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Urban Resilience and City Infrastructure

Urban resilience of Baghdad

Dr. Sanaa Sati Abbas [a]
sana2010a@yahoo.com

Sura Kassim Ameen [a]
9008@uotechnology.edu.iq

University of Technology / Department of Architecture/ Iraq - Baghdad [a]

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ABSTRACT

This paper aims to study urban resilience as an adaptive system in a complex dynamic world along with its ability to comprehend disorder, change and reorganization to conserve identity. Urban resilience can be understood through the interrelationship between people and nature as a source-ecological system. The case study is represented by analyzing (Adelaide City in Australia) in depending on resilience advantages in which optimized by a renewable resource, zero carbon, equity in distributing energy, active environment, sustainable transportation and investing natural materials. Hence, these advantages have been applied on (Al-Karkh Haifa Street) in Baghdad in order to develop its infrastructure by employing renewable resources such as energy, sustainable transportation, refuge recycling, water system and submit suitable solutions for sewage water.

المرونة الحضرية والبنية التحتية للمدن

المرونة الحضرية لمدينة بغداد

أ.د سناء ساطع عباس [a]
sana2010a@yahoo.com

سرى قاسم امين [a]
9008@uotechnology.edu.iq

الجامعة التكنلوجية/قسم هندسة العمارة/العراق- بغداد[a]

المستخلص:

يتناول البحث موضوع المرونة الحضرية باعتبارها نظام قابل للتكيف والتنوع في عالم ديناميكي معقد , فضلا عن قدرته على استيعاب الاضطراب والتغير ثم إعادة التنظيم حفاظا على الهوية . تفهم المرونة الحضرية من خلال العلاقة بين الناس والطبيعة في النظم الاجتماعية والبيئية. تمثلت مشكلة البحث بوجود فجوة معرفية حول المرونة الحضرية للبنية التحتية للمدن , ويهدف البحث الى توضيح كيفية تحقيق المرونة في البنية التحتية للمدن , ويفترض البحث ان بالإمكان تطوير البنى التحتية للمدن القائمة من خلال ميزات المرونة. تمثلت الدراسة العملية بتحليل مشروع عالمي هو اديلايد الاسترالية اعتمادا على مميزات المرونة ثم محاولة تطبيق هذه المفردات على مرونة البنى التحتية لشارع حيفا \ منطقة الكرخ في مدينة بغداد .

توصل البحث الى اهمال جانب البنى التحتية لهذه المنطقة وبالإمكان تطويرها من خلال اعتماد مفردات الطاقة المتجددة في توليد الطاقة الكهربائية واعتماد النقل المستدام (السيارات العامة والدراجة) بدلا من الخاصة ومحاولة إعادة تدوير النفايات وإعادة تصنيفها بدلا من تركها مكدسة في الأماكن العامة وتطوير شبكة الحفاظ على الطاقة والمياه ووضع حلول مناسبة لتصريف مياه المجاري .

الكلمات المفتاحية
المرونة؛ المرونة الحضرية؛ البنى التحتية؛ الطاقة المتجددة؛ إعادة تدوير النفايات.

Introduction

The city is an entity of a dynamic nature, controlled by some variables such as (climatic, social, economic and technological). As a result of the rapid growth and urban development witnessed in the world after the industrial revolution, the cities encountered severe pressures and contradictions between the requirements of life and its renewable technology and the external influences. This dangerously rapid change threatens the balance of the city's functional entity, its composition, and the features of the urban environment that have been marked by confusion and distortion as a result of losing control over change and the lack of balance between traditional urban life and the demands of contemporary life and future trends. All this required intervention to control change in regards to a new vision. The future vision will be used to use resilience as a method to describe human activities that are intelligent, secure and sustainable, capable of adapting to the new 21st century technologies, and having systems that enabling them to respond to extreme events, as well as being built in the past and sustainable to be part of the solution to influential changes in cities generally and on society in particular.

- The research problem: - A knowledge gap about the role of urban resilience in urban city infrastructure.
- The objective of the research: - How to achieve resilience in the infrastructure of city.
- The research_methodology: - Building a knowledge framework on both urban resilience, infrastructure, extracting vocabulary and indicators concerning to urban resilience and infrastructure.
- Extract the theoretical framework, vocabulary for measuring the resilience of the infrastructure.
- Application of the theoretical framework, vocabulary in a local area (Al-Karkh / Haifa Street).
- Research results and conclusions.

The Resilience

"Resilience" has been chosen as a term for the planning and design strategies, develop the capacity needed to face the challenges of the future. It is an ecological term that represents the ability of the ecosystem to withstand various disturbances without collapse or it is the ability of materials to withstand external influences without the Change. (Brand-et al, 2007, P23). The need of cities to increase its capacity to be resilient, through the planning and approval strategies that allow to develop its ability to react better respond and adapt to the economic, social and physical pressures that will face because they face, challenges of increasing energy capacity, climate change, population change and natural disasters (Karol, 2012, P13)

There are several definitions of resilience**:**

- Resilience means: the ability to adapt to disturbances and to invest in unforeseen opportunities (A Dictionary of Environment and Conservation, 2007, P 332).
- Resilience means the possibility of change, and the choice of the easiest solutions from the available alternatives, undo the order taken when the finding a better decision. (Holling, C. S.1996, P13 -44).
- Resilience is the product of successful adaptation processes and it is the result of strong adaptive capacities of governments, Institutions, civil society organizations, families and individuals (Global Report on Human Settlements Cities,., 2011, P37).
- Resilience is the ability of the system to absorb a particular disorder and to reorganize the underlying structure when change occurs. In order to remain the basis for the same function, structure, and identity. (Walker-el al, 2006, P5).
- Resilience is an adaptive and diverse system within a complex and dynamic world, have the ability by repetition developed to read from a resilient perspective. Continuous change and prediction are difficult to apply in this system. The resilience thinking is a new way to search in the natural world and it’s part of a world made by man (Sawin-el al, 2007, P90-107).
- Resilience is the ability to absorb disturbances, reach change, then reorganize and maintain the same identity (retaining the same structure and basic means of action). This includes the ability to

learn from disturbance, it is a flexible system adapted to shocks. (*http://www.resalliance.org/3871*, 2010, P15)

The procedural definition of resilience: -

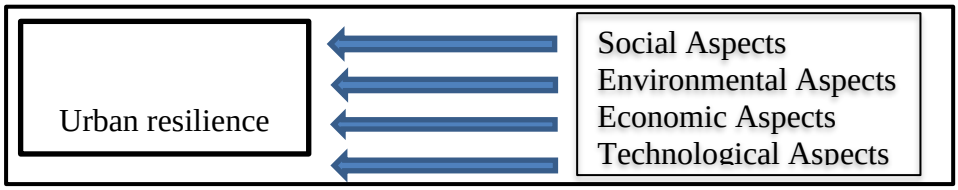
The ability of the system to absorb the disturbances as a result of changes and reorganize itself in order to preserve the identity of the city.

The most important vocabularies that emerged through the definition of resilience are:

- Changeability, adaptability, diversity, ability to absorb disturbances, change and reorganization in order to preserve the identity and structure.

The Urban resilience

The Urban resilience is the capacity of the system and social, environmental, and technical networks to maintain urban areas or to quickly return to the functions required to face of disturbance, adaptation to change, and rapid transformation of systems that will enable current or future adaptability. (Müller,,2010, P18,).The Urban resilience is dynamic and offers multiple paths of resilience that represent, advance, and transition across formations. (It calls for general adaptability rather than adherence and visualization). Urban systems are complex, adaptive and consist of social, environmental and technical networks that extend across multiple spatial ranges, (Adger-el al, 2013, P347-364). It is understood through a related and equal relationship between people and nature in social and environmental systems. Urban resilience assumes that social and ecological systems are complex in cities and are in fact constantly changing and subject to change when faced with a less or greater degree of disturbance. Their ability to innovate and use the assets available, to be renewed and to rebuild themselves. (Carmin-el al , 2012, p40).Urban resilience as a theory is contemporary theory. Ecologists mentioned that urban resilience helps to improve the integration of the environment, social sciences and planning to enhance urban resilience and help cities to adapt in the context of change. More effective assistance comes from working together in different disciplines and areas of knowledge, bringing designers, ecologists, sociologists, economists, policy makers and community partners together to solve the problem and improve the capacity of cities to adjust, adapt and preserve the environmental, social functions, identity and quality of life. This can be illustrated in“ Fig. 1” (Resilience Alliance, 2007, P11).



“Figure 1” shows resilience in various aspects / prepared by researchers

Urban resilience relationships in different aspects

1- **The Economic aspects:** This aspect addresses the economic resilience of the cities, which included industrial and economic diversification, contributing its growth, providing an appropriate spatial environment that contributes to the growth and innovation of creative ideas, in order to the resilience of cities and facing economic challenges by providing employment opportunities for the entire population.

- The diversity in industries.
- The dynamic economy of generating growth
- The spatial conditions that allow innovation
- Provide jobs, education, services, skills training and provision for people. (OECD, 1961,P16).

2- Environmental aspects The ecosystem is the basis for creating and sustaining cities by providing an ecosystem that has adapted to the various climatic changes and benefiting from local resources, seeking to increase these resources through their investment and development through:

- A diverse ecosystem.
- Meeting the basic infrastructure needs.
- The existence of adequate natural resources.

- A coherent policy on land use (OECD, 1961, P17)

3- Social aspects These aspects are related to the community. It focuses on individuals unity of society and encourage social organizations that contribute to the awareness of the individual's interest to the various aspects of life of an individual, This must be achieved through the following:

- The community cohesion and inclusiveness.
- The existence of active communities that have a relationship with the citizens
- Security of citizens. (OECD, 1961, p18)

4- The Institutions The Institutions are the main part of cities, through the political decision-making, cities are created to address risks. Through the following:

-There are clear leadership and management
- Adopting an integrated strategy by leaders
- Public ownership of the appropriate skills
- Government privilege with openness and transparency (OECD, 1961, p18).

The Cities resilience

The Cities resilience is defined as the capacity for adaptability, which is the potential of any system, such as the government of any city, or any level of the population, such as low-income groups (or individuals / families) to take action to help and to achieve a rapid recovery from any effects resulting from climatic change. Resilient cities are the cities with the capacity to absorb and prepare for future shocks in terms of (economic, environmental, social and institutional aspects), which can adapt by promoting sustainable development, well-being and inclusive growth. (World Report on Human Settlements, 2011, p38). The resilient cities can face shocks again using lessons learned from its past experiences, through optimal use of local resources. Cities are taking innovative approaches to responding to the challenges represented by the policy of open innovation, citizen engagement, diversification of industrial structure, integrated city policies and the formation of the Cities and Universities Alliance (Newman-el al, 2008, P55)

The OECD stated that cities share the following challenges:

- Slowing the economic growth in cities.
- High unemployment rates in cities.
- The growing issue of aging.
- The natural disasters. (OECD), 1961, P14)

The above text can be explained in the below “fig. 2”

“Figure 2” shows the measurement of city resilience / OECD preparation

From the above, with regard to the concept of resilience, urban resilience and flexible cities, the following items can be found which reprinted The theoretical framework of urban resilience as shown in "Table 1".

"Table 1" Elements of the theoretical framework of urban resilience / preparation of the researchers

Vocabularies	Indications
Diversity	-Increase the diversity of the different systems that make up our cities. - Contributes to survival and coping with external shocks and pressures
Repetition	- Building the resilience of cities and their communities to face shocks and pressures of environmental issues
Inclusiveness	- Increased resilience when the components of the overall system which can determine the damage or failure in system components
Ability to change	- The ability of the system to detect and respond to changes in its constituent parts
Adaptability	- The city systems and infrastructure that is designed to be adaptable - Adaptive systems which increase the overall resilience of the city
Responsive environment	- Relatively low negative impacts of the city and increasing environmental pressures associated with climate change.

The Infrastructure concept

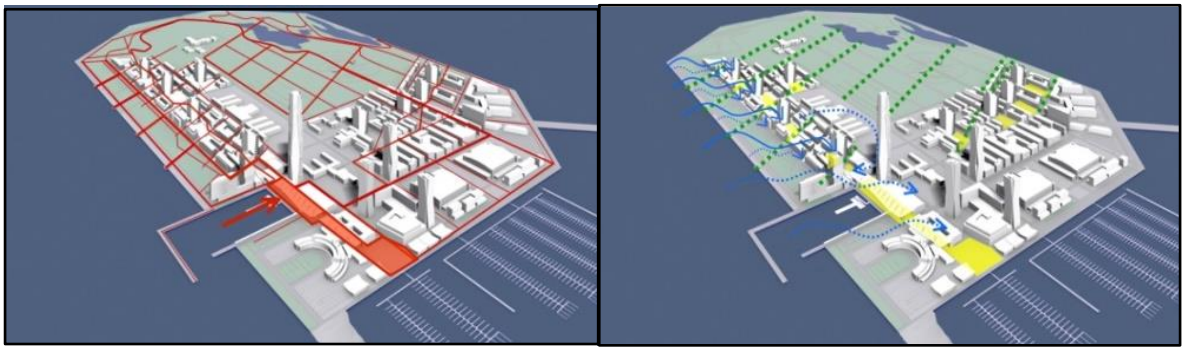
A set of interrelated structural elements that provide a framework which supports the overall structure of development and often refers to the technical structures that support society, such as roads, bridges, water resources, sewage and electrical networks, (Arthur, Sullivan, 2003, Etc.). Can be defined as "The physical components of interconnected systems that provide the necessary goods and services necessary to enable, sustain or improve the social life." (Fulmer-el al, 2009, P30-32). The infrastructure is resilience, if it can withstand, adapt and recover from external disturbances (e.g., Extreme weather, hurricanes and rain), which are natural forces (intensification, over-abundance, environmental degradation, vandalism). Which is man-made. (Alberti-et al, 2003, P1169) Literature review should that resilient of infrastructure are appearing in the following:

- Renewable energy.
- Equity of energy distribution.
- Effective environment.
-The Sustainable transport.
- Investment of natural resources

These features, in the city are overlapping in their approach and results, but each has a view on how to achieve resilience city. The challenge faced by urban planners is the application all these items in a single approach, to generate a new sense of technology,
mix, city design and community-based innovations in resilient infrastructure ((Newman-el al, 2008, P73-76).

1- The Renewable energy A number of urban areas now, partially operating with renewable energy technologies, from part of building to the whole, which minimizing the environmental footprint. There must be renewable energy production within cities and integrated land use, so that cities are not just energy consumers, but have more sustainable catalysts in energy paths. There are some solar city projects (including San Francisco Treasure Island), which is the concept of an

adaptive urban society consisting of multiple housing units, and artificial wetland area integrated with water treatment, wind power, recreation areas, parks, harbor and a small commercial area. Treasure Island is centered on the pedestrian scheme and the traffic of bicycles as shown in“ Fig. 3”, which contributes population to use ordinary buses and services. There are major cities in the world that are working on renewable energy. (Scheurer-el al, 2008, p80)



“Figure 3” shows the location of the treasure island Source\ https://www.*langan*.com/portfolio/*treasure-island*

2- Equally energy distribution It aims to improve energy and water systems that distributed to transform large power and water systems for small projects to systems within cities. The use of energy and water distribution helps the city to reduce the ecological footprint. Electricity and water can also be more efficient using electronic control systems. Most of the energy and water systems of cities over the past years have become larger and more centralized. While new forms of energy and water are increasingly moving towards a smaller scale. The aim is how this new technology can contribute to changing cities through a group of networks known as “distributed energy and distributed water systems”, As in the city of Malmö which was privileged, through a comprehensive approach to urban development of cities and investment in new developments, focusing on the modern development of existing areas and infrastructure investments, through its image of clean technology and comprehensive transport planning including public transport, as well as investment in alternative fuel vehicles and increased cycling. Malmö is investing in renewable energy and focusing on energy efficiency through the adoption of new water and waste technologies, such as rainwater reservoirs and gray water recycling. As shown in “Fig. 5” (City of Malmö, 2005, P 47-50)

“Figure 5” Malmö, Sweden Reference \(Source https://teamgeographygcse.weebly.com

3- Effective environment Is an attempt to improve the ecological efficiency of cities and regions moving from linear to circular systems, providing large amounts of energy and relying on the physical needs of waste streams. Environmentally-efficient cities reduce environmental footprint by reducing waste and natural resource requirements. There is a concept of environmental efficiency gains in urban areas called "cradle-to-cradle" design for all new products and new systems such as the industrial environment, where the resources industries and waste represented in the ecosystem. Good Examples in Clondburg, Germany, and Quinana in Australia. (Newman-el al, 2008, P77).

4- The Sustainable transport Transportation is the basic infrastructure of the city, and it creates the primary form of cities. (Newman-el al, 1999, p67). The design of cities, neighborhoods and regions is growing through familiarity with the distribution of roads and traffic, and has recently been supplemented by renewable energy vehicles. Cities with more sustainable transport through reliance on renewable energies and away from fossil fuels, as well as reducing urban sprawl and using the car. The agenda of large cities now is to be more sustainable transport options to reduce traffic and reduce greenhouse gases by %50 at least by 2050, in line with the global agenda identified by the International Panel on Climate Change, for many cities, and reduction of car use. (Went-el al, 2008, P34-37).

5- Investment of natural materials: Natural processes are used as part of infrastructure, energy production, provision of food and materials locally. Infrastructure can be developed through the use of photosynthetic processes in cities that reduce environmental impact by
replacing fossil fuels and can achieve significant ecological benefits by focusing on natural systems (Beatley-el al, 2005, P78 78). Table (2) shows the vocabulary obtained for the resilience of the infrastructure**.**

Table (2) shows all the above mentioned words and their descriptions / prepared by the researchers

Vocabulary	Its descriptions
Renewable energies	- Take advantage of the renewable energies existing at the level of a building or a whole city
Power Distribution Equally	- Using energy systems to reduce of ecological footprint.
An Effective environment	- Reducing waste use and minimizing the use of natural resources
Sustainable transport	- Dependence on fossil fuels and minimizing urban sprawl and minimizing the use of the car.
Investment of natural resources	- Providing energy, food and local materials and achieving significant ecological benefits through natural systems

The research problem, objective and hypothesis

The **research problem** was a "knowledge gap on the urban resilience of urban infrastructure.". The **objective of the research** is to "demonstrate how urban infrastructure is resilient." **The research hypothesis** suggests that city infrastructure can be developed by adopting resilience features.

Practical study

The practical study illustrates the concept of resilience in infrastructure through:

- Study and analysis of the Australian city of Adelaide.
- Attempting to develop infrastructure locally in the Karkh / Baghdad area and linking it with resilience

1- Adelaide Australian City It is the capital of South Australia, the most populous city, and the fifth-largest Australian city, with more than 1.1 million, of the population a coastal city near the Southern Ocean, in the Adelaide plains, north of. Florio Island, the city is named by the name of Queen Adelaide of Meiningen Saxony (Australian Bureau of Statistics, 2008, P9). As shown in "Fig. 6"

"Figure 6" (Adelaide City, Australia \ (Source https://www.seabourn.com.)

The city of Adelaide is one of the cities that developed according to the concept of resilience, where we find that each part of the city has been used and developed in a manner appropriate to the needs of the individual and society. The aim of this process was:

A- city adapting with climate change Changes in the global climate are evident through the rise in the average global air and ocean temperatures, melting snow and ice, rising sea level average (Climate Change, 2013, P136), and Adelaide, climate changes are expected to be through:

- Increasing frequency and intensity of heat waves.
- Increase in average temperature.
- Decreased average precipitation and significantly reduced spring precipitation.
- Increase in precipitation intensity events

B- Potential impacts on the region as a result of climate change include

- Health effects of heat waves, especially for vulnerable community members
- Effects of heat waves on the quality of living and accessibility
- Availability of water, which increased heat, resulting in increased tension and resources to maintain spaces, Public Domain and Vegetation. (Australian Open Bureau of Statistics, 2008, P 45).

C- Using the natural resources Plantation represents a major opportunity to return some lost plant types of the Adelaide plains. Several projects for re-vegetation have been signed in partnership between the Council and the Trees Program in the state government of 1 million community volunteers. , The Adelaide City Council is the co-founder and sponsor of biomedical cities and the urban habitat center, and the University Research Center, which aims to increase understanding and awareness of urban nature. (United Nations General Assembly, 2016, p18).

D- Make the city rich for booming natural ecosystems The ecosystem is defined as a natural ecosystem "a group of living organisms that live in a specific environment and interact with elements of the non-living environment and with each other so that they maintain their continuity." The ecosystem can also be defined as "a community of living organisms With elements of the surrounding non-living environment through the entry and exit of the material (chemical elements) and energy. "(United Nations General Assembly, 2016, p. 19)

E- Water conservation Water is one of the most precious resources and requires the need for water for biological and ecological purposes. South Australia is one of the driest areas. As such, they must ensure that water resources are used wisely. Therefore, a plan has been developed to address the risks of flooding, identify the characteristics and quality of water, rainwater and reuse, protect

waterways and river ecosystems, land use planning, preparedness, resilience and flood issues around the major watercourses in watersheds to reach appropriate solutions and conserve water. (United Nations General Assembly, 2016, p. 20).

The methods used in the city to achieve urban resilience:

A- PVC solar systems, Photovoltaic The utility of solar systems, Photovoltaic is low for carbon production and does not cause significant cost of electricity. There will be the solar technology developments.

B- Energy storage systems Energy storage can help to maximize the internal consumption of electricity generated by the photovoltaic solar system on site. It's systems in conjunction with the on-site solar system. Distributed infrastructure strategies that
enable small-scale water power to thrive in cities almost entirely and have a fully networked water supply and a complete grid and electricity system covering all buildings. As water, energy and waste systems become more mature, it will be possible to place them in the city while maintaining central reserves. http://www.adelaidecitycouncil.com.

C- Electric cars and bicycles (EV) Electric cars and bikes are a convenient and efficient way of commuting to work. An electric car can be either an electric car battery or plug-in hybrid electric vehicles. Sustainable transport strategies are now firmly on the agenda in all Australian cities with plans to double capacity. Most of the city's railways, cycling programs. http://www.adelaidecitycouncil.com

D- Smart energy in apartments Application and implementation of one-time energy projects in residential buildings is a great way to manage the building. Qualified buildings for energy with smart apartments may be applied as an incentive to implement energy efficiency measures in the common property areas of residential complexes.

E- Energy control system Energy control can greatly help in identifying potential energy savings.

F - Green Program is a program that helps reduce the use of energy and emissions of heating gases. Green infrastructure strategies are being considered to complement biodiversity strategies and the urban agriculture strategy, which is a good example of community in a number of cities. http://www.adelaidecitycouncil.com

Adelaide is one of the cities that has gradually addressed the concept of resilience because it has identified the problems that the city suffers from (climate change, low rainfall, etc.). It then began to gradually adapt to the changes that existed, In addition to finding alternative solutions to the radical changes that have taken place in some cities. And found that the adaptation process tends to rely on the ecosystem through which the environment is interacting with living organisms in order to achieve the sustainability of the city's existence, while other solutions, it's deal wisely with natural resources, through the cultivation of plants and the return of species of plants that have been lost in the city and thus we find that the process is the facing up changes and withstand them in order to find appropriate solutions as well as adapting to changes in all field of life, so it had been depended on resilient methods to maintain the city resilience, then included the following methods:- (Solar PV systems, electric cars, charging bicycles, smart energy, power control system, and green program). This represents the latest methods adopted in order to achieve the continuity of the city and the survival of its existence**.**

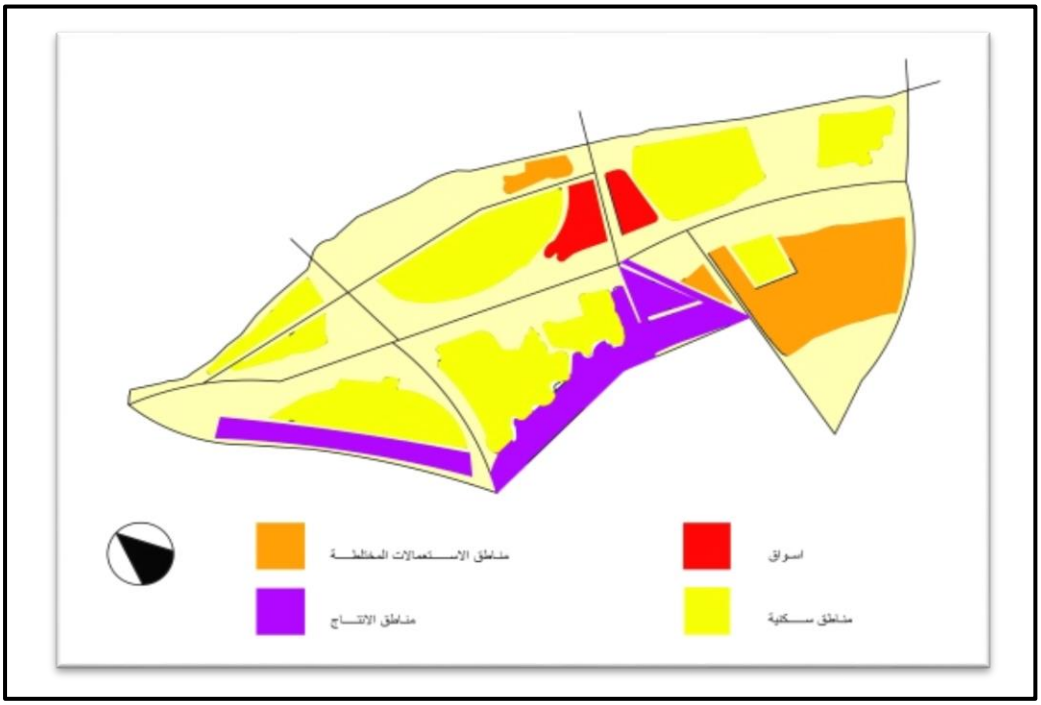
Case Study Baghdad City:

Baghdad city is one of the cities that have a great cultural and historical heritage and has witnessed many events since its establishment. So that, we find that this city has undergone various changes and environmental, social, economic and political which terms to adapt to these changes. The study area was in Al-Karkh side of Baghdad, which contain a variety of different urban aspects in terms of the existence of heritage and conservation areas as well as industrial areas in addition to the recent development of the area from the intersection of Haifa Street and the construction of

apartments belonging to a class of society different from the existing social classes in that area. (Al-Alousi, 1982, p10-18).

The Study Area: The study area was determined from Al-Ahrar Bridge to Bab Al-Mu'amad Bridge, which is parallel to the edge of the Tigris River and towards Haifa Street Apartments. This area is characterized by a number of local events that are practiced in this area as well as two types of residential buildings , one of which is an old traditional
building pattern associated with the heritage, and other The pattern of residential apartments represented by Haifa Street apartments as shown in "Fig. 7&8"

"Figure 7" The horizontal plan of Al-Karkh area and its uses / Al-Alousi 1982, p57



"Figure 8" The General Plan for Land Use in Al-Karkh Region / Al-Alousi1982, p55

The analytical study represented by the study of the infrastructure, the study showed a number of the missing axes of infrastructure in this area and are represented by the following points:

1. **Energy and Water Conservation Network** The network is old and depends on old methods of providing water to the area and is not enough to meet the need of the region, in addition to the loss of a plan to treat and identify the characteristics and quality of water. And the absence of treatments of rainwater investment and reuse, loss of protection of river ecosystems. So there should be a resilient solution in issues related to watersheds in order to reach appropriate solutions or conserve energy and water.
2. **Sewage system** The network in the area is an old one, undeveloped network that does not have the absorptive capacity to accept the population growth of that area and is connected to the main sewerage system in Baghdad "Fig. 9". Therefore, it needs to be
developed so that water networks can thrive in the city almost completely. The Sewage Supply Network is integrated and connected to Baghdad's core network and resilience to meet changing environmental conditions by developing appropriate solutions around the major watercourses in watersheds to reach high resilience and adaptive networks.

"Figure 9" illustrates the nature of the sewerage system

3. **Electric power** The electric power in this region is based on inefficient electric generators through the use of visible or underground cables, wires and the existence of generators that are distributed in a way that is not connected to any controls. "Fig. 10". There is no method for energy storage process, although it helps to maximize of the domestic consumption of electricity generated by relying on the photovoltaic solar system on site, and the energy storage network can be connected to a complete grid and electricity system to cover all buildings.

"Figure 10" illustrates the nature of the sewerage system

4. **Cars and bicycles** The population of Al-Karkh depends on the use of cars in general, as well as motorcycles in particular and specific areas in narrow alleys and find that the idea of replacing personal cars with public transport vehicles and dependence on bicycles that contributes, the promotion of transport and to ensure the sustainability of public transport.

5. **Garbage spread** The presence of open spaces in Al-Karkh area has become, over time, places for the accumulation and collection of waste. Therefore, the environment and the continuity of life must be maintained. The accumulation and disposal of waste must be properly handled through recycling or classified according to the materials manufactured to facilitate recycling. This maintains an environment from pollution and make the individual conscious and aware of the bad effects caused by the waste, if left untreated, and also possible to invest and return to nature by converting them into raw materials benefiting the various industries.

Conclusions

1. Resilience has been defined as the ability of the system to absorb disturbances as a result of change and is reorganized in order to preserve the identity of the city's infrastructure.

2. Resilience included two aspects. The first one is urban resilience that helps improve the integration of environment and social science and planning to enhance urban resilience and help cities adapt in the context of change. The second aspect is that resilience of cities,
cities that are able to adapt by promoting development, sustainability, prosperity and overall growth.

3. External influences affect cities in different areas, so that, the study indicates the role of infrastructure resilience to face these changes, and the most important characteristics of infrastructure resilience, which are (Renewable energies, effective environment, sustainable transport, (According to previous studies).

4. Developing the urban infrastructure and make it resilient to climate change and to promote the sustainability of communities in different countries rapidly.

5 . Reflecting the resilience of the infrastructure on the members of the community and users by responding positively to the variables.

6. The study area of Al-Karkh area in Baghdad showed neglection of the infrastructure aspect due to the lack of development (infrastructure) within this area despite the changes in the region.

7. Draw an initial vision for the solutions that will help in developing the infrastructure of Al-Karkh region. It related to the executive institutions and the social side as well as the economic aspect and how to revive the natural resources in the region in relation to the network of conservation of energy and water, Waste systems.

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