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Research Paper

Evaluating the Placing Pattern of Green Squares in the Realization of the Biophilic City (Savannah, USA; and Hamedan, Iran)

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Abstract
Urban squares reflect urban planning cultures, and also to some extent even a reflection of overall nations' cultures. Squares are microcosms of urban life, offering excitement and repose, markets and public ceremonies, and a place to meet friends and watch the world go by. They have been shaped by popular whims, topography, and architectural fashion. Some grew piecemeal; others were planned at a stroke, as a symbol of power or the foundation stone of a new development. In this study, efforts were made to compare two selected cases from two different cultures, West vs. East; and Savanna, Georgia, USA vs. Hamadan, Iran. In this comparison, the indicators of the biophilic city (pedestrian, nature-friendly, accessible, and sociable city) have been considered. The descriptive analytical method was used to collect and classify the indicators and the space syntax theory was used to analyze and compare the placing pattern of squares in urban contexts. The method of data collection was a library and field survey, and the data analysis tool was UCL Depthmap software. The study of the biophilic city in the two studied cities revealed differences and similarities that are effective in increasing theoretical understanding, recognizing anomalies, and understanding how indicators work in these two different urban structures and contexts.

Keywords: *Green square, Biophilic city, Space syntax, Savannah, Hamedan.*

1. INTRODUCTION

Urban squares are a reflection of urban planning cultures, if not necessarily a reflection of the overall nation's culture. The interesting cases of London vs. Berlin are good examples to be described here. London's residential estates with their garden squares had been admired by many. Continental, particularly German, visitors not only admired them but demanded the transfer of this form *rus in urbe*[1] to their own cities. They wanted it as an 'urban quiet public green square for taking a rest. They wanted a public space to be planned and realized by a public authority and to be used by the general public. (Fehl, 2011). Public squares have always been a vibrant part of urban life. They have played different roles as public spaces in different places and at different times. Michael Kimmelman (2016), says what's important about a square is that it acts like a magnet, drawing people in. Unlike a park, where people go to retreat, a square is all about mingling with a crowd, it's like a living organism in the heart of a city. "For me a square is about a notion that we have of what an urban life can be and why we go to cities, what we look for in cities," Kimmelman (2016) says "and it has to do with a sense of community, a sense of shared values, a sense of greater possibilities and a sense of humanity" (Marron, 2016).

On the other hand, biophilic cities have abundant open spaces based on green spaces in public arenas that provide the opportunity for people to interact and meet with each other in nature. In these cities, there is a high percentage of pedestrian spaces, cultural and historical places related to nature, diversity of uses and

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permeability in the structure and texture of the city. In this study, to evaluate the pattern of green squares in the realization of the biophilic city, two historical cities that are famous for their urban structure and the way of their green squares have been selected to be compared in terms of responding to the biophilic city criteria. The research question of the study is: What are the differences and similarities in the pattern of green squares in the two studied cities in terms of biophilic urban planning manifestations? The hypothesis is that the appearance of the biophilic city in the two studied cities reveals differences and similarities that can be effective in increasing theoretical understanding, recognizing anomalies and understanding how indicators work in two different urban structures and contexts.

Today, the biophilic approach has become an interesting topic for turning soulless urban environments into attractive and exciting environments due to the attention to planning and redesigning existing urban parts and reproducing urban centers. Therefore, knowing the solutions as well as examining the experiences of cities with a historical background that have been successful in this field can be effective for planning to improve the performance and efficiency of contemporary cities as well as planning new cities. Finding aspects of the relationship between the ways of formation and evolution of the physical and social structures of two historical cities with two completely different contexts has been an important motivation for conducting the present research that the results of which can provide solutions to achieve a biophilic city regardless of climatic and cultural differences.

The purpose of the research is to investigate the differences and similarities in the pattern of green squares placement in the two studied cities in terms of biophilic urban planning impression to identify the functioning of biophilic indicators in two different urban structures and contexts while increasing theoretical understanding. The methodology includes a comparative study based on the theoretical framework related to biophilic city indicators and the historical background of both cities as well as software analysis.

The sophistication of the work is that the significant cultural, social, historical, and climatic differences between these two cities may be considered an obstacle to a meaningful comparison. However, the existence of many similarities in the physical structure of the city and the location of urban squares and how they are related to the functional structure and the access network provide important and thought-provoking results which will help to develop an urban planning perspective.

2. MATERIALS AND METHODS

In this research, the descriptive analytical method has been used to deduce the indicators of a biophilic city and the logical reasoning method has been used to study the indicators in urban structures. The method of data collection is library and field survey. The data analysis tool is UCL Depthmap software. The strategy of comparative analysis and comparison has also been used to evaluate urban structures in terms of biophilic criteria. As Durkheim (1982, as cited in Kantor & Savitch, 2005) suggests, only by comparing and measuring relationships we can achieve greater certainty. There are other reasons why comparison enables scholars to clarify and better explain phenomena. First, because comparison more precisely shows how variables work differently in a variety of settings; second, because comparison affords us a better chance to understand how the discovery of anomalies within different social systems can be refined and ultimately enhance theoretical understanding; and third, because comparison provides contrast models that point up crucial distinctions within a given set of findings. Few studies have moved across national boundaries. Most often studies that do venture across different national terrains limit their analysis to Anglo/American comparisons. In this study, efforts were made to, probably for the first time, compare two selected cases from two different cultures, Savanna, Georgia, USA; and Hamadan, Iran. No doubt, there are considerable problems associated with developing such a comparative agenda. Significant differences between the two could be construed as a major obstacle to a meaningful comparison. However, in spite of those differences, there are some similarities that make it very useful for the purpose of this study.

2.1. Selecting Cases

Why these two cities? There are several important similarities, in spite of significant differences, between these two cities. Similarities are planned cities, historical aspects, historic districts, their size, the existence of several vibrant squares, the existence of significant monuments, major role squares play in the city plan, structure and functions, preservation area/buildings, tourist-oriented, and socializing. Differences are autocratic planning and design in the case of Hamadan, and semi-democratic in the case of Savannah, different climates, different cultures and behavior patterns, different development stages, and the role of motor-vehicle traffic. However, the dominance of similarities against the differences is a

plausible justification to select these two cities for comparative analysis of urban squares.

2.2. Data Analysis Method

To study biophilic criteria in the pattern of green squares, based on the method of space syntax, first, the biophilic city indicators were classified. Then, to evaluate these categories extracted from the research literature, the related indicators in space syntax theory were used. Finally, 4 final indicators in the biophilic theory resulting from the classification of categories with the help of 4 indicators of space syntax theory were used in the comparative evaluation of the studied urban structures. "Spatial hierarchy and complexity in the same order" was examined using the "depth" index. The "sociability" of green squares was assessed using the "space traffic" index. "Access to green squares" through "connectivity" was studied and the "integrity of the green squares network" was analyzed through the "integration" index. Evaluating the placing pattern of squares in two scales (the core of the city construction and the whole historical context) was done in the UCL Depthmap software space.

3. THEORETICAL FRAMEWORK

3.1. Urban Square

An “urban square” is defined as an open public space in a city that supports social interaction by serving as a meeting place and which is used by the citizens for activities like strolling, sitting, and communicating, often in connection with a variety of consumption offerings (Marcus et al., 1998). According to Rob Krier (1979, p. 15), it is quite possible that the first idea used in urban space was the square. Rob Cowan defines squares as pedestrian green spaces in rectangular form and enclosed on some or all sides by buildings (Cowan, 2005, p. 213). A small city may have a single square that serves as a traffic hub and a distillation of its character. Great cities boast squares of every size, style, and purpose, demonstrating the varied ways in which space can be contained and manipulated. (Banerjee, 2001).

Open access and accessibility by public transportation are typical attributes of urban squares. Besides their function regarding social and health (e.g., well-being or recovery) aspects, urban squares have an esthetic function as part of the structural design of a city (Richter, 1981). Squares are synonymously called either “piazzas” due to their Italian origin or “plazas” due to their Spanish origin. Initially, this architectural form was left unplanted, but this has changed over the course of time so that nowadays squares often have trees (Forrest & Konijnendijk, 2005). Nevertheless, in comparison to other urban areas, e.g., public gardens or parks, the vegetation in squares is rather sparse. As squares are usually paved and surrounded by streets and buildings (Marcus et al., 1998), they often represent “gray” rather than “green” spaces (Rašković & Decker, 2015).

Urban squares, despite their apparently self-evident consistency, actually represent one of the most uncertain issues of present urban planning. Denied and neglected by modern architecture, then sought after in the last decades, squares are commonly recognized as fundamental identity-making elements in urban settlements as well as in their respective communities. Since their revival in the late 900s, the design of urban squares has been a challenging task for generations of planners and urban designers, since, despite any effort, most of the squares worked out can hardly succeed in competing with the historic ones. What appears to explain the failure of most attempts is the actual uncertainty in the definition of what an urban square really is, or what it should be: not a mere open space, nor only a pedestrian path, nor necessarily a wide or regular space, nor always a junction of streets. Perhaps all these things together, along with something more, "what makes the matter to overcome the limits of a strictly physical vision to approach social and cultural meanings" (Cutini, 2014). Exactly as towns in their totality either have grown naturally from villages, trading posts, military camps, castles, and monasteries, or were built following a preconceived design so the individual square within a town either might have developed gradually out of certain existing conditions or might have been planned. In contrast to the originally grown squares, planned squares always appear as clearly defined as any individual piece of architecture (Zucker, 1959, pp. 1-17). Many different types of squares exist in cities. Each of them serves as a current set of purposes that may differ from the ones intended when it was built. Over time, some have been successful in providing for the activities and enjoyment of the people who use them. Others have been forgotten and fallen into disrepair (Lang & Marshal, 2017, p. 15).

3.2. Biophilic City

Biophilia expresses the innate human desire for natural systems and processes (Xue et al, 2019, p. 52). It also means being fascinated by all living things (Cabanek & Newman, 2016, p. 66). The concept of a biophilic city has emerged for how to design and organize future cities and is based on biophilia insight (Beatley, 2011, p. 48). The pioneer of this concept is

Erich Fromm, a social psychologist who understood the consequences of being away from nature (Fromm, 1964). Biophilic cities or garden-oriented cities seek to build a favorable city-nature connection that is fairly accessible and enjoyable for all residents (Beatley, 2011, p. 50). In addition, Biophilia plans and redesigns existing urban areas and reproduces urban centers (Mehaela, 1993, p. 55). This concept has many applications in transforming soulless urban environments into attractive and exciting environments (Kellert, 2012, 5). Biophilic citizens have many opportunities to connect with each other in nature over time (Tally & Femida, 2015, p. 5). Biophilic cities are full of nature and have many open spaces and long shades of trees and abundant biodiversity. In order to achieve biophilic design, three main approaches containing modeling space through nature, simulating natural patterns and the nature of space have been proposed (Browning et al, 2014). Biophilic development is also based on green space and public transportation, so it predicts population density around these two centers or a natural indicator element. Patterns and natural processes as a component of biophilic design are formed through order and complexity (Salingaros, 2012, p. 14), creating a mysterious and revealing environment, charm and beauty (Herzog & Bryce, 2007, p. 51) and connection with the geographical and historical context. Thus, the biophilic city imitates nature in two direct (natural elements) and indirect (artificial elements) Ways.

Biophilic urban planning emphasizes the creative combination of green urban design and the need for outdoor living and the protection and rehabilitation of green infrastructure from the area to the neighborhood (Beatley, 2011, p. 46). In such cities, there are many opportunities to join others in learning and enjoying nature (Kellert & Wilson, 1993, p. 34). Public spaces and squares for walking, gatherings, and the placement of sculptures and statues with natural shapes and materials in these spaces lead to more people connecting with nature and with each other. Residents of the biophilic city are actively present in nature. One of the characteristics of a biophilic city is the use of natural forms and shapes in the construction of the city, the high percentage of traveling by foot and the uniqueness of their biological nature. Biophilic design elements include courtyards and green areas, green streets, urban trees, a high degree of permeability, natural and artificial landscapes and suitable visual conditions, connectivity with the surrounding nature, clean transportation and good access, variety of uses and activities, traffic reducing speed, pedestrian capability, the existence of cultural and natural sites, and many other direct and indirect influences of nature. Figure 1 shows the characteristics of a biophilic city in relation to green squares and how to measure them using space syntax indicators.

4. STUDY CASES

4.1. City of Hamedan

The location of the city of Hamedan is shown in Figure 2.

Hamedan as "one of the most important thoroughfares in Iran" and "a large number of fruit trees in the passages and squares" (Grothe, 1991, p. 45) has been considered in historical sources of the Qajar era. In the past, the city was divided into four neighborhoods in terms of administrative affairs, each of which had a separate headman (Jackson & Valentine, 2010, p. 171). Mostofi in the eighth century AH describes the city of Hamedan with several tombs, including the tomb of Khajeh Hafez Abol Alai Hamedani, Baba-Taher, Sheikh Ein Al-Qozat, etc. (Mostofi Qazvini, 2011, p. 71). In the map of 1230, eleven tombs and shrines are mentioned (Mehryar et al., 1999, p. 158) which were generally located on the outskirts of the historical core of the city. According to historical sayings, "the gardens and springs and streams of the city and the fountains and gardens of the passages, had made it look like woods" (Zarei, 2012, p. 80). Figure 3 shows the historical map of Hamedan, and Figure 4 introduces some historical points.

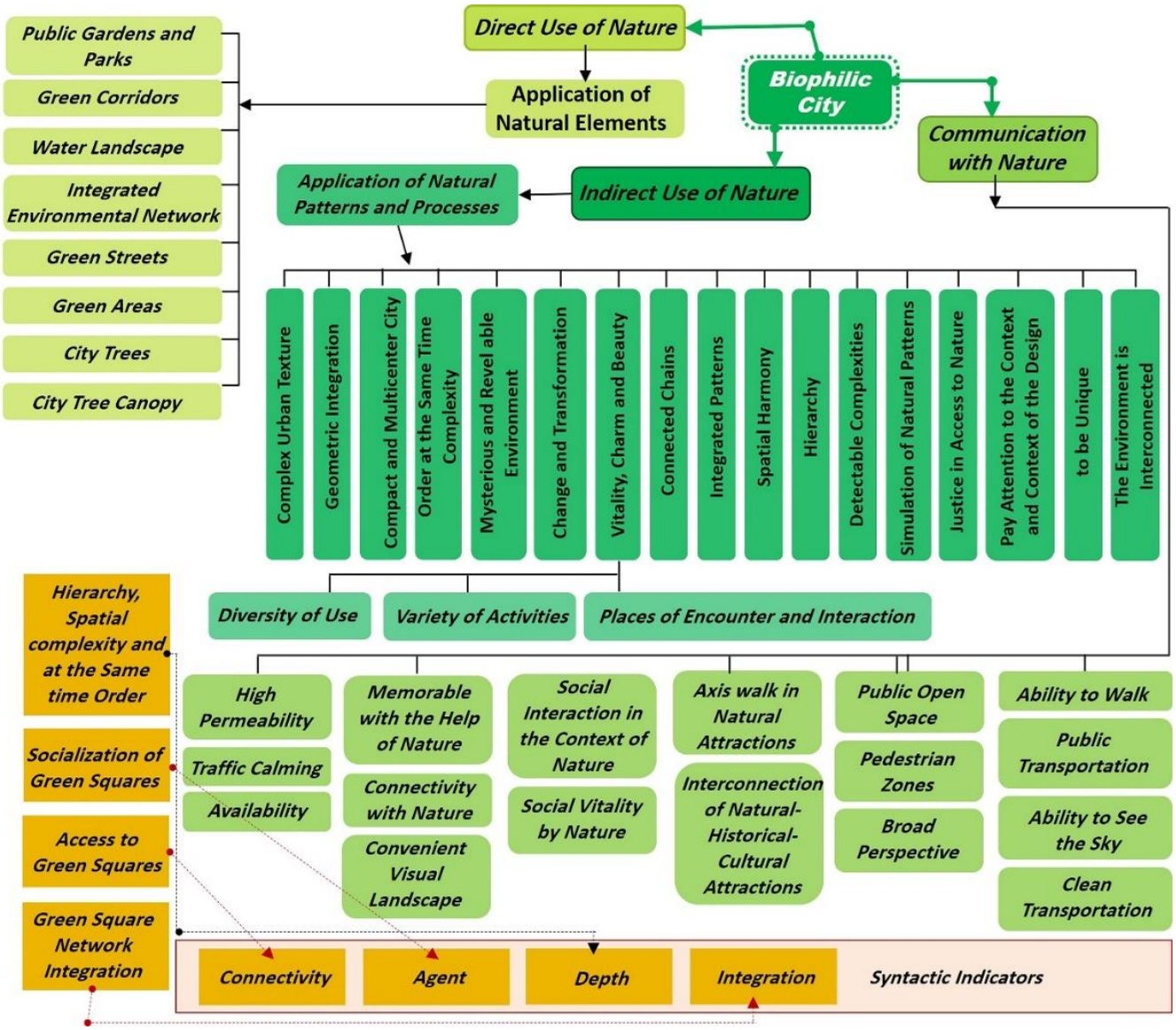


Fig 1. Characteristics of a Biophilic City in Relation to Green Squares and How to Measure them using Space Syntax Indicators

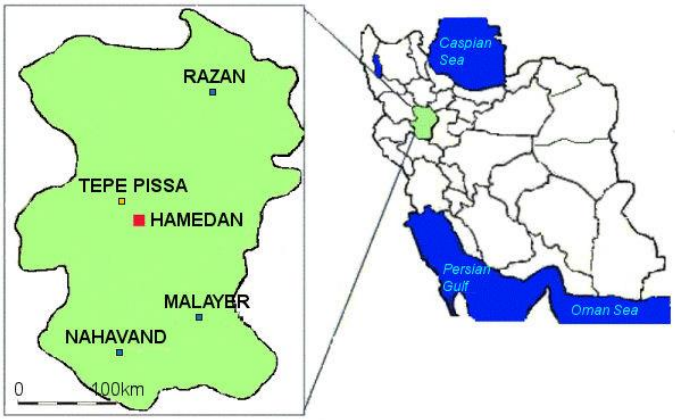


Fig 2. Location of the City of Hamadan in Iran

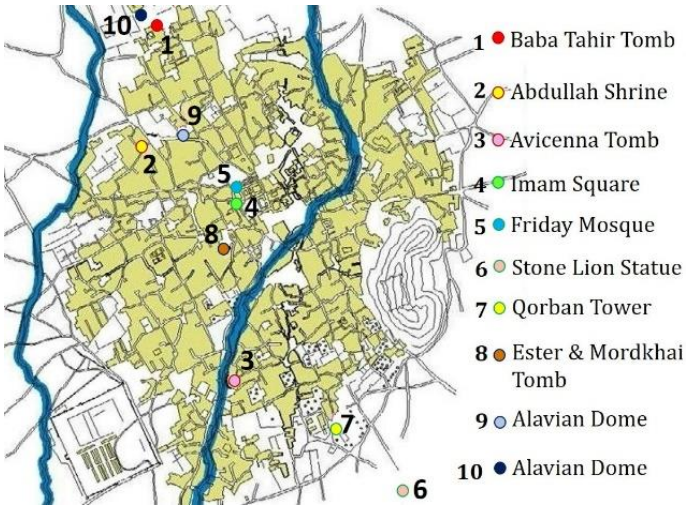


Fig 3. Hamadan City Map and its Rivers, Prepared by the British Army in 1919 (Geographic Organization of Iran Army, 1956)

Fig 4. Some Historical Places (Top); Esther and Mordechai Tomb (Down): Stone-Lion Square (Photo by the Author)

The first green spaces were formed in the center of many neighborhoods of the city during the Qajar period (Mofidi Shemirani et al., 2022, p. 167). The green square of the neighborhood, as one of the most important elements of the general structure of the city's neighborhoods, is located in the center of these neighborhoods and is still popular among the people with the term "Chaman" (lawn) (Azhang, 2009a, p. 39). One of the first reasons for the formation of Chaman was its communication function (Qaragozlu, 2010, p. 47). Also, an important part of the social, economic, and cultural interactions of the city has been in charge of this space (Ibid, p. 48). The four important neighborhood centers with the names of Haji, Kolapa, Kababian, and Mosalla now remain almost in the same original form. Among the social and economic functions of these lawns were the morning gathering of construction and agricultural workers to find work, the

sitting of the poor, and the activity of trustees who provided charitable aid to the poor and also delivered the trusts of travelers at the time of their return (Azhang, 2009b, p. 89). Other functions of the lawn were the establishment of jugglers, magicians and athletes, the hangout of perfumers and drug dealers, and especially the gathering of mourning groups during the annual mourning processions on their way to the green squares (Chaman) of other parts of the city.

Cultural and religious functions included holding mourning ceremonies and congregational prayers in Chaman Mosque and sometimes pilgrimages and prayers of the people and their vows on Friday nights and religious days in Imamzadeh that was existing in Chaman (Farshchian & Balali Oskooi, 2016, p. 59). There were two types of neighborhood centers, including linear and centralized centers (Ghadakchi, 2009, p. 23). The linear lawn along the main passage, including a number of shops, mosques and other public spaces, was located at the intersection of several neighborhood passages (Figure 5. Haji Chaman). The concentrated lawn was a square that was located at the intersection of the main passages or next to the most important passage of each neighborhood (Figure 5. Kababian, Kolapa and Mosalla Chaman). The middle part of the lawn area was the place of water ponds, wells, springs and aqueducts, lawns and flowers, and around it a mosque, baths, shrines, public drinking places and several shops were built to provide the daily necessities of the people of the neighborhood (Jameh Bozorg et al., 2021, p. 207). The number, variety, and range of lawns in the urban structure indicate their social, economic, and recreational functions, some of which remain and are still used today (Iran Housing Development Consulting Engineers, 1993, pp. 88-108).

4.1.1. Hamedan Squares

The historical context of "Fifty-one neighborhoods of Hamedan in the Qajar era" (Biglari, 1977, p. 45) was gradually changed by changing the city structure with the construction of squares and streets since the beginning of the Constitutional Revolution (1946) and the establishment of a provincial association and especially the municipality (1949) was formed (Azkaie, 2002, p. 171). The contemporary map of the city was designed radially by a group of German engineers, following the pattern of Hussmann urban planning and with a structure and shell influenced by the Neo-Baroque style, in 1308 and was executed between 1932 and 1935 (Figure 6). The central square of the city with a radius of 80 meters was located at the central point of this radial structure and a belt at a distance of about one kilometer connected six streets (Zarei, 2012, p. 69).

Important and historical squares of the city include Imam Square (the Central Square of the city), Bouali Tomb Square, Baba-Taher Tomb Square, Imamzadeh Abdullah Square, and Stone Lion Square. Avicenna's tomb in 428 AH. It was built in a large garden behind the southern part of the city (Ahqar, 2009, p. 37) and remained as a "square brick tomb" until the middle of the thirteenth century AH (Azkaie, 2009, p. 15). In its western part, the Mesopotamia River and many trees were the gathering place of people (Mehryar et al., 1999, p. 53). It was rebuilt during the Qajar period and emerged in 1951 by the National Monuments Association in its present form (Figure 8).

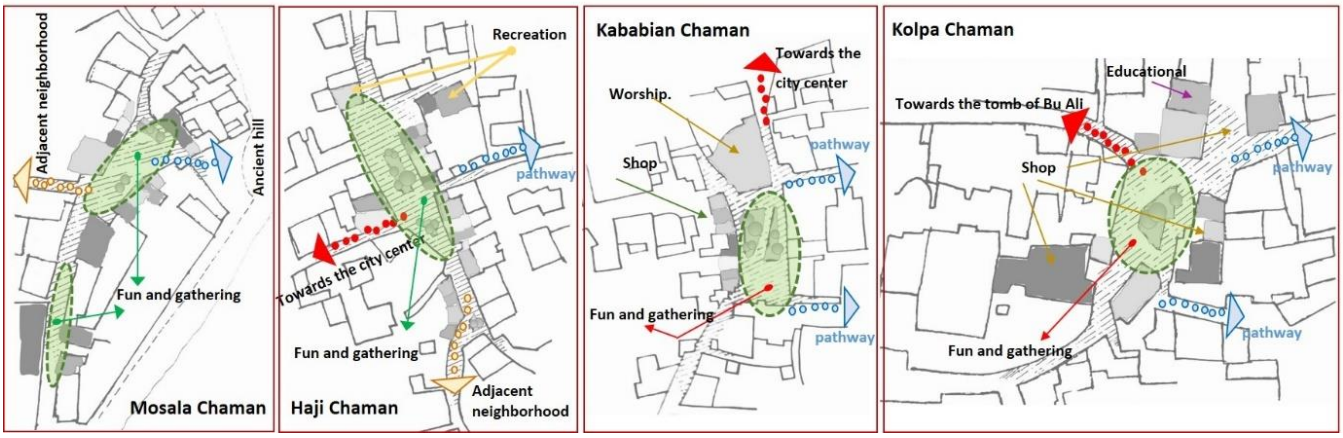


Fig 5. Functions of the Lawn (Green Square) of the Neighborhood (Source: Author, 2022)

Fig 6. The Central Square of the City and the Surrounding Squares
(Road and Urban Development Organization, 2018)

Fig 7. Two Views of Imam Square
(photo by the author)

Fig 8. Two Views of Avicenna Square
(photo by the author)

Baba-Taher's tomb was built as an octagonal brick tower in the sixth century outside the city wall (Ahqar, 2009, p. 38), which was the center of dervishes' gathering on a hill in the current position as a simple and humble tomb (Saberi Hamedani, 2004, p. 204). A new tomb was built in 1969 and its square in 1972 to celebrate the 2500th anniversary of the empire (Figure 9).

Imamzadeh Abdullah was also a small but important building and was welcomed by the people (Zarei, 1997, p. 87). This building was placed inside the enclosure during the street construction and expansion of the city and later became a square (Figure 10).

Hamedan urban squares are in fact historical sites that are located in urban squares today as a result of urban planning developments. However, they still retain their function as a social base for citizens. Although the middle island of these squares is now surrounded by cars, people are using them even more (Figure 11). Hamedan Parks Square, on the one hand, has the most dangerous traffic junctions and, on the other hand, constitutes the most attractive social spaces of the city. With their tombs, shrines, ancient elements, and old trees, these places play the dual role of a square and an urban park on a large scale in modern urban planning, which is contrary to the current role of contemporary squares as a facilitator of vehicle movement in front of safe pedestrian space.

Fig 9. Baba-Taher Tomb Square (photo by the author)

Fig 10. Imamzadeh Square; A Religious Gathering; Shrine (photo by the author)

Fig 11. Two Views of Crowds in Imam Square; Social Gathering and Down Prayer Time (photo by the author)

4.2. City of Savannah, U.S.A.

Savannah, a coastal Georgia city, is separated from South Carolina by the Savannah River. It's known for manicured parks, horse-drawn carriages and antebellum architecture. Its historic district is filled with cobblestoned squares and parks such as Forsyth Park shaded by oak trees covered with Spanish moss. At the center of this picturesque district is the landmark, the Gothic-Revival Cathedral of Saint John the Baptist (Figure 13).

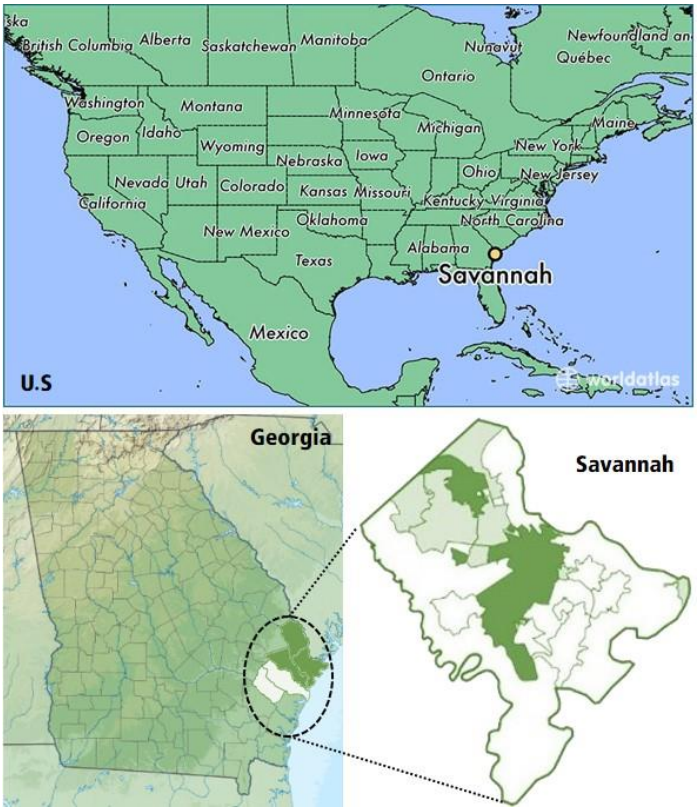


Fig 12. Location of the City of Savannah, Georgia in the U.S

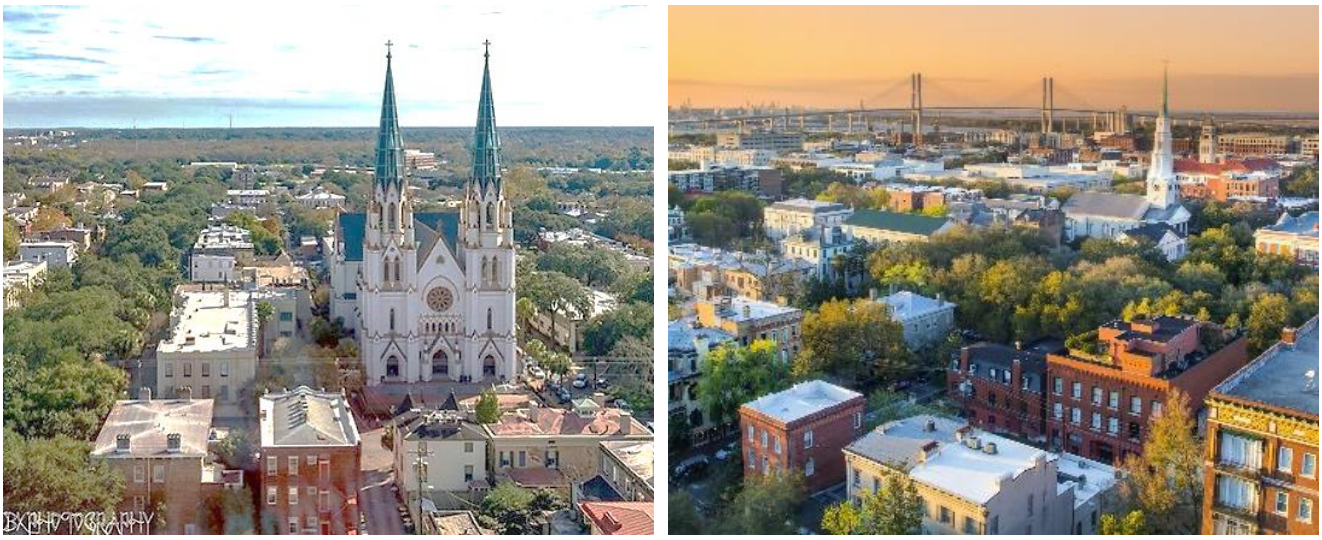


Fig 13. Savannah Cityscapes (Savannah, 2022)

Savannah is the largest registered urban Historic Landmark District in the United States. It encompasses over 1600 structures restored all within 2.2 square miles. It was not only the state of Georgia's first city and capital but also America's first planned city utilizing the grid system and public squares (Jones & Charles, 2017). This city is described as a garden and is the first planned city in the US. With its 22 squares and many parks and other public green spaces, it sparks a sense of community amongst its neighbors and a sense of love among visitors. Savannah Historic District which includes the downtown district, Victorian district, and 22 park-like squares, is one of the largest National Historic Landmark Districts in the United States designated by the U.S. government in 1966 (Figure 14).

Downtown Savannah largely retains the original town plan prescribed by founder James Oglethorpe (a design now known as the Oglethorpe Plan). Oglethorpe named the thirteenth colony Georgia after King George II, and Savannah became the first city. Under the charter, the colony was to benefit the poor, increase trade, and provide a protective buffer between the northern English colonies and the Spanish in Florida. The last and poorest of the colonies would serve as a religious haven for all but Catholics who were originally banned from the new colony.

Oglethorpe and his engineers designed "America's first planned city" around a system of wards and shady public squares, which were used for public services and as meeting places (Figure 15). Homes and shops were built on the town lots, while the larger trust lots facing the squares east and west were reserved for churches and other public buildings. The squares provided for good defense and an equal division of labor. Savannah's historic squares have been designated as a National Historic Civil Engineering Landmark (Fraser, 2018).

Fig 14. Savannah Historic District (Author, 2022)

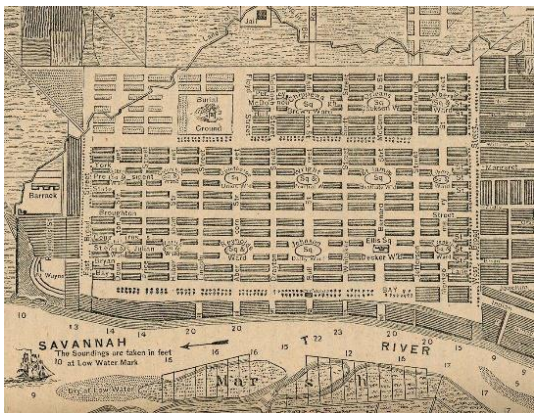


Fig 15. Savannah Map of 1818 (University of Texas Libraries)

4.2.1. Savannah Squares

Savannah Squares are the Heart and Soul of the City. In fact, the historic district is defined by the limit of the squares. As the squares developed through time, so did the history of Savannah, as the history took place almost entirely around and in the Savannah squares. During most of the development of the city, the squares were used for communal activities, such as gathering water, baking bread, celebrating holidays and victories and many more activities. They were also used as stockyards and gathering places for those from outside the city for protection in time of the attack. As originally laid out, each of the Savannah squares was at the center of a basic organizational unit called a ward. Each ward contained a square. All communal activities of a ward took place in the square which was at its center. As the wards and squares were planned, the east and west sides of each square contained two large lots, known as “trust lots”. These lots were reserved for public buildings, such as churches, schools and institutions. On the north and south sides of the squares, the land was divided into 20 “tithing lots”, with a lane down the middle for passage. These lanes form the streets of Savannah’s historic district today (Jordan & McCay, 2015).

The original plan of the city included 24 squares (Figure 16), of which only six were built originally by James Oglethorpe. Four in 1733 and two in 1736. They were, in chronological order, Johnson Square, Wright Square, Ellis Square, Telfair Square, Oglethorpe Square and Reynolds Square. The remaining 18 squares developed through the late 18th century and 19th century, spreading south from the original squares and eventually including Franklin Square, Warren Square, Washington Square, Liberty Square, Columbia Square, Greene Square, Elbert Square, Orleans Square, Chippewa Square, Crawford Square, Pulaski Square, Madison Square, Lafayette Square, Troup Square, Chatham Square, Monterey Square, Calhoun Square and Whitefield Square (Walker, 2011). Two of the squares, Elbert and Liberty Squares, were lost to “progress”, Elbert to a freeway exchange and Liberty Square to a courthouse.

Savannah was laid out in 1733 around four open squares, each surrounded by four residential ("tything") blocks and four civic ("trust") blocks (Figure 17). Once the four wards were developed in the mid-1730s, two additional wards were laid out. The layout of a square and eight surrounding blocks was known as a "ward." The original plan (now known as the Oglethorpe Plan) was part of a larger regional plan that included gardens, farms, and outlying villages (Wilson, 2012).

All of the squares measure approximately 200 feet (61 m) from north to south, but they vary east to west from approximately 100 to 300 feet (30-91 m). Typically, each square is intersected north-south and east-west by wide, two-way streets. They are bounded to the west and east by the south- and north-bound lanes of the intersecting north-south street, and to the north and south by smaller one-way streets running east-to-west and west-to-east, respectively. As a result, traffic flows one way (counterclockwise) around the squares, which thus function much like traffic circles (Wilson, 2012). Each square is placed at the center of a ward, which often shares its name with its square. The lots to the east and west of the squares, flanking the major east-west axis, were considered "trust lots" in the original city plan and intended for large public buildings such as churches, schools, or markets. The remainder of the ward was divided into four areas, called tythings, each of which was further divided into ten residential lots (Jordan, 2017). Additional squares were added during the late 18th and 19th centuries, and by 1851 there were 24 squares in the city. In the 20th century, three of the squares were demolished or altered beyond recognition, leaving 21. In 2010, one of the three "lost" squares, Ellis, was reclaimed. Most of Savannah's squares are named in honor or in memory of a person, persons or historical event, and many contain monuments, markers, memorials, statues, plaques, and other tributes (Jordan & McCay, 2015). Figures 18, 19, and 20 show the location of some squares and the historical elements in them.

These squares are surrounded by some churches, historic homes, inns and museums and are all shaded by huge live oak trees. These squares are places for children to play, family picnics, family and intimate celebrations, and outdoor appointments in Georgia’s First City. Although the city was cherished by many today for its aesthetic beauty, the first squares were originally intended to provide colonists space for practical reasons such as militia training exercises (Fraser, 2018). Some grand homes, such as the well-known Mercer House, stand on trust lots, while many of the residential lots have long-hosted commercial properties (Figures 21, 22).

All of the squares are a part of Savannah's historic district and fall within an area of less than one-half square mile. The five squares along Bull Street (Monterey, Madison, Chippewa, Wright, and Johnson) were intended to be grand monument spaces and have been called Savannah's "Crown Jewels." Many of the other squares were designed more simply as commons or parks, although most serve as memorials as well (Harden, 2017). Architect John Massengale has called Savannah's city plan "the most

intelligent grid in America, perhaps the world", and Edmund Bacon wrote that "it remains as one of the finest diagrams for city organization and growth in existence" (Fraser, 2018). The American Society of Civil Engineers has honored Oglethorpe's plan for Savannah as a National Historic Civil Engineering Landmark, and in 1994 the plan was nominated for inclusion in the UNESCO World Heritage List. The squares are a major point of interest for millions of tourists visiting Savannah each year, and they have been credited with stabilizing once-deteriorating neighborhoods and revitalizing Savannah's downtown commercial district.

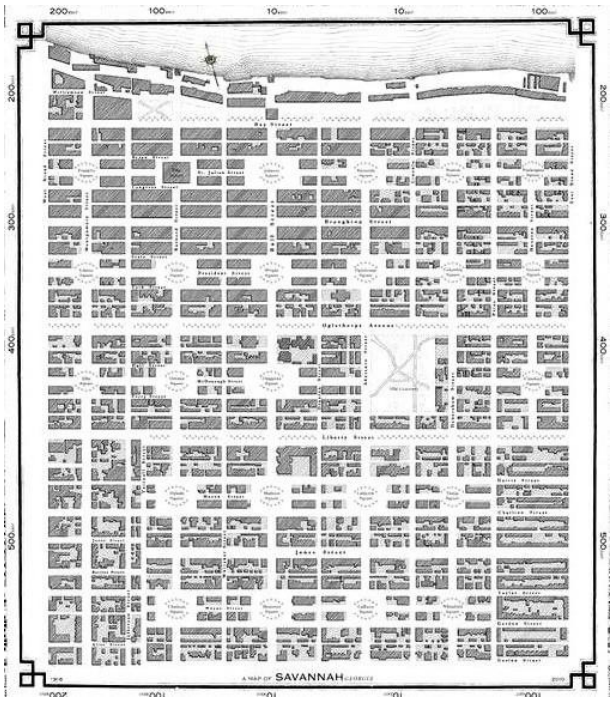


Fig 16. Location of Squares in Savannah Downtown Historic District (Jordan & McCay, 2015)

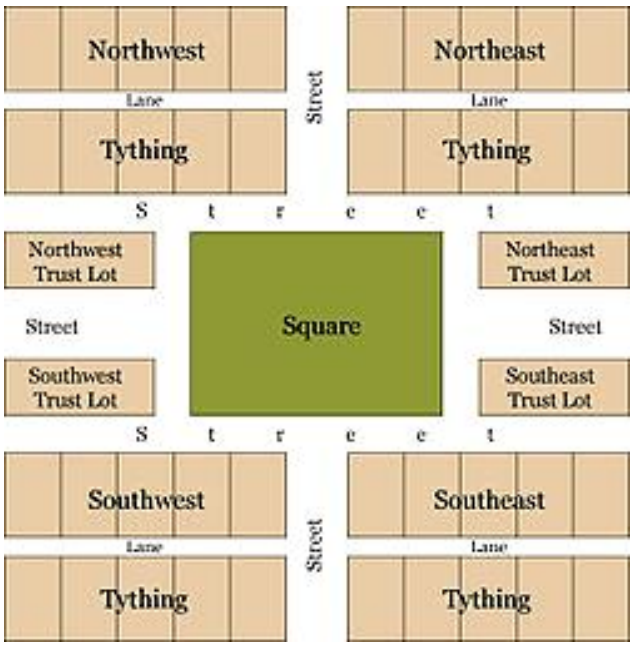


Fig 17. The Layout of a Typical Ward in Oglethorpe's Plan (Jordan & McCay, 2015)

Fig 18. Location of the Wright Square and Jonson Square in the Historic District of Savannah; ■ Tomochichi Monument in Wright Square; ■ the Pond in Johnson Square (Author, 2022)

Fig 19. Location of Chippewa Square and Monterey Square in the Historic District of Savanna; ■ the Fountain in Monterey Square; ■ the Bronze Statue of Georgia Founder General James Oglethorpe (Author, 2022)

a b c

Fig 20. Pulaski Monument, Monterey Square (A), Jasper Monument, Madison Square (b) and Nathanael Greene Monument, Johnson Square (c) (Pinterest, 2022)

Fig 21. A View of the Mercer House (Mercerhouse, 2022)

Fig 22. First Baptist Church in Chippewa Square (Pinterest, 2022)

5. DISCUSSION AND RESULTS

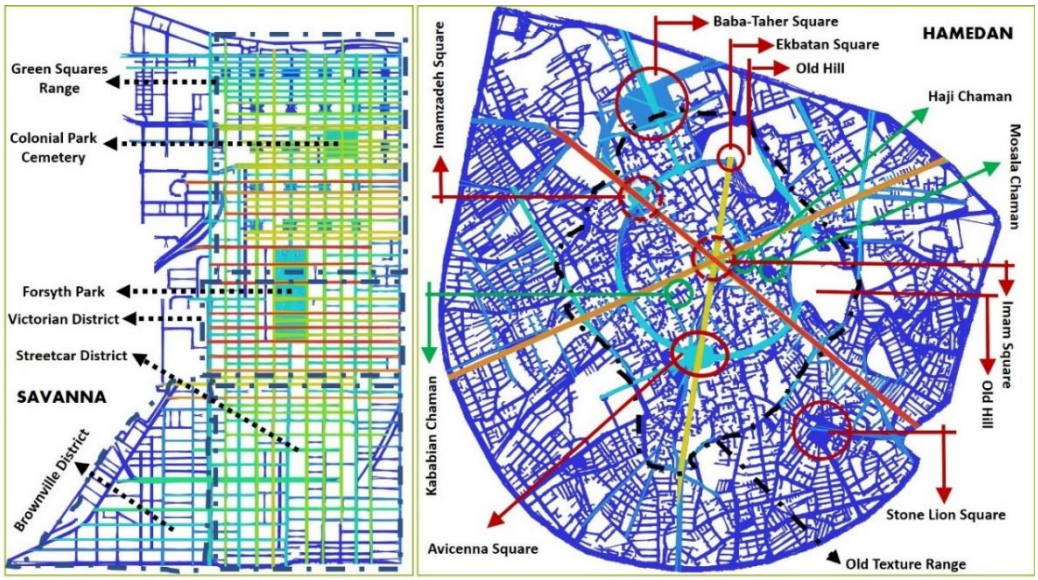
To evaluate the patterns of green squares, first, the historical contexts of both cities were drawn in AutoCAD software and then analyzed and compared in the Depthmap software space in terms of the "Connectivity" index in radius n. The obtained map and numerical outputs are presented in Table 1, which can be analyzed in terms of the amount of coordination of patterns with biophilic indicators.

The study of the connectivity index of Hamedan texture shows that the most connectivity is in the historical-cultural axis from Imam Square to Imamzadeh Square. After that, the natural recreational axis and in the third stage, the commercial recreational axis have suitable connectivity. In the n-radius connectivity map, the internal organic tissues have the same value as this index. The amount of access in areas far from the central square where the impact of the radial network is less has a different situation, so some axes within the tissue also have good access. The radial network of the main squares has caused the green squares within the neighborhoods to have spatial value only to the extent that they are connected to this network. Thus, in the n-radius, the Stone-Lion Square, although having a high amount of access within the tissue, has a very low value compared to the overall structure in combination with the radial lattice. The high connection of the passages adjacent to the green squares shows the role of these places in increasing accessibility, while the green squares of the neighborhoods do not show this role in the overall structure. Placing green squares on the radial network on the one hand has caused the general connectivity of public green spaces and on the other hand, has reduced the balance in the city structure and inconsistency with the organic geometry of internal tissues and thus reduced justice in access to areas and uses.

In contrast, placing Savannah squares at relatively equal intervals within the checkered lattice has increased context availability (2190/46). Also, the location of the historical context in the northern extremities and the existence of distance from other areas did not have a negative impact on the value of the connectivity index of this area. Coordinating the development of the geometric network with the

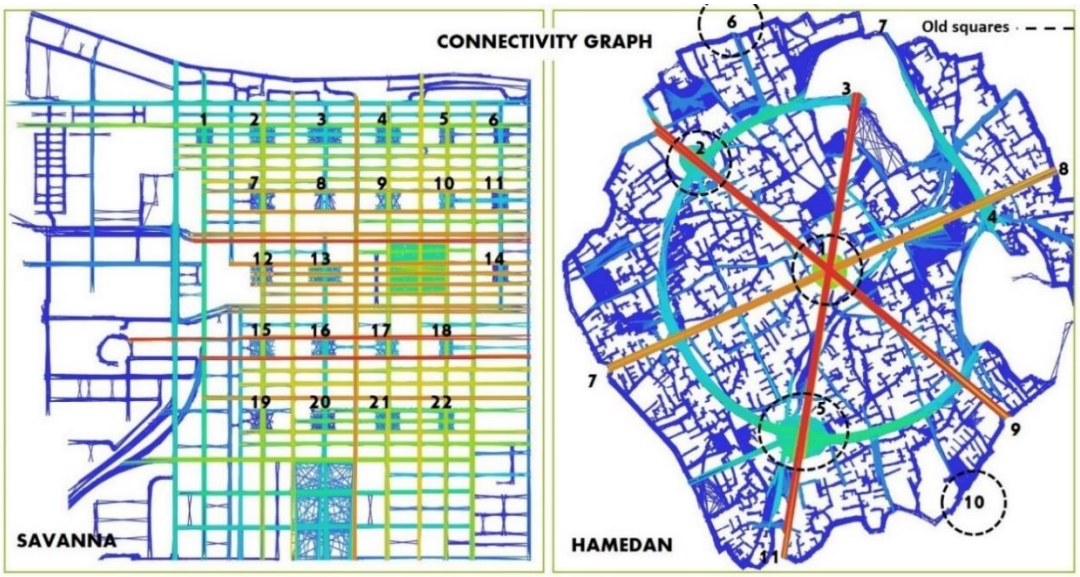
network of the original historical context plays an important role in connecting and equal benefit of citizens from the green city. Most connectivity in Savannah is in the area of Forsyth Park, i.e. the central context of the study area, which gradually decreases to the north and south. Leaving the centrally coordinated network to the west has reduced the connection. Connectivity numbers show a big difference between the two cities (1674/214). There is a big difference in the minimum and maximum values. The general texture of Hamedan, despite the general harmony, is in conflict with the imposed geometric structure, and this has reduced the role of old and new green squares in the realization of biophilic city indicators. Table 2 shows and compares the degree of connectivity in the primary context of cities.

Table 1. The Obtained Morphological and Numerical Outputs of the Connectivity Index



Sava	Ave	2190/46	Std Dev	1685/06	Ham	Ave	516/246	Std Dev	1114/87
	Min	6	Count	38451		Min	2	Count	139984
	Max	11251	>10126	95		Max	9831	>8848	58

Table 2. Comparing the Degree of Connectivity in the Primary Context of Cities

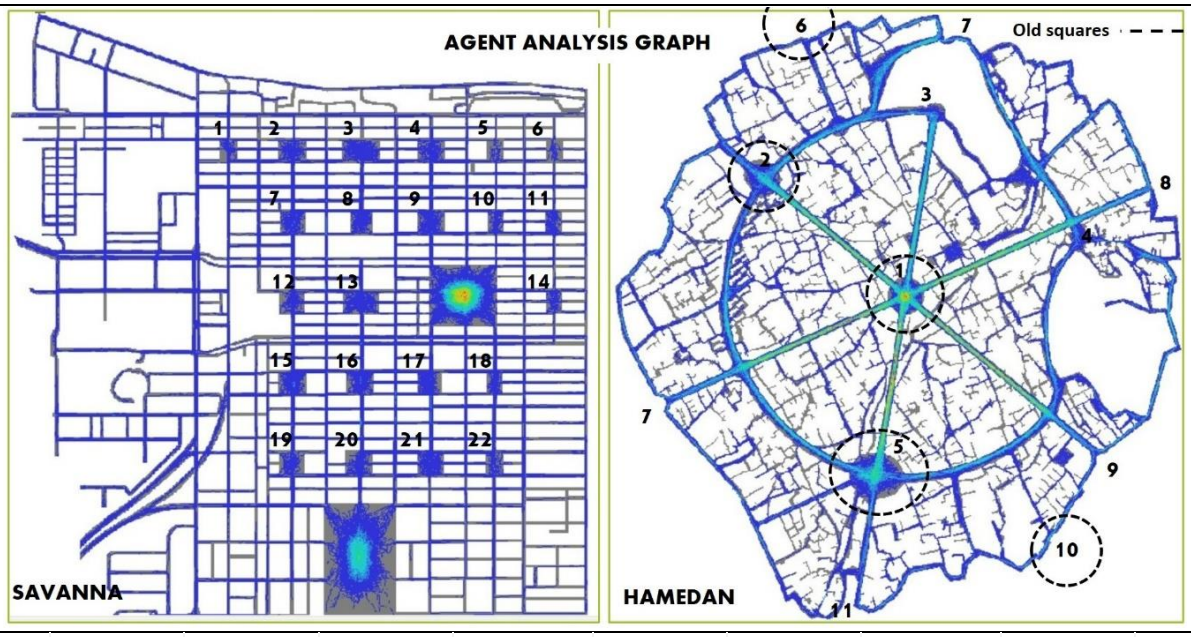


Sava	Ave	1102/56	Std Dev	818/904	Ham	Ave	331/646	Std Dev	613/734
	Min	6	Count	14983		Min	2	Count	65089
	Max	4311	>3880	27		Max	4800	>4320	70

In the area of the first ring (historical primary core) in Hamedan, the commercial and entertainment axis has more access. However, the value of the index depends largely on the length of the axes of vision. In Hamedan, there is not much difference between access in the two studied scales. While the placement of two geometric and organic networks on top of each other only affects access to the main squares of the city (important historical and green points) but has caused the low value of green lawns in the neighborhoods. In Savannah, green squares in combination with large parks help to provide balanced pedestrian access. The difference between the connectivity values (770/914) in this scale is also very high. Savannah has performed better locally on biophilic indicators (connectivity with nature, clean transportation, and public open spaces). In this scale, the middle squares have more connection than the peripheral squares, but in Hamedan, there is not much difference between the two scales. Table 3 compares the simulation of morphological and numerical spatial traffic in the two studied contexts.

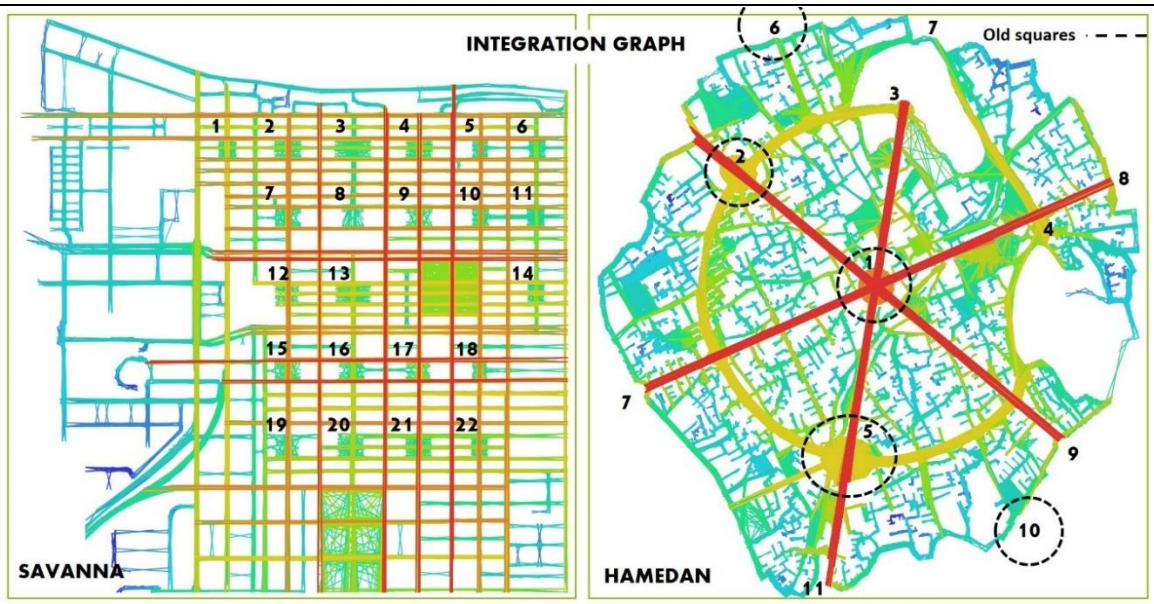
Software analysis shows that Hamedan squares have much more sociability in the whole context and after that, the communication axes of the squares have the most spatial traffic. These radial axes towards the central square (Imam) are pedestrian crossings, among which, the axis of Imam square to Avicenna square (commercial-recreational axis) has the highest index value. Thirdly, the axes branching from the radial paths, including the junction ring of the squares, as well as the passages and open and green spaces around the historical hills, have a high degree of sociability. There is the least amount of traffic in the bypasses and mazes within the tissue. In contrast, Savannah squares do not have this spatial diversity. There is not much difference between sociability between squares as well as between squares and connecting passages. Colonial Park Cemetery has a very high level of sociability due to its almost central location, large dimensions and a large number of passages leading to it. Forsyth Park has the second degree of sociability and space traffic. Biophilic city indicators such as change and transformation, detectable complexities, order at the same time complexity and uniqueness are not observed in these squares. However, the pedestrian orientation of the whole texture and the multiplicity of squares at short distances have provided the connection of the city with nature and the connection of the citizens with each other in nature. Table 4 compares the amount of integration and depth in both morphological and numerical modes in the two studied contexts.

Table 3. Comparing the Simulation of Morphological and Numerical Spatial Traffic in the Two Studied Contexts

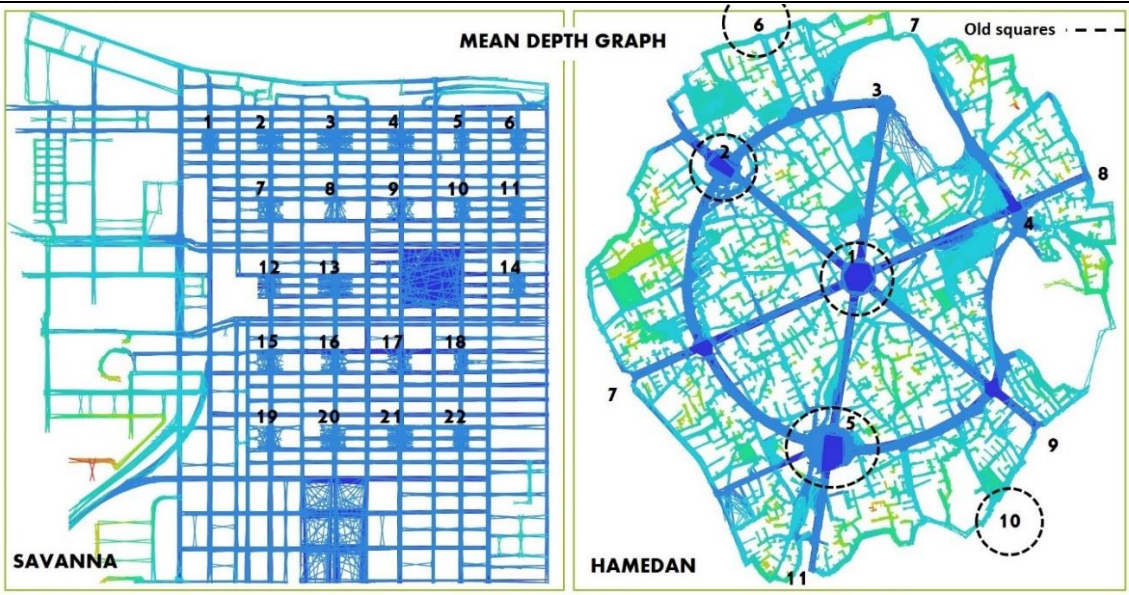


Sava	Ave	4/4304	Std Dev	8/11776	Ham	Ave	7/40477	Std Dev	8/83085
	Min	1	Count	103970		Min	1	Count	54703
	Max	135	>121/6	7		Max	67	>60/4	26

Table 4. Comparing the Amount of Integration and Depth in the Two Studied Contexts



Sava	Ave	7/70864	Std Dev	1/69645	Ham	Ave	2/90917	Std Dev	0/7347
	Min	1/59426	Count	14983		Min	1/15206	Count	65089
	Max	13/2495	>12/083	74		Max	5/48511	>5/051	772



Sava	Ave	2/5568	Std Dev	0/475027	Ham	Ave	5/89207	Std Dev	1/18725
	Min	1/85189	Count	14983		Min	3/44397	Count	65089
	Max	8/07983	>7/457	3		Max	12/636	>11/71	6

The context of Hamedan is in a desirable condition in terms of the integrity of the squares network. Also, the organic geometry of the old texture of the neighborhoods is coherent. Due to the small area of the neighborhood green squares, these points do not play an important role in the overall structure integration, although at the neighborhood scale they can provide context cohesion. The communication loop of the squares is less integrated than the radial axes. However, the ring has played a greater role in increasing the integration of the surrounding passages than the axes. The factors of the biophilic city, including the simulation of natural patterns, the mysterious and revel able environment, order at the same time as complexity, the compact and multicenter city in Hamedan have helped to cohesive the texture and increase the integration. The study of integration in Savannah shows that although the checkered lattice has played an important role in increasing the integration, the location of the green squares has not

contributed to this. In other words, axes without green squares in the network have a higher interconnection. The location of the squares in the sub-axes of the city's geometric network has reduced the integration of these squares. However, the total amount of this index in Savannah is much more than Hamedan (7/70864 vs. 2/90917). In Savannah, biophilic indicators, including the coherence of geometry, interconnected chains and series, spatial harmony, and the interconnected environment, have contributed to the equitable benefit of the general public.

Although the depth index in the whole old Savannah texture shows the same low value, the middle axes (squares 15, 16, 17, and 18) have the lowest depth, which means greater permeability, accessibility, and spatial justice. This less amount depends on the central position of these squares among other green squares. The difference in the value of this index between different parts of the old texture of Hamedan is greater. So that the lowest depth is in squares 1, 5, 2, and 4 and the highest depth is in the inner passages and the farthest passages of the organic texture compared to the geometric network. The combination of geometric and non-geometric networks, on the one hand, has increased the access and better efficiency of the main green squares of the city and on the other hand has reduced the efficiency and spatial value of the green squares of the neighborhoods. Depth simulation in Hamedan shows that biophilic indicators such as justice in access to space and natural resources and attention to the context and design context have a low value in the placing pattern of green squares in the neighborhood compared to the green square in the city.

6. CONCLUSION

Software analysis in response to the research question showed that the placing patterns of squares in Savannah and Hamedan, reveal differences and similarities in meeting the criteria of a biophilic city. The placement of Savannah squares on a uniform checkered grid at close distances in the pedestrian zone of the city has resulted in high permeability, fair accessibility, clean transportation, and optimal provision of places for interaction in nature. This deployment has led to an increase in the connectivity index and a decrease in depth. The establishment of two types of squares (main squares on a radial grid) and (small green squares within neighborhoods) has provided diversity and hierarchy and complexity in the same order. Also, the uniqueness of the squares in terms of location, area, uses, activities and historical elements in them has helped to make these places memorable, attractive and beautiful. This type of deployment reduces the overall amount of connectivity and increases the relative depth. However, this increase or decrease in values means the hierarchy of access and the desired spatial diversity in the urban structure. The integration index in both cities is favorable. However, the Savannah map shows a higher value of this index due to the interconnected chains and the integrated pattern.

In the final conclusion, both establishment patterns have been successful in achieving biophilic indicators, but the difference is in the type of indicators and their appearance. Savannah garden city in terms of its integrated environmental network and extensive use of green streets, courtyards and green areas has paid more attention to the direct use of nature and communication with nature. There is also a variety of uses and consequently sociability in all historic green squares. In contrast, Hamedan has modeled the indirect use of nature. Also, the variety of land uses is not observed in all squares, but exclusively religious, commercial, recreational, leisure, historical land uses, and in some cases, the variety of land uses has made each of the squares unique, resulting in attractiveness and beauty. Spatial traffic and socialization in the squares of Hamedan show a higher figure. However, the population attracts in Savannah is more in terms of greenery and land use mix. The software output in the two scales studied shows that the centralized structure of Hamedan provides similar values of indicators in the central core and the whole historical context. While the longitudinal expansion of the historical texture in Savannah and the distance of the primary nucleus from other historical areas has caused differences in the values of the indicators in the two studied scales.

NOTES

1. *rus in urbe*: country in the city: a city garden or park evoking the rural countryside (Merriam Webster, 2021).

REFERENCES

Ahqar, M. (2009). *Historical background and antiquities of Hamedan*. Hamedan: Islamic Azad University, Hamedan Branch.

Azhang, N. (2009a). The names of the old alleys, neighborhoods and streets of Hamedan. *People's Culture Quarterly*, 7 (26), 46-38.

Azhang, N. (2009b). Lawns of Hamedan neighborhoods. *People's Culture Quarterly*, 7 (26), 84-85.

Azkaie, P. (2009). Hamedan at a glance. *People's Culture Quarterly*, 7 (26), 12-21.

Azkaie, P. (2002). *Hamedannameh: Twenty speeches about Madistan*. Hamedan: Madistan.

Banerjee, T. (2001). The future of public space: Beyond invented streets and reinvented places. American Planning Association. *Journal of the American Planning Association*, 67, 1.

Beatley. T. (2016), *Handbook of Biophilic City Planning and Design*. Washington-Covelo-London: Oisland Press.

Beatley. T. (2011). *Biophilic Cities Integrating Nature into Urban Design a Planning*. Washington-Covelo-London: Oisland Press.

Biglari, E. (1977). Iranian Markets. *Journal of Art and Architecture*, (33-34), 39-49.

Browning. W., Ryan. C. & Clancy. J. (2014). *14 Patterns of Biophilic Design. Improving Health & Well-Being in the Built Environment*. Terrapin Bright Green llc, New York.

Cabanek, A. & Newman, P. (2016). Biophilic urban regeneration: can biophilicsbe a land value capturemechanism?, *Sustainable Development and Planning VIII*, 3, 65-74.

Cowan, R. & Rogers, L. (2005). *The dictionary of urbanism.* Streetwise Press.

Cutini, V. (2014). Spatial Analysis of Urban Squares, in: Smart City Planning for Energy, Transportation and Sustainability of the Urban System. *Journal of Land Use, Mobility and Environment*, Special Issue.

Durkheim, E. (1982). The rules of sociological method and selected texts on sociology and its method. The Free Press, New York, NY in Kantor, P. and H.V. Savitch (2005). How to study comparative urban development policies: A Research Note. *International Journal of Urban and Regional Research*, 29, 51–135.

Farshchian, A. H. & Balali Oskooi, A. (2016). Manifestation of perceptual geometry in the development of Iranian cities in history (case study: the city of Hamadan). *Urban Studies*, (15): 53-68.

Fehl, G. (2011). Berlin and London: two cultures and two kinds of urban squares. *Urban Morphology*, 15(2)-121-32.

Forrest, M. & Konijnendijk, C. (2005). A history of urban forests and trees in Europe, Urban Forests and Trees. A Reference Book. Berlin: Springer.

Fraser Walter, J. Jr. (2018). *Savannah in the New South: From the Civil War to the Twenty-First Century*. University of South Carolina Press.

Fromm, E. (1964). *The heart of man, its genius for good and evil*. New York, NY: Harper & Row.

Ghadakchi, E. (2009). Introduction on the historical role of neighborhoods. *People's Culture Quarterly*, 7(26): 22-37 (in Persian).

Grothe, H. (1991). *Travelogue of Grothe*. Translated by M. Jalilvand. Tehran: Markaz.

Harden, W. (2017). *A History of Savannah and South Georgia*. Vol. 2. Lewis Publishing Company.

Herzog, T. R. & Bryce, A. G. (2007). Mystery and preference in within-forest settings. *Environment and Behavior*, 39(6), 779-796.

Jackson, W. & Valentine, A. (2010). *Travelogue of Jackson (Iran in the Past and Present)*. Translated by M. Amiri & F. Badrei. Tehran: Kharazmi.

Jameh Bozorg, Z., Najafi, A., Fakharzarin, Z. & Heidari-Babakamal, Y. (2021). Study of the spatial and physical organization of historical neighborhoods in Hamadan during the Qajar period and their impact on the development of social relations. *Iranian archaeological studies*. 4 (14), 203-222.

Jones, C. & Charles Jr. (2017). *History of Savannah, GA: From Its Settlement to the Close of the Eighteenth Century*. Syracuse University.

Jordan, M. L. (2017). *Hidden History of Civil War Savannah*. The History Press.

Jordan, M. & Mick M. (2015). *Savannah Square by Square*. Historic Savannah Foundation, Spanish Moss Publishing.

Kellert, S. (2012), *Birthright: People and Nature in Modern World*. New Haven: Yale University Press.

Kellert, S. R. & Wilson, E. O. (1993). *The Biophilia Hypothesis*. Island Press.

Kimmelman, M. (2016). *City Squares: Eighteen Writers on the Spirit and Significance of Squares around the World*. Harper Collins.

Krier, R. (1979), *Urban Space*. London: Academy Edition.

Lang, J. & Nancy M. (2017). *Urban Squares as places, links and displays, successes and failures*. Taylor and Francis.

Marcus et al. (1998). *Urban Plazas: People Places: Design Guidelines for Urban Open Space, Van Nostrand Reinhold*, New York.

Marron, C. (2016). *City Squares: Eighteen Writers on the Spirit and Significance of Squares Around the World*.

Mehaela, S. (1993). The new urbanism movement: The case of Sweden (Unpublished master's thesis). *International Master Program in European spatial planning*. Japan, Osaka.

Mercerhouse, (2022). Retrieved from http://www.mercerhouse.com/history.htm

Merriam webster, (2021). Retrieved from https://www.merriam webster.com/dictionary/rus

Mofidi shemirani, S. M., Etemad sheykholeslami, S. F., Zarei, M. E. & Mortezai, S. R. (2022). Recognition of Neighborhood Native Open Spaces in Hamadan Community Centers. *Iranian Archaeological Research*, 11(29), 165-182.

Mostofi Qazvini, H. (2011). *Nozhatolqolub*. Corrected by G. Lestering. Tehran: Asatir.

Qaragozlu, Q. (2010). *Hegmataneh to Hamedan (history of centuries in our oldest city)*. Tehran: Iqbal.

Rašković S. & Reinhold D. (2015). The influence of trees on the perception of urban squares. *Urban Forestry & Urban Greening*, 14(2), 237-245.

Ritcher G. R. (1981). *Handbuch Stadtgrün–Landschaftsarchitektur im städtischen Freiraum [Handbook of Urban Greening*. Architecture of Landscape in Urban Open Space. BLV Verlagsgesellschaft, München. (in German).

Saberi Hamedani, A. (2004). *Detailed History of Hamedan*. Qom: Shaker.

Salingaros, N. A. (2012). Fractal art and architecture reduce physiological stress. *Journal of Biourbanism*, 2(2), 11-28.

Savannah, (2022). Retrieved from https://www.savannah.com/savannah-historic-district/

Tally, K. G. & Femida., H. (2015). Environmental Philanthropy and Environmental Behavior in Five Countries: Is There Convergence Among Youth? *VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations*, Vol. 26, No. 4, PP. 1485-1509.

Walker, N. R. (2011). Savannah's Lost Squares Progress versus Beauty in the Depression-era South. *Journal of the Society of Architectural Historians*, 70(4), 512-531.

Wilson, T. D. (2012). *The Oglethorpe Plan: Enlightenment Design in Savannah and Beyond. Charlottesville*. VA: University of Virginia Press.

Xue, F., Gou, Z., Siu-Yu L., S., KitLau, S., Hung Chung, K. & Zhang, J. (2019). From biophilic design to biophilic urbanism: Stakeholders' perspectives. *Journal of Cleaner Production*, 211(23), 1444-1452.

Zarei, M. I. (2012). the physical-spatial structure of the city of Hamedan from the beginning of the Islamic period to the end of the Qajar period based on available evidence. *Archaeological Letters*, 1(1), 52-87.

Zarei, M. I. (1997). Imamzadeh Yahya, *Hamedan Culture Quarterly*, 6 (23-24), 85-91.

Zucker, P. (1959). *Towns and Squares, from the Agora to the village green*. MIT press.

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