

Assessment of Urban Structure for The Holy City of Al-Najaf in light of Sustainability

Hamid Athab Al-Jameel

*Civil Engineering Department,
University of Kufa*

hamid.aljameel@uokufa.edu.iq

Ahmed Yahya AbdAbas

Dep. of Geographic, University of Kufa

Feyada@uokufa.edu.iq

Abstract

The sustainability represents a measure of the efficiency for the urban structure. Al-Najaf city is one of the most important cities in Iraq in terms of religious and historical issues. This study tries to assess AL- Najaf Urban structure – as a sample of Iraqi cities- in the light of sustainable to investigate the extent of the application of urban sustainability principles such as how the density of the population distributed across different quarters, the land use and the hierarchy of the roads in the city. GIS program has been adopted to represent the city and the length of roads. The results of this study indicate that the AL- Najaf urban spatial structure is inefficient, It contains a lot of faults, the city lacks in the hierarchy of roads and land use, which spread across a large area, the population density distribution is irregular, most densities are farther away from the city center, which leads to long trips and random and irregular in it.

Keywords: Al-Najaf city, sustainability, urban structure, road hierarchy and GIS.

الخلاصة

الاستدامة تمثل مقياس الكفاءة للتركيب الحضري. مدينة النجف الاشرف هي واحد من اهم المدن في العراق من الناحية الدينية والتاريخية. هذه الدراسة تحاول ان تقيم البناء الحضري لمدينة النجف -كعينة من المدن العراقية- في ضوء الاستدامة لاكتشاف مدى تطبيق مبادئ الاستدامة ككيفية الكثافة السكانية موزعه على الاحياء واستخدام الارض والتوزيع الهرمي للطرق في المدينة. برنامج GIS قد تبني لتمثيل المدينة وطول الشوارع. النتائج في هذه الدراسة بينت بان البناء الحضري لمدينة النجف هو غير كفؤ وهو يحتوي على كثير من الاخطاء المدينة فيها نقص في هرمية الطرق و ان استخدام الارض تنتشر على مساحة واسعة وكثافة السكان تتوزع بصورة غير منتظمة واغلب الكثافات هي ابعد عن مركز المدينة والذي يؤدي الى رحلات طويلة وعشوائية. **الكلمات المفتاحية:** مدينة النجف الاشرف، الاستدامة، البناء الحضري، هرمية الطرق و GIS.

1. Introduction

Al-Najaf city is from the ancient city which has been mentioned in the history before burying Al-Imam Ali (A.S.) there (Alabdly, 2016). Nowadays, Al-Najaf city is one of the Iraqi provinces locating to the south of Baghdad by about 120km as indicated in Fig.1. The corner stone for the city is the old city which represents the historical foundation. This old city is located on a plateau which is higher by 60m over the level sea. Level terrain represents the eastern bound for the old city; whereas, Al-Salam cemetery lies on the north and east bounds of the city represents Al-Najaf Sea. The east bound represents the Kufa city.

The road links Najaf with Kufa has been developed rapidly and his influence is so obvious in the land use along this road. A lot of institutions, medical centers and educational institutions were constructed. This made the area around the road as a highly developed area with different activities.

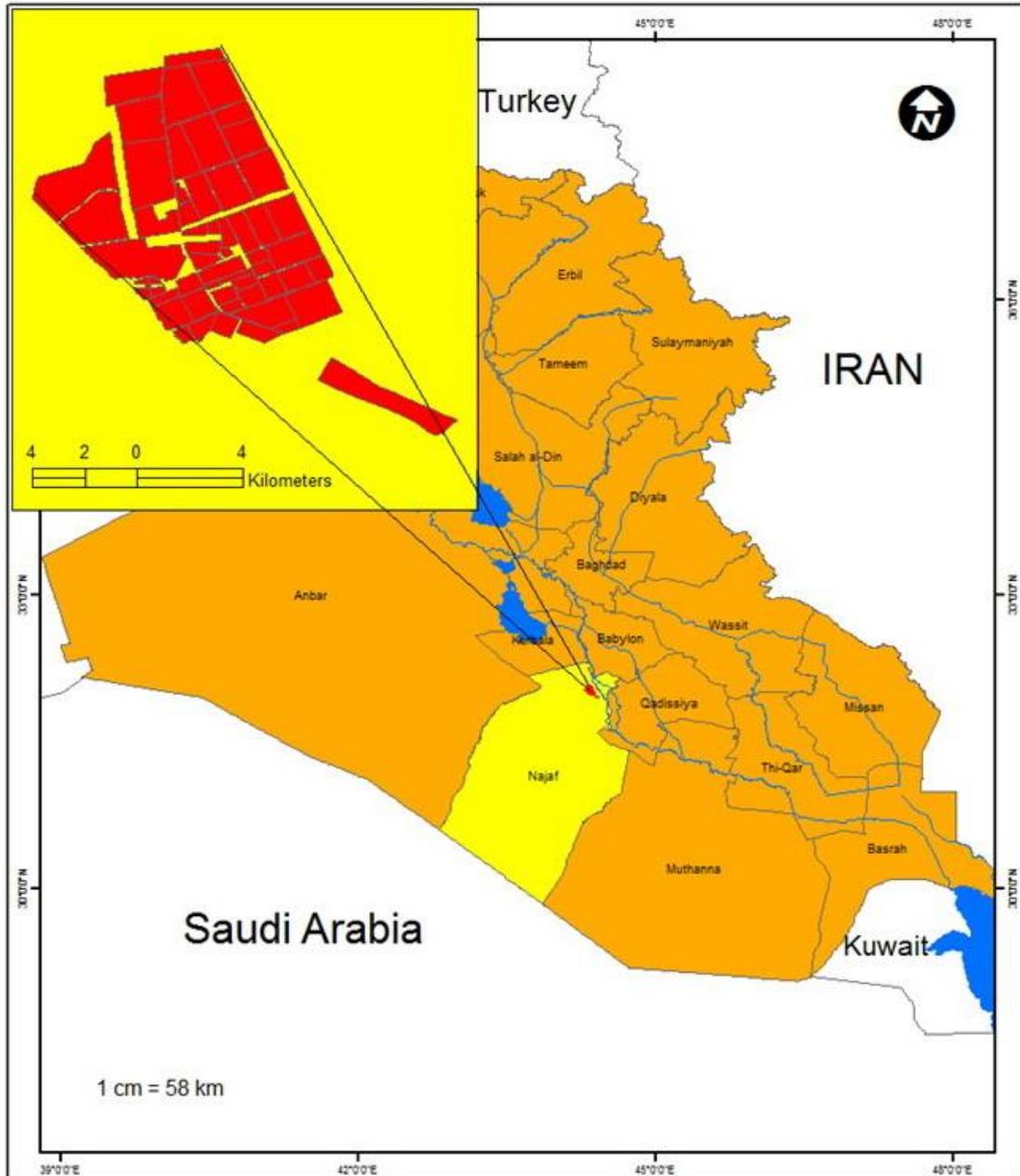


Fig1. Site of the city of Najaf, Iraq

However, the central development for Al-Najaf city is around the Holy Shrine of Al-Imam Ali (A.S). The city contains residential and commercial areas in addition to its religious issues such as mosques and cemetery. Due to increasing in the number of populations with the significant increment in economical facilities, the city has been growth and it was extended to ward the east along Kufa-Najaf road in the north direction. On the other hand, another extension is in the Kerbela-Najaf road and in the direction of Al-Dewainay city. This leads to developing a residential area away from the city Centre. Accordingly, the opportunity of extension is just for north (Kerbela-Najaf direction) and south-east (Najaf –Manathera direction) (Tweej , 2008).

To organize the city in terms of administrative and metropolitan, it was divided into five sectors: firstly, Old city sector (Al-Meshraq, Al-Braq, Al-Umara and Al-Hwash), secondly, Al-Jedadat sector (First Jedada, Second Jedada, Third Jedada and Fourth Jedada), thirdly, South Sector including the right side of Kufa-Najaf road

which extended from Najaf to Kufa, the fourth sector is the north sector including the area on the left side from Kufa-Najaf road and the fifth sector is Al-Radawea sector(Report No.1, 2007) ,as indicated in Fig.2.

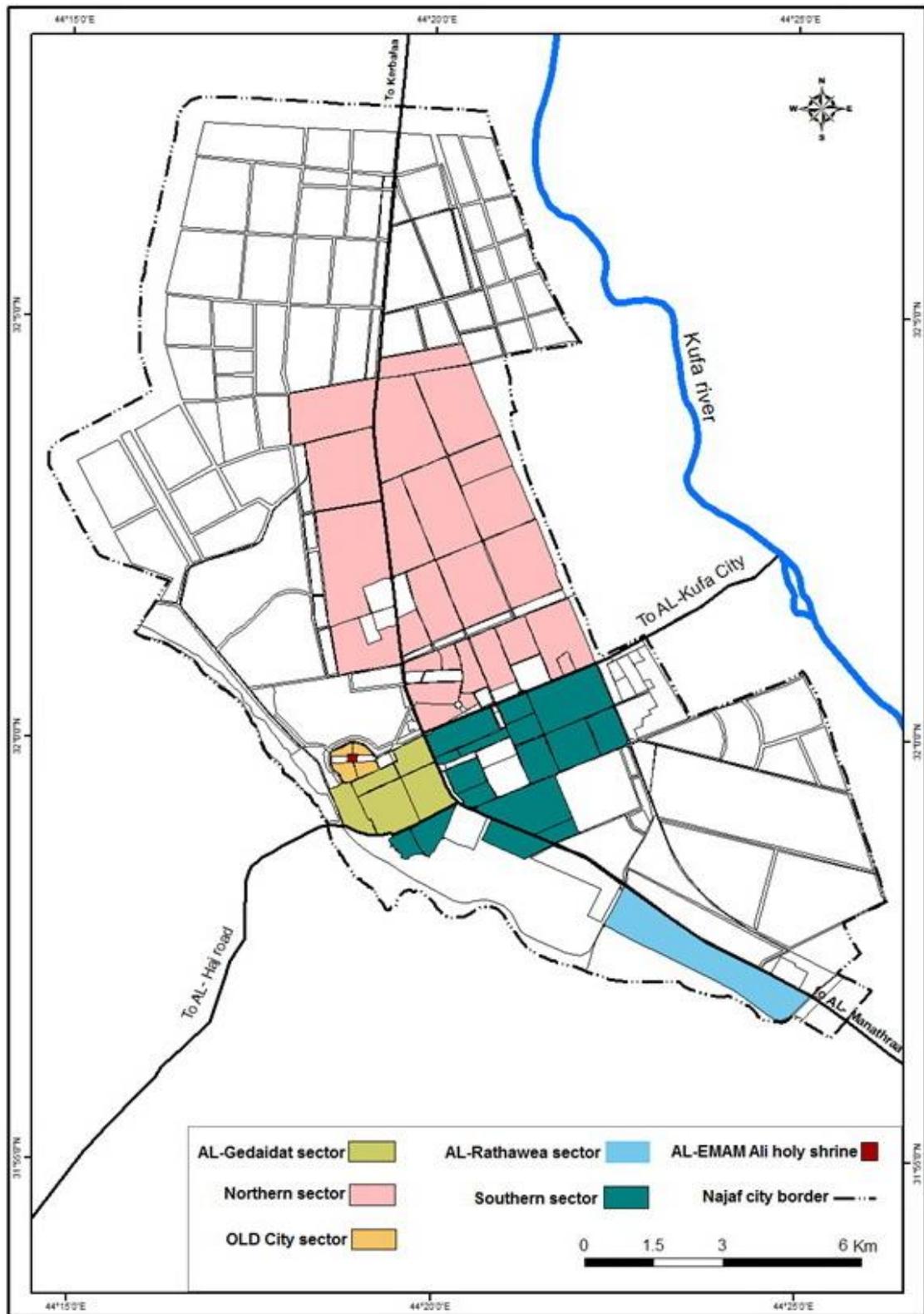


Fig.2 Holy city of Najaf sectors.

The aim of this study is to assess the city in terms of sustainability measures such as how the population density spread over the city land and the hierarchy of its roads. To implement our aims of this study, the GIS program has been used as practical application, including building database to connect these data with their descriptions. This will help in studying different spatial phenomena that deals with different storage data. These databases are ease in terms of retrieval, display and coding, storage and change between adding and dropping.

The study is based on data of remote sensing, such as visible US moon (Quick bird) discriminatory accuracy (60 cm) taken to the holy city of Najaf and corrected from the source, used in the operations of the visual interpretation of the visible through reliance on standards and elements of interpretation as the size, color, shape, color, fabric and other. As has the use of maps design basis prepared by the architect firm (ADEC) and Associates (Liewelyen Davies Yeang) and (TRIBAL Urban Studio) year (2010), a scale (1: 60,000) and (1: 125 000), corrected (Registration), according to the global system of coordinates (UTM), according to the option (Image to Image), using a program ((ERDAS IMAGINE, as well as the study is based on the sectoral charts for shops and neighborhoods in the holy Najaf Municipality Directorate and the Directorate General of Urban planning in the holy city of Najaf, the city of Najaf. This scale (1: 1000. And 1: 2000) (Report No.2, 2010).

The data entry, analysis and coding and creation of files and classes and definition of coordinates, a trader with the system at work, layout area of the data using a program (ARC GIS), which includes several attached to programs, since this program provides high flexibility in the field of coding and representation Alcartokrava and classification of phenomena and has a high capacity to deal with cadastral data (Raster) and linearly (Vector).

2. Urban Structure and Sustainability

There is a relationship between urban structure and sustainable development. This relation is not simple and direct. The sustainable urban structure for the city requires suitable size for riding bikes, walking, efficiency of public transportation and making improvement in the health social status and environment of the city. This helps in the efficiency of land use, the use of a minimum number of vehicles, the mobility, fewer amounts of pollution, good accommodation, and health living environmental.

A lot of studies refer those dense cities which depend on public transportation and provide a hierarchy for different functions. The dense city provides all urban sustainability requirements. This is a reasonable solution to the dangerous challenges that facing the world through the comprehensive and local solutions.

Urban structure represents the physical shape or urban structure that reflects on each joints of the city, especially transportation movement and economical activities (Sandra, 2008). Another definition could be as the spatial style or arrangement of individual elements such as buildings and land use in addition to social and economic activities, public institutions within an urban area, the distribution of the population and networks that connected them; whereas, spatial structure is the spatial distribution for the population and lane use in the urban area or it is the style of the daily journey within urban areas (Bertaud, 2001). The urban structure connects with the developing transportation system.

The relationship between the transportation and land use is so complex. The urban structure has reverse feeding relation with the transportation and trip demand. It is the first step towards understanding the urban planning process. The urban spatial structure is complex. It is a natural result of unseen function relationships resulting

from city activities (residential, commercial, industrial and services) in one hand and on the other hand, the limitations and determinations of developing these activities (land cost, limitations of constructions and social behavior). Moreover, the urban structure has a clear effect on different urban activities and their distributions.

Generally, the cities could be with one center or multi-center which should be taken into consideration in order to evaluate the urban structure. The type of city could be recognized depending on public transportation lines. If these lines connect to the city center is the only the city with one center; whereas for mutli-centers city the movement of public transportation is connected with the outskirts of the city.

There are different patterns for city configurations which connect with topographical and physical factors in addition to economic factors as indicated in Fig.3. Fig. 3-a represents compact development which is the best pattern among others. Pattern in Fig. 3 -b is the scattered one which spreads on a large and arbitrary area. Pattern c, the linear strip connects mostly with the growth around movement axis due to the benefit from economic opportunities providing for this movement. When the city becomes large, the pattern d is the dominant one. Finally, pattern e is known as leapfrogging due to leaving some area without developing and transferring to the next one.

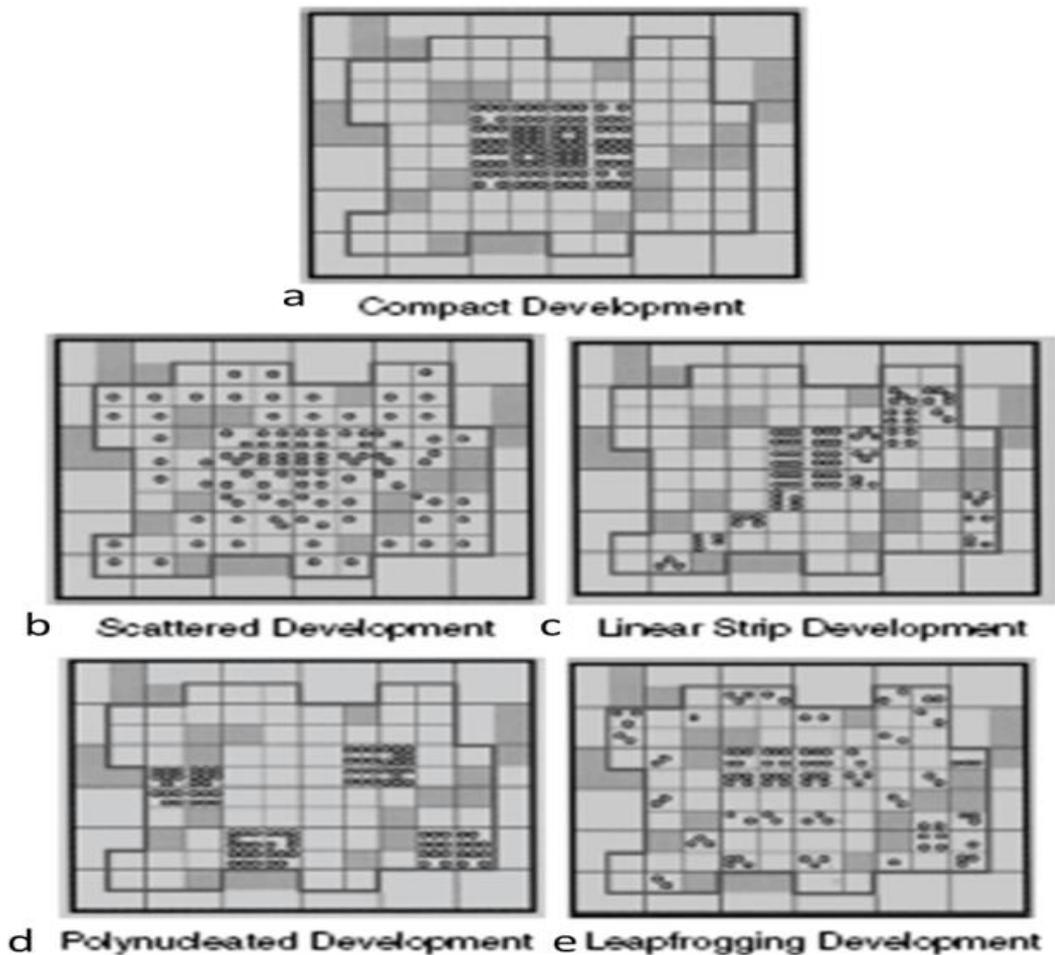


Fig.3 Physical pattern defining sprawl (Galaer *et.al.*, 2001).

Due to the religious and cultural importance of Al-Najaf city for the Islamic community in Iraq and other countries in addition to its location and its relation to other regions, the city has witnessed rapid urban development. This development depends mainly on the accelerator possibilities which lead to increasing the population growth either normal growth or the growth resulting from immigration from different regions due to different reasons for various periods (Tweej, 2008). Consequently, dominated city in terms of population and area has been produced.

3. Population distribution

Table 1 shows the population number for 2016 is 851351.6 people distributed over the city as indicated in Table 1 and Fig.4. One could say that the first class (0-68.4 people/Hectare) which represents low population density in some quarters such as Al-Furat and Al-Qudas. This low density results from large house with low people as in Al-Furat. On the other hand, high density quarters (309.9-481.4 people/Hectare) are represented by (Al-Ansar, Al-Hwaesh, Al-Jadeeda, Abu-khalid, Al-Rehma and Al-Hussein). This type is characterized by small houses and high persons in addition to be unplanned quarters. The rest could be within moderate density.

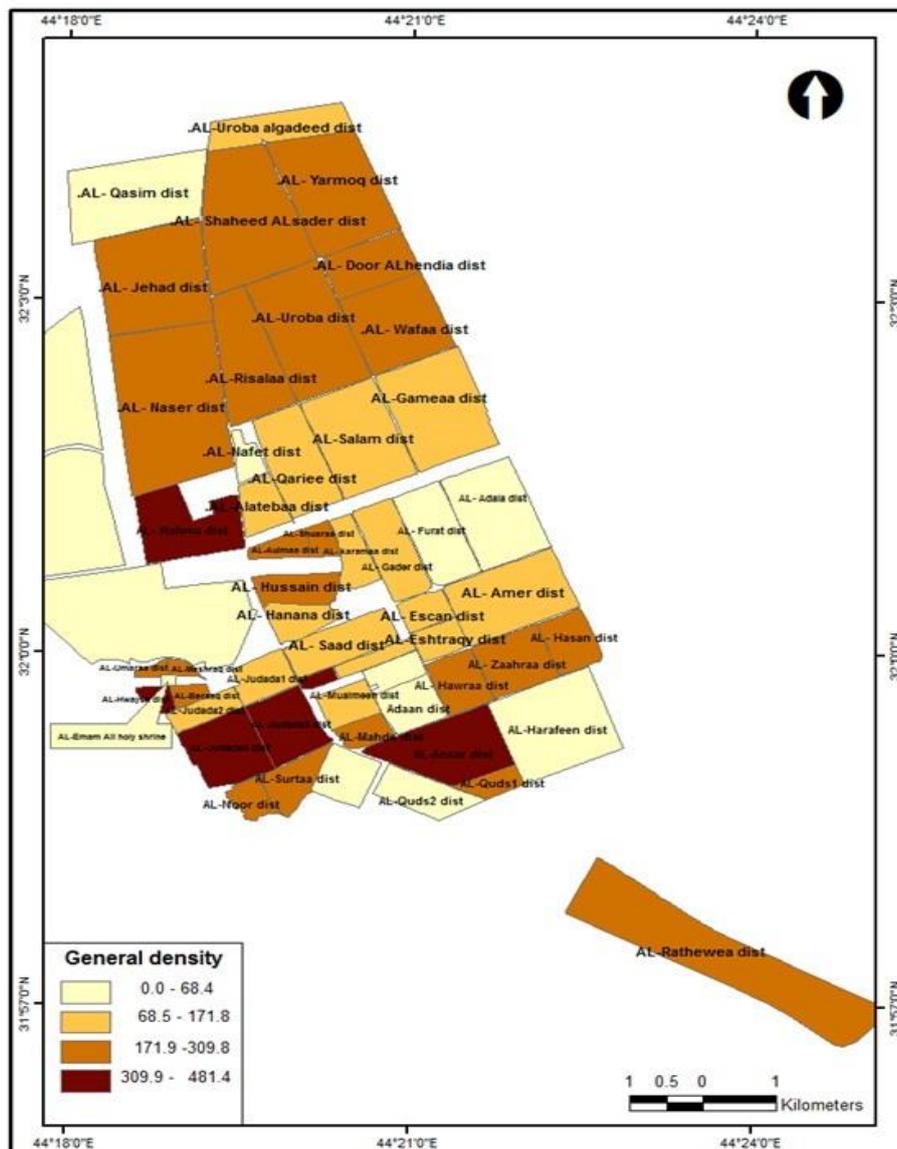


Fig.4 General population density (person / hectare) as Districts in the holy city of Najaf in 2016

Table (1): General population density by Districts in the city of Najaf in 2016.

District name	No.of population 2016	area (hectare)	General density of the population person / hectare	District name	N0.of population 2016	area (hectare)	General density of the population person / hectare
AL-Hanana dist	4136.0	39.808	103.9	AL-Wafaa .dist	27741.61	145.37	190.8
AL-Hussain dist	11269.35	41.18	273.7	AL-Rahma dist	26797.1	61.36	436.7
AL-karama dist	7093.27	41.28	171.9	AL-Zaahraa dist	20969.47	72.28	290.1
AL-Gader dist	9485.58	82.03	115.7	AL-Eshtraqy dist	3657.952	29.93	122.2
AL-Gamea dist	26623.04	180.45	147.5	AL-Saad dist	7114.859	76.06	93.5
AL-Risalaa .dist	24607.18	114.12	215.6	AL-Salam dist	24881.09	167.18	148.8
AL-Rathewea dist	40966.1	210.82	194.3	AL-Uroba dist	50600.1	212.06	238.6
AL-Qarree .dist	8391.3	95.06	88.3	AL-Aulmaa dist	4501.265	21.71	207.3
AL- Jihad .dist	62487.43	273.52	228.5	AL-Alatebaa .dist	6979.929	41.89	166.6
AL-Shaheed ALsader .dist	52391.97	231.544	226.3	AL- Furat dist	3365.154	54.27	62.0
AL-Yarmoq .dist	61664.36	202.92	303.9	AL- Adala dist	8813.628	128.75	68.5
AL- Qasim .dist	52748.18	192.28	274.3	AL-Muthnaa dist	2216.9	19.45	114.0
AL-Mahde dist	5548.32	27.212	203.9	Abokhaleddist	2303.255	5.28	436.2
AL- Escan dist	3787.48	29.58	128.0	AL-Noor dist	5629.28	25.6	219.9
AL- Amer dist	18942.82	151.24	125.3	AL-Urobaalgadeed .dist	8439.872	73.81	114.3
AL-Ansar dist	51431.27	137.12	375.1	AL-Hasan dist	15681.56	50.61	309.9
AL-Beraaq dist	3571.597	12.7	281.2	AL-Shurtaa dist	9480.182	45.97	206.2
AL-Meshraq dist	1843.144	6.937	265.7	AL-Quds1 dist	4302.918	19.66	218.9
AL-Hwaysh dist	5228.54	15.12	345.8	AL-Quds2 dist	5306.797	78.17	67.9
AL-Umaraa dist	1968.63	7.26	271.1	AL-Mualmeen dist	6441.558	48.83	131.9
AL-Judada1 dist	9016.02	44.56	202.3	AL-Hawraa dist	10168.32	52.98	191.9
AL-Judada2 dist	4848.03	32.21	150.5	-----	-----	-----	-----
AL-Judada3 dist	27742.96	57.62	481.5	-----	-----	-----	-----
AL-Judada4 dist	34492.16	97.74	352.9	-----	-----	-----	-----
AL- Door ALhendiadi .st	16654.41	78.674	211.7	-----	-----	-----	-----

4. Land use

Al-Jera represents the fundamental unit of Iraqi city structure and it is the smallest unit for the city. This is the idea of KlarnsBerl in 1925 (Walters *et.al.*, 2004). He put this idea as a part of his report about regional planning in New York city to be as a guide for developing urban area. This was produced due to arbitrary distribution of houses and congested traffic in America during the first twenty centuries.

Figs. 5 and 6 indicate the land use in two different districts (Al-Eshtraqi and Al-Mahdei). These figures demonstrate how land use distributes from residential, commercial and industrial.



Fig.5 Land use in the AL-Eshtraqi District 2016.

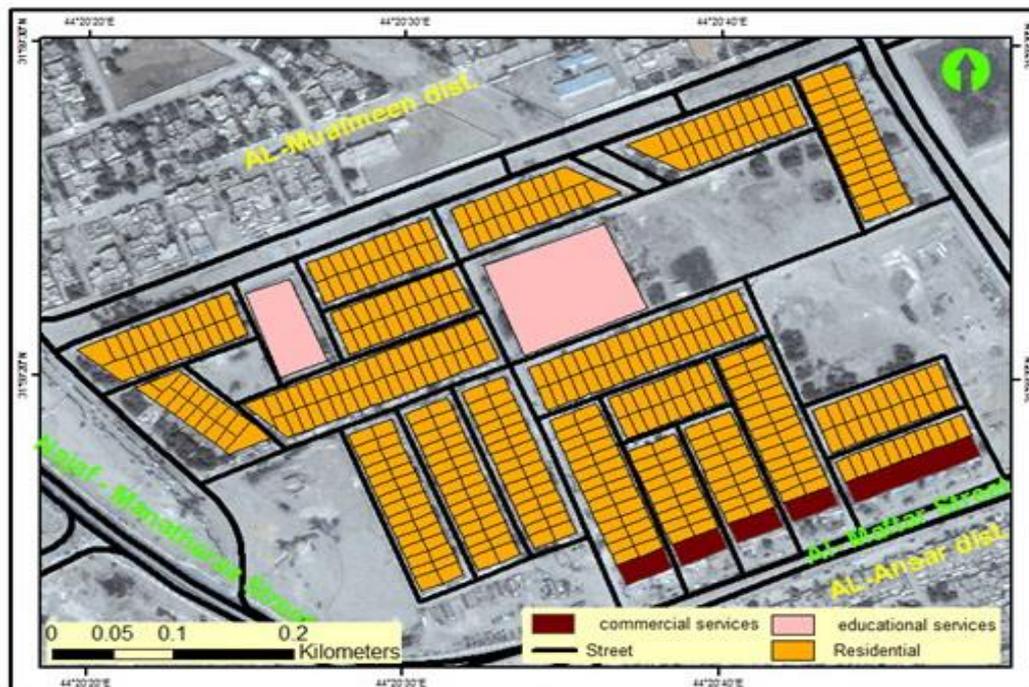


Fig.6 Land use in the AL-Mahdei District 2016

5. Hierarchy for the roads

The optimum hierarchy of the roads provides the suitable mobility and accessibility for each class of road as indicated in Fig. 7. The hierarchical distribution for the roads in Al-Najaf city indicates (see Fig. 8) a large lack of these roads, especially in the peak hours and several bottlenecks along some major roads in the city.

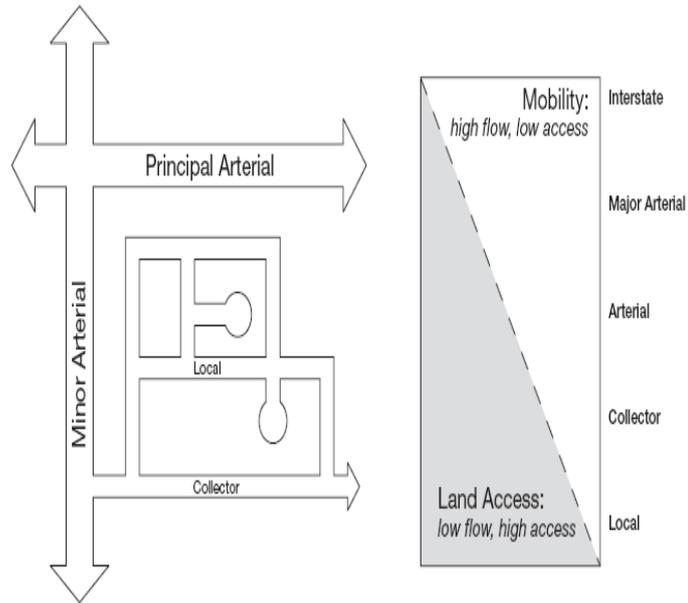


Fig.7 Hierarchy of roads with accessibility and mobility.

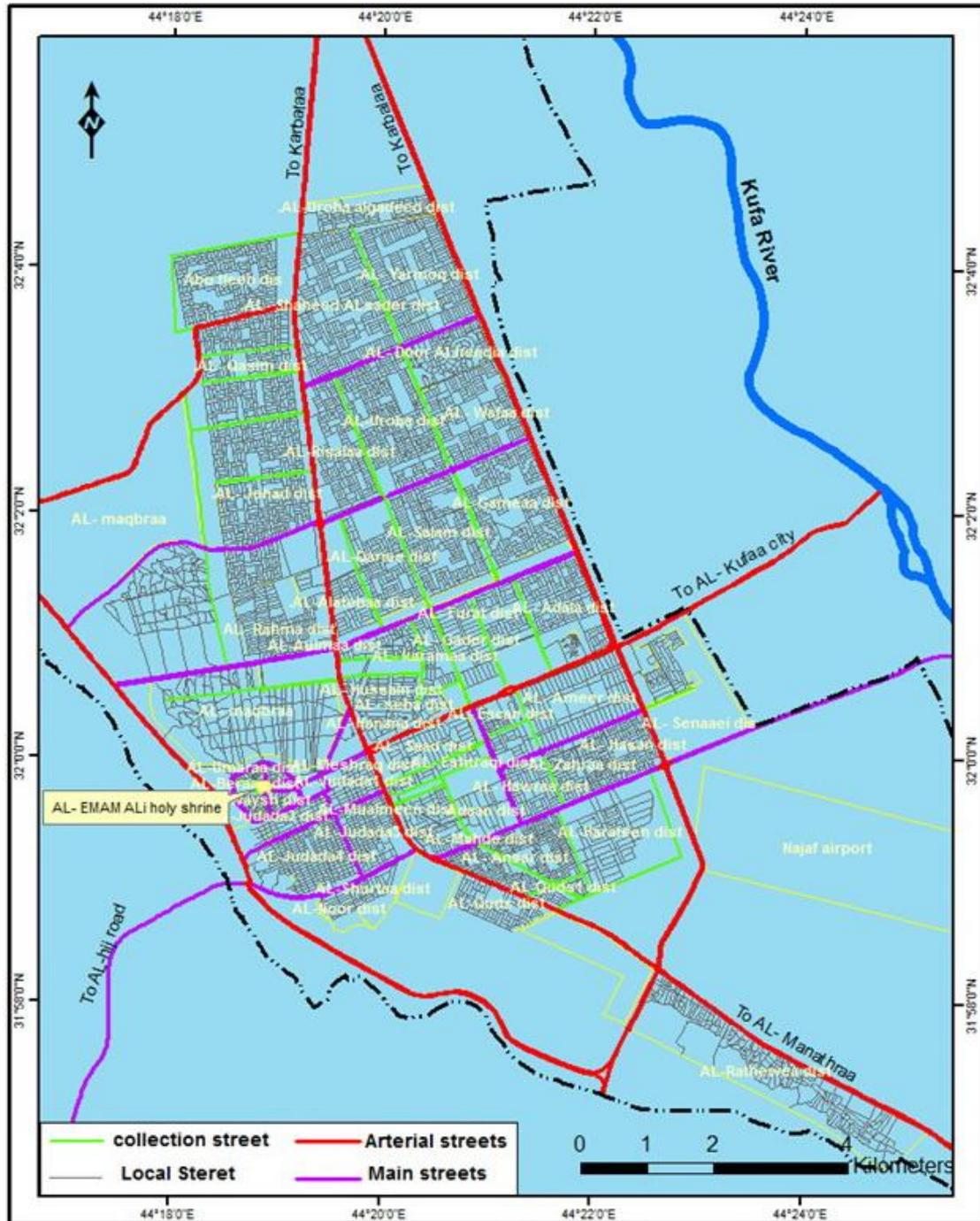


Fig.8 Varieties streets in the city of Najaf in 2016

There is a lack in the arterial roads for the city, according to the HCM 2000 which are parallel to Al-Kufa-Najaf arterial road or these perpendiculars to its direction. There are three alternatives could be used: firstly, highway option as in the US. Secondly, it is a public transportation as in the Europe or finally a mixed option (balance option). For the first option, it needs more new roads and interchanges over these roads to provide mobility and accessibility as indicated in Fig.7. But for the second one there is a need for new lines of Tram or Metro or train.

For each road, there is a function within the city structure. The hierarchy ought to satisfy the accessibility for roads. The sustainability requirements insisted on encouraging the use of public transportation rather than the private transportation and

give the priority for using bike and walking to reduce the pollution and congestion. Therefore, the re-structure of transportation system needs studies and planning policies to consider planning roads, origin and destination for buses connecting with pedestrian movements as mentioned in Towers (2005).

On the other hand, a sustainable highway is required to satisfy lifecycle functional of social and economic needs to enhance the natural environment and reduce consumption of natural resources to meet the present requirements without compromising the ability of future generations (Asim, 2014).

Asim (2014) reported that the factors (measures) which affect pavement performance criteria are traffic volume, roughness, pavement serviceability, International Friction Index, pavement strength, air pollution and noise. In Al-Najaf city, according to the GIS program, it was found that more than 60% of roads are in bad conditions and with very low serviceability indices. More than 90% of local roads are out of the serviceability index in most quarters such as Al-Mkrama, Al-Jamah, Al-Askiri, Al-Meelad, etc.

6. Criteria of road lengths

GIS model has been adopted to determine the length of roads for each quarter. Using analysis function in the GIS is to intersect overlays of quarter with road overlay to get second generation information which is useful information in the analysis. The merits of using such function in the GIS help storing new information in a new layer. Table 2 indicates the lengths of road in the whole city in terms of principle arterial, minor arterial, collector and local. The calculated results show that the percentage of length for arterial is within the range as mentioned by FHWA (2016) see Table 3. Whereas for minor system is out of the range as well as for collector and the local system. This demonstrates the urgent need for increasing the percentages of minor arterial and collector system. Moreover, most of roads suffer from low serviceability which leads to low capacity. This makes unbalanced flow distributions among these roads leading to congestion phenomenon on some roads.

Table (2) Calculated length and percentage of roads using ARC GIS.

Street type	Length(km)	Percentage (%)
Arterial system	68.1838	5.478
Minor arterial system	44.06746	3.5404
Collectors Streets	51.6294	4.148
Local Streets	1080.791	86.8334
Total	1244.672	100

Table (3) Guidelines of percentage of total road length (FHWA, 2016).

System	Percentage of total road length
Principal arterial system	2-4%
Principal arterial plus minor system	6-12%
Collector road system	20-25%
Local road system	65-75%

7. Discussion

The residential density gives an important indicator for the urban planner to distribute and re-arrange the fundamental functions for the city, according to its size, number of populations in order to create efficient urban environment in its functions

and services. Fig. 4 indicates that the net density in the quarters of the city does not have harmonic gradation. This never agrees neither with Clark principle regarding with density gradation as shifting away from the center nor Newzlink in the reduction of population number in the city center. But it satisfies with Northam in population density variation. In Al-Najaf City in 2016, the density is higher in the city center and starts decreasing relatively in the area away within the city center. Then, the density raises and drops towards eastern, southern east and northern west the because of the outskirts of the city. The issue of non- uniform in the quantity and direction of density in general refers to the privacy of Najaf city in its natural conditions, historian, and economic, social and cultural characteristics.

Generally, cities change continuously due to economic or demographic or social factors. This is due to the fact that the cities represent collecting of different powers for several functions and services which have connection resulting from continuous functional interactions. This interaction among these activities and changes within urban environment is a complex interaction which leads to economic and function changes has an effect of urban city architecture and urban Morvologitha.

The change is based on a disciplined and systematic foundation may be emphasized natural and healthy state of change. It may be a way uncontrolled terms of planning, which would entail negative effects of working to undermine the Layout balanced land use and confuse the functions of the city and the aging of urban structure, from here highlights the importance of guiding the development and growth of the urban environment and upgrading of intent to create a functional balance and behavior of an ideal of the elements of the urban fabric It provides a decent life for their community and create an atmosphere suitable for living, work and rest.

The Al-Najaf city has characterized by fast development based on the provisions of fasting possibilities. This city has different elements of attracting such as religious issues not only for local people, but people from different parts of the world. This leads to increase in the average of growth in population due to normal growth or growth resulting from immigration from other different cities. This produces large population results in city with high population and area within Al-Najaf city.

During its history, Al-Najaf city has two types of urban growth: one is arbitrary (unplanned) and the second is planned (1976-2000). The first one makes the city suffering from arbitrary in distribution which led in narrowing the extension in the area and unbalanced in functional performance; whereas, the second one was more realistic with the city conditions and urban environmental (Fuad, 2011). However, after 2003, the illegal used of the land, extension, changing the building and their functions lead to unplanned growth and this has negative effects on the city. Therefore, the city suffers from an absence of functional hierarchy. The population density was not considered with urban functions. It seems to be as one residential sector and other land uses are distributed in different sides of the city. This affects the land use within the master plan and has bad influence on the transportation planning (Fuad, 2011).

8. Conclusions

The main points come with this study could be summarized as:

1. The urban spatial is not efficient due to unplanned distribution coming from the fast development in some quarters.
2. There is a lack of road hierarchy in terms of length and percentages of specific road system.

3. The sustainability measures for urban structure and highway suffer from high lack in terms of population density, road rutting and other measures mentioning in previous sections.

References

- Alabdly, K. 2016. Islamic Holy Cities and It's Contemporary Constituents Case study: The City of An-Najaf. PhD Thesis. University of Baghdad, College of Engineering.
- Asim, B. 2014. Developing Sustainability Performance Measures for Highway Facilities in Iraq. MSc Thesis, AL-Mustansiriya University, Iraq.
- Bertaud, A. 2001. The Spatial Structure of Cities. Washington.
- Clarke, J. 1972. Population Geography. Second Edition
- FHWA 2016 http://www.compassidaho.org/documents/prod_serv/func/Rural-Functional-Classification.pdf (Accessed on 25/9/2016).
- Fuad, A. 2011. Geographical Analysis for Functional Changes Within Urban Structure for Al-Najaf City After 1990. PhD Thesis, University of Kufa.
- Report No.1. 2007. The Ministry of Municipalities and Public Works, Directorate of Najaf. Unpublished data.
- Report No.2 2010. The Ministry of Municipalities and Public Works, Urban Planning Directorate in Najaf. Unpublished data.
- Rymond.E.Murphy. 1966. The americencyahurbangeography mc graw-hill book company newyourk, 1966,p.158.
- Sandra , W., Cunningham , B., Dacanay, R., Howard, A., Jortner, R., Martin, K., and Raggett, M. 2008. Urban form. Comp Plan Evaluation –Urban Form Technical Working Group Draft.
- Tweej, W. 2008. The Urban Growth in Al-Najaf City. MSc Thesis, University of Kufa, Educational College for Girls.
- Walters , David and Brawen , Linda Lusise 2004. "Design First" Design Based Planning for Communities. London, p 57.