreshing breezes of air, and so rises the importance of preserving the spatial and morphological aspects of the old city due to their eco-friendly aspects.

- Low degree of legibility for the old city of Mosul is due to the social nature of this city and the fact that it is basically a residential area where the buildings are directed inward. It is noticed that legibility increases in areas of public use such as mosques and stores which are concentrated at the edges of areas. Therefore, it is important to respect the privacy of the city and preserve its traditional legacy. Areas with high degree of legibility can be utilized to create high-active places that increase legibility of a said area and, at the same time, maintain privacy of residential areas.

(9) Since Mosul's old city is currently undergoing rehabilitation and reconstruction operations, the research recommends studying the overall spatial structure of the city in order to give way for sound design judgments that help maintain the original physical aspects of the city and stop morphological alterations to the city. In addition, unfamiliar elements and structures to the city (such as the addition of open green spaces) should not be forced because they will change the traditional structure of the city, which is based on the compact design to suit the climate and social conditions. This, in fact, makes the traditional design an eco-friendly one as the

diversification in the width of its alleyways and openness to squares generates healthy environment, and any change in this design will lead to adverse results. Also, renovated buildings in the city should be used to create new activities so that the city maintains its traditional aspects without the need to force new and unfamiliar buildings to the city that could result in the loss of its old part.

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