Toward an Integrated Sustainable Urban Design Framework in the Historic Center of Baghdad

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Abstract: *The old center in Baghdad is well defined by its unique urban fabric, surrounded by modern urban pattern and by modern roads, which replaced its walls. Narrow alleys, natural shading, mixed use, human scale, privacy, walkable and natural environments are the most significant features in the historic center, which also represent the main principles of urban sustainability. Nowadays, the historic area in Baghdad is suffering from many problems such as air pollution, a lack of modern facilities, traffic congestion, uncontrolled land use, and a low standard of infrastructure. These problems have brought into focus the extent to which a sustainable urban design framework can provide appropriate solutions to regenerate the traditional fabric in terms of urban form, land use, transportation, and create a new vision to deal with the social and economic processes. This paper will explore how the traditional urban fabric in Baghdad might be the perfect solution for implementing urban sustainability. Consequently, our challenge in this paper is to find a solution that can serve as a platform to resolve the conflicting values of traditional urban form and modern design models, sourcing new sustainable technologies and the integration of the infrastructure systems.*

Keywords: Urban Sustainability, Modern Urban Pattern, Traditional Urban Form, Sustainable Technologies

Introduction

Over the last five decades, many types of research and projects have been made through UNESCO, ICOMOS, and other organizations to conserve historic places in different cities of the world. Iraq has participated in the efforts of UNESCO for the preservation of its culture heritage, by proposing a number of sites for inscription to the World Heritage Committee (Hatra, Ashur, Samarra, traditional Iraqi houses and the Iraqi Museum) as having outstanding universal value and some of the most important archaeological collections in the world.

The capital, Baghdad, is the largest city in Iraq. The population of Baghdad as of 2015 is approximately 8,000,000, making it the second largest city in the Arab world after Cairo, Egypt. There are four historic areas in the modern city of Baghdad: Rusafa, Karkh, Adhamiya, and Kadhimiya. The area of old Rusafa represents the main historic center of Baghdad. Generally speaking, in most of the traditional areas in Baghdad city and especially the area of Old Rusafa, due to the lack of standard infrastructures, the deteriorating built environment and rundown houses, air pollution and a lack of modern facilities, the younger generation is abandoning these areas. Nowadays, most residents are low-income families who cannot afford to live in better sectors with higher rent(Al-Akkam 2012). However, the significant features in the historic part of Baghdad such as narrow alleys, natural shading, the hierarchy between public and privet space, mixed use, human scale pattern, high density/low rise living, a walkable and zero carbon environment are providing an extraordinary base to implement sustainable standards. Unfortunately, there is a huge amount of evidence of a decline in the social function, historic urban fabric and traditional Iraqi houses of Old Rusafa (Al-Akkam 2013). Thus, this research will illustrate how sustainable design might transform the historic urban environment in the traditional area of Rusafa.

Urban Heritage context

Urban heritage involves a vast set of aspects, including archaeological sites, ancient monuments, individual buildings or groups, streets and ways connecting those groups, and places surrounded by buildings (Daher 1996). Due to these aspects, we cannot narrow down the urban heritage to monuments of historic interest or individual buildings. Urban heritage exists in the physical features of buildings, public spaces, and urban morphology. Thus, a better understanding of urban heritage will depend on understanding both heritage context, and the categories of heritage values derived from modernity. Let us define what is heritage:

Heritage was defined by ICOMOS as "the combined creations and products of nature and of man, in their entirety that make up the environment in which we live in space and time. Heritage is a reality, a possession of the community, and a rich inheritance that may be passed on, which invites our recognition and our participation" (ICOMOS 1982).

Heritage Canada Foundation has defined the heritage area as “A synonym for a designated historic district or conservation area, which denotes a neighbourhood unified by a similar use, architectural style and/or historical development” (HCF 1983). Urban conservation offers sustainable solutions to social and economic problems and also will promote the historic environment, create new opportunities and bring new life to run-down areas (EH 2004).

Since policymakers and urban authorities have turned to 'culture' as an instrument for urban regeneration, the importance of historic environments has become increasingly evident as part of urban regeneration initiatives (Pendlebury 2002). At the same time, "conservation initiatives try to enhance strategies which not only ensure the continuing contribution of heritage to the present and the future through the thoughtful and intelligent management of change responsive to the historic environment and collective needs, but also the preservation of fundamental elements of social environments. Such strategies will lead to more equitable and sustainable solutions to the problems currently faced by the historic quarters" (Akkar Ercan 2011).

To sum up, previous studies have not illustrated a clear vision for dealing with the assets of urban heritage and their relationship with environmental, social and economic issues, especially in an age of such significant transformation. Therefore, an evaluation of urban heritage conservation under the light of sustainable urban design is required to regenerate urban form and fabric.

Sustainability

We hear the word 'sustainable' but the fundamental questions remain as to what sustainability means and deals with, is it about people, economy, city, culture, environment, politics, government etc.? Sustainability is about all of these things and more. The concept of sustainability has become an essential concept in national and international discussions, which have attempted to identify the role of cities in terms of modern concerns about the requirement to obtain environmental sustainability. Sustainability has been defined as "a global process of development that minimizes the effect on environmental sinks using processes that simultaneously promote the economy and the quality of life" (World Commission on Environment and et al. 1987).

The strategies for the future form of cities that should be adopted in a global economy and information age are still being debated. A high quality of life for the whole society within a new socio-economic framework is the main objective to achieve urban sustainability and reduces the impact of the city on the local and global environment. Therefore, our cities must tackle all the dimensions of sustainability such as the social, the environmental, and the economic (Figure 1). The relationship between these three elements needs more research as one cannot exist without the others. Urban life, activities, and culture depend on their wider environment. UNCED through their Agenda 21 noticed that about 70% of the procedures required to implement sustainability needed to be accomplished locally (UNCHS 1992). Thus, the fundamental thing to achieve sustainable cities is to produce new active generations able to participate to make decisions and change the political structures (Jenks and Dempsey 2005:28).

Urban Sustainability:

The population growth in cities has increased in recent years to exceed the proportion of population growth in rural areas. This demographic change will require new methods, and our current tools will not be sufficient. The approaches we use require intelligent ways to face the fast growth in cities. In the next 50 years, we will need to build cities for 3 billion human beings, double what we have today. This will also confirm the necessity to implement urban sustainability in cities that have not yet been built. The new sustainable cities will participate significantly to promote the urban environment and create livable, efficient cities. Consequently, urban designers need to rethink land use and the horizontal division of functions and design productive and active cities. In order to achieve that we need also to consider urban morphology and how it will participate in the city's long-term economic growth (Reutersward 2009).

The sustainability of a city has typically focused on technical solutions for a more efficient urban life and on sustainability effects occurring within the city's administrative boundaries. In the future, to improve urban sustainability cities will require creative strategies, flexibility and have the ability to move from sustainability to regeneration. In addition, cities must be economically effective, have the ability to reduce poverty and must deal with the issue of equity. Cities also will need to reduce the impact on the environment and face rising sea level, landslides, drought, and extreme weather events. Education will be an essential component of sustainable urban development. Everybody must have the right to obtain the right education in order to elevate themselves out of extreme poverty and stagnation.

All these elements will demand to utilize intelligent methods and modern thinking to administer this massive change, creating new systems of gain (zero carbon, zero waste, green transportation, sustainable food, equity, happiness, health and culture) and implement green infrastructure in terms of green space, parks, gardens, civic space, water, waste, transportation and energy (Figure 2) (Reutersward 2009).

Jenks and Dempsey identify urban sustainability is to "achieve a high quality of life for the whole community within a socio-economic framework that minimizes the impact of the city on the local and global environment". They propose that "crucial to the development of a sustainable city is the commitment and will of the population".

Unfortunately, there is an emphasis on people as consumers rather than as citizens and therefore sustainable cities need the active involvement of the people; they need active citizens. Jenks and Dempsey argue that the city has to meet the business requirements of the new economic paradigm by employing the right people; increasing interaction and communication; promoting accessibility, openness and convenience; achieving flexibility of operation, functional, financial and physical; and maintaining and promoting value through image differentiation (Jenks and Dempsey 2005:24,26). Adinyira & Adjei-Kumi also identify urban sustainability as "a desirable state or set of urban conditions that persists over time. It is often characterized by issues such as inter-generational equity, protection of the natural environment, minimal use of non-renewable resources, economic vitality and diversity, community self-reliance, individual well-being, and satisfaction of basic human needs" (Adinyira, Oteng-Seifah, and Adjei-Kumi 2007).

Williams argues that to realize a sustainable city there have to be clear concepts about what it should look like and how it should function. They also state, "A prerequisite to achieving sustainable urban form is knowing what it is" (Williams, Jenks, and Burton 2000:347). The strategies for the future form of cities that should be adopted in a global economy and information age are still being debated (Jenks and Dempsey 2005:24). Urban form is one of these concepts, as it conceptualizes the overall spatial patterns of cities and in turn their physical pattern (Lynch 1984:38). Williams, Burton and Jenks in their book 'Achieving Sustainable Urban Form' showed that the physical form of urban areas has contributed to the massive problems of cities. Therefore, the search for sustainable urban form today requires a reorientation of the search for a number of sustainable urban forms which respond to a variety of existing settlement patterns and contexts (Williams, Jenks, and Burton 2000:7). In this regard, significant arguments have been put forward to measure the implications of urban form on a number of sustainability dimensions and this has given rise to the term 'sustainable urban form' in recent literature.

Walton argues that comprehensive methodologies for the evaluating of sustainability in the urban context are fundamental for urban decision makers such as planners, architects, engineers, and managers. He confirms through his work that there are many criteria and tools to assess the sustainability of urban development in cities such as scale, life cycle, location, context and all stakeholder values. The results of his consortium's work confirmed that "there is no tool currently capable of simultaneously covering all assessment criteria but demonstrated the need not for a new tool but for a framework that integrates those that already exist. Consequently, the consortium proposes the development of an integrated sustainability assessment toolkit (ISAT)" (Walton et al. 2005).

Sustainable Cities Challenges

The method of designing a sustainable city is a complex and multidisciplinary decision-making process, which is concerned with the management of huge amount of data within the built and natural environment. The type of these data usually contain rich information about population, the economy, society and the environment within the various field at the local and national levels and this data can be used in urban sustainability analysis. Sustainability and quality of life will be the main elements to evaluate this information that comes from different sources such as National Statistics, local councils, commercial survey companies and government departments (Cooper, Evans, and Boyko 2009:243).

Nowadays, cities are facing several essential challenges in terms of improving sustainable urbanism and development. One of these challenges is how to solve problems of unsustainable geographical expansion patterns and ineffective urban designing and planning methods that have increased the number of slums areas, unsuitable delivery of basic services and inefficient resource use and poverty. Another challenge is cities continue to be the major contributor to the total greenhouse gas emissions that have led to the global climate change. Therefore, if we want to achieve sustainable cities, we will need new visions of multilayered understanding of a what a city might become. We will need also to depend on a wide-ranging selection of initiatives. Some of these initiatives will be top-down and demand powerful leadership and large-scale investment programmes, other initiatives will be bottom-up and depend on shifts in actions. For example, the integration between individuals, businesses, and organizations in terms of making sustainable choices will enable us to be more aware of the processes of sustainable urban development. This will be supported by technology, a suitable design of the physical environment, information and feedback. The critical thing for cities to face their future challenges is to move towards a sustainable future over both the moral and physical organization of the city (Williams 2010).

Figure 1: The Main Dimensions of Sustainability: Environmental, Social, and Economic
Source: Author 2016.

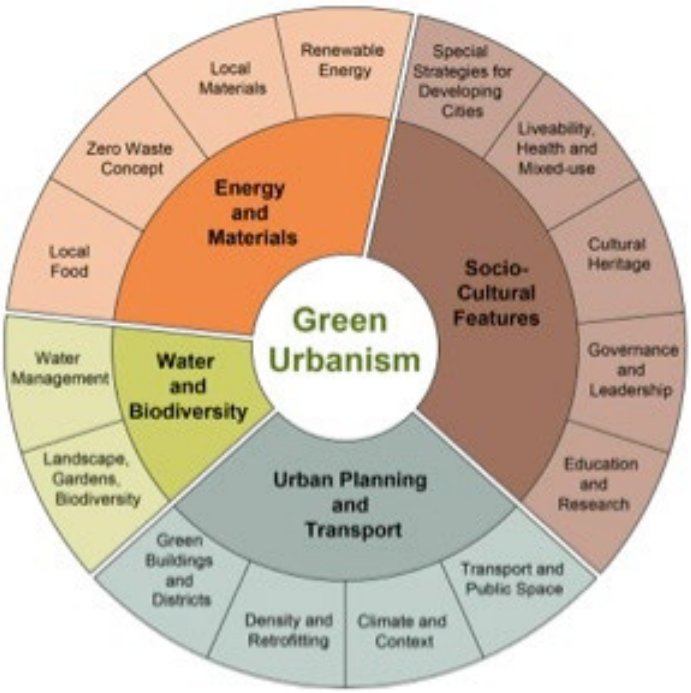


Figure 2: The Green Urbanism to Measure Sustainable Design.
Source: http://www.eco-business.com/opinion/transforming-city-sustainable-design/.

Case Study Information: Old Rusafa
Outline and Scope of Research

Rusafa is the core of Baghdad and has a long history, which spans well over 1000 years, and has become a complex urban organism. The area of Old Rusafa once enclosed within the old wall is approximately 5.4 square kilometres, has a population of about 203,000 (1980), and contains nearly 15,700 buildings (JCP 1984). Nowadays, Rusafa forms a contracting mixture of dense irregular traditional fabric and gridiron modern developments often conflicting with each other in form, scale, and function (Al-Hasani 2012).

Old Rusafa, located on the eastern of the Tigris River, is an integral part of the central business district furthermore being the largest of all historic areas (Karkh, Adhamiya, and Kadhimiya) in the city (Figure 3). The importance of Rusafa is of not only local but also regional and national dimensions (Al-Akkam 2012). It contains the biggest concentrations of traditional suqs, and workshops and some of the most significant mosques, government and administrative buildings in Iraq. Below we explain the main reasons for choosing this area as a case study:

- The area of Old Rusafa represents the main core and the oldest part of Baghdad (Figure 4).
- Old Rusafa contain several significant historic buildings, 132 monuments are listed 21 monuments of them are belong to Abbasid Empire (762-1258) and the rest to Ottoman Period (1638-1917), therefore, it is considered as an important heritage which demands emergency protection for its historic identity (JCP 1984).
- The decline of the traditional urban fabric in most Iraqi cities and Arab World cities have brought into focus the extent to which sustainable design policies can contribute to the management of change in historic areas, therefore, Old Rusafa is a good example of this phenomenon.
- The significant features in the historic part of Baghdad such as narrow alleys, natural shading, mixed use, human scale pattern, a walkable and zero carbon environment provide an extraordinary base to implement sustainable standards.

Revitalising Urban Heritage in Old Rusafa

During the last few decades Rusafa has suffered both to its monuments and areas, however, enough fabric remains to evoke its past grandeur. “The State of Iraq Cities Report (SICR) 2006-2007 reported that the structures of historic areas have been modified, with many buildings evolving toward commercial and government use. The city has many seriously deteriorated structures without infrastructure, leading to poor internal sanitation, drainage problems and effluences” (Al-Akkam 2013). The architectural heritage in Rusafa is mainly composed of dense traditional courtyard housing. The comprehensive surveys by JCP in 1984 showed that the historic area contains 3900 houses which mostly belong to the late 19^{th} and early 20^{th} centuries, 63 mosques, 5 tombs, 6 madrassas, 11 khans, 6 hammams, 4 churches, 9 suq and 3gates. Of the listed 132 monuments in the old area of Rusafa, only 21 monuments belong to the Abbasid Empire (762-1258), while the majority is of Ottoman Period (Figure 5) (1638-1917).

The Municipality of Baghdad presented a study to develop the Old Rusafa that showed many problems with the historic center, such as demolition of buildings and deterioration of the historic urban fabric. As a result, many initiatives were started by the Union of Architectural Heritage in 2010 to rescue Baghdad’s architectural heritage. “Unfortunately, however, all these projects focused on physical aesthetics and appearance and proposed either to demolish significant parts of the historic areas or to imitate the urban development of Western countries. These studies did not deal with the local community and tried to use the term “sustainability” as a label for propaganda and no more. These studies were vague and did not follow a clear urban policy, or take into consideration public participation” (Al-Akkam 2013).

Existing Physical Condition of the Case Study

According to the JCP surveys, Rusafa accommodated more than 50% of the population and employment of the CBD (Central Business District) of Baghdad; it occupies 5.4 square kilometres, which is approximately 23%of CBD area. The majority of its buildings have two or less storeys, giving it a predominantly low “horizontal” skyline. The land use pattern of Rusafa is fairly mixed with residential use and road transport facilities at around 23% and 20% respectively. Commercial, business and industrial uses represent other significant types. The residential areas are now squeezed onto the inner part of old Rusafa, between the service and industrial part of Sheik Omer Street and the predominantly commercial and business part of Rashid Street. Many reasons have led

to the deterioration of the physical and environmental conditions of Old Rusafa such as high population densities, clearances for new roads and neglect of the historic urban fabric. More than 50% of all buildings in the case study were in a poor or very poor structural condition (Figure 6) (Al-Akkam 2012).

The complex development and transformation in the traditional urban fabric have created many different, separate and partly conflicting urban systems (Bianca 2000:253). The area of Rusafa is characterised by commerce and business, hotels and restaurants with tourist and entertainment facilities, a civic centre, including the headquarters of the Baghdad municipality, supplies, and technical services. The land use of Rusafa includes many different activities Industry is represented by two types of activity, Sheikh Omar Street which is related to numerous independent car maintenance businesses, whereas the other type is traditional crafts. The old housing includes the textile, printing, and wood- and metal-working industries. The second major activity is commerce and business represented by Al-Rashid Street, which is considered as one of the highest concentrations of commercial and business activities. The third one is Public and governmental offices were constructed between Port Said Street and Muthanna bin Harith Shaibani Street. Housing is another activity, which is concentrated at the center of Kulafa Street and Sadoun Street (Al-Akkam 2012).

The process of urban morphology in Old Rusafa

In 892 AD, a new city center in Al Rusafa was constructed with a half-circular wall (Bianca 2000). A market growing around the new urban center, Thulatha, developed many urban districts, which became the historical center of Baghdad city (Old Rusafa). These districts having their own center containing the two main components the mosque and the market, and a variety of buildings for instance school, libraries, public baths, hospitals and the most significant area composed of compact, houses in narrow alleys. The new public center grew from three sides and was connected with the other side of the Tigris River by a bridge. This growth was organic in nature, which depended on the old existing paths and nodes. Paths distribution, the relationships between mass and space, compact fabric, gradation of urban paths from public to private and the narrow alley were the fundamental characteristics of the urban structure of the city (Al-Silq 2008). The extension of the new urban center has led to the building of a new wall for more protection from the external power. This city wall and its structure remained until the end of the 19th century. In the 17th century, a map shows Old Rusafa surrounded by a quadrilateral wall with four gates on the eastern bank of Tigris River while Karkh on the western bank was reduced to the linear area with small neighbourhoods (Figure 7). Another map in the 18th century documented the city with its four gates, Kulwatha Gate or Eastern Gate, Muatham Gate, Wistani Gate and Talsam Gate. In addition, it was indicated that there were 22 Khans, several public baths, and 20 big mosques (Figure 8). The urban components were well organized and combined in the 19th century due to the geometrical form of the city. The street pattern of Baghdad was narrow and irregular the houses were more suitable for the social and climatic characteristics of the city and fully integrated with their urban context. In the late of the 19th century, the Ottoman began to cut the first axis in Baghdad and attempted to import Westernization into the urban evolution pattern (Al-Hasani 2012). The opening of Rasheed Street in 1908 and then completed by the British was the first change in the traditional urban fabric. The street became the most significant feature and the center of business in Baghdad city for decades. The traditional buildings on Rasheed Street had a unique type, which gave the street an outstanding character. Again three major roads (Kifah Street, Sheikh Omar Street and Khulafa Street) were penetrated into the historical fabric of Rusafa parallel to the Tigris River between World War One and Two (Al-Hasani 2012), with a rate of demolition of about 32 hectares or 6% of the whole site of the old city (Figure 9) (JCP 1984).

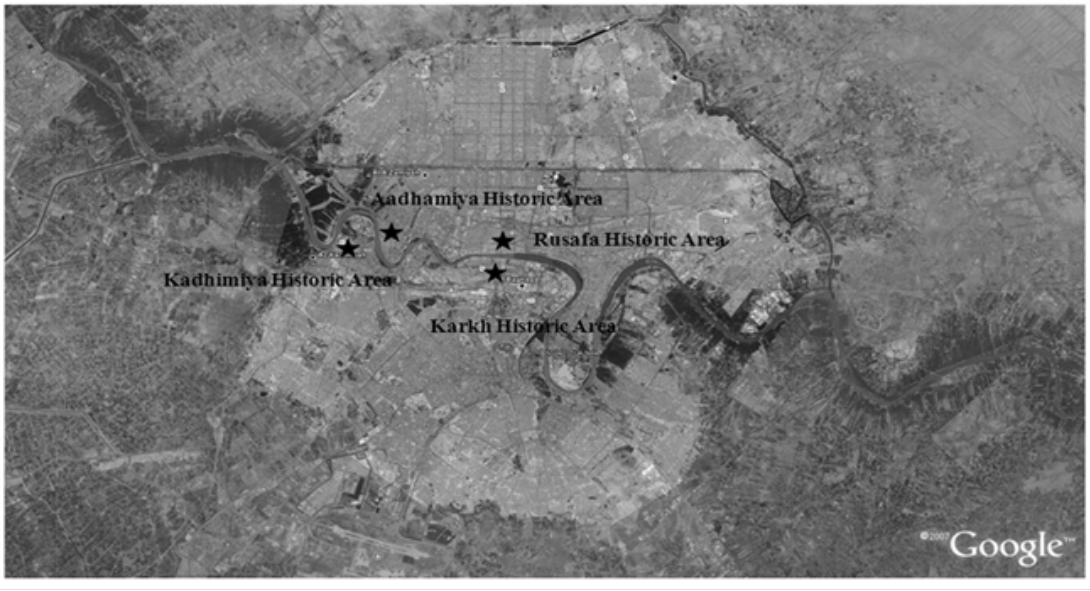


Figure 3: Existing Historic Areas in General Plan of Baghdad
Source: (Al-Akkam 2013).

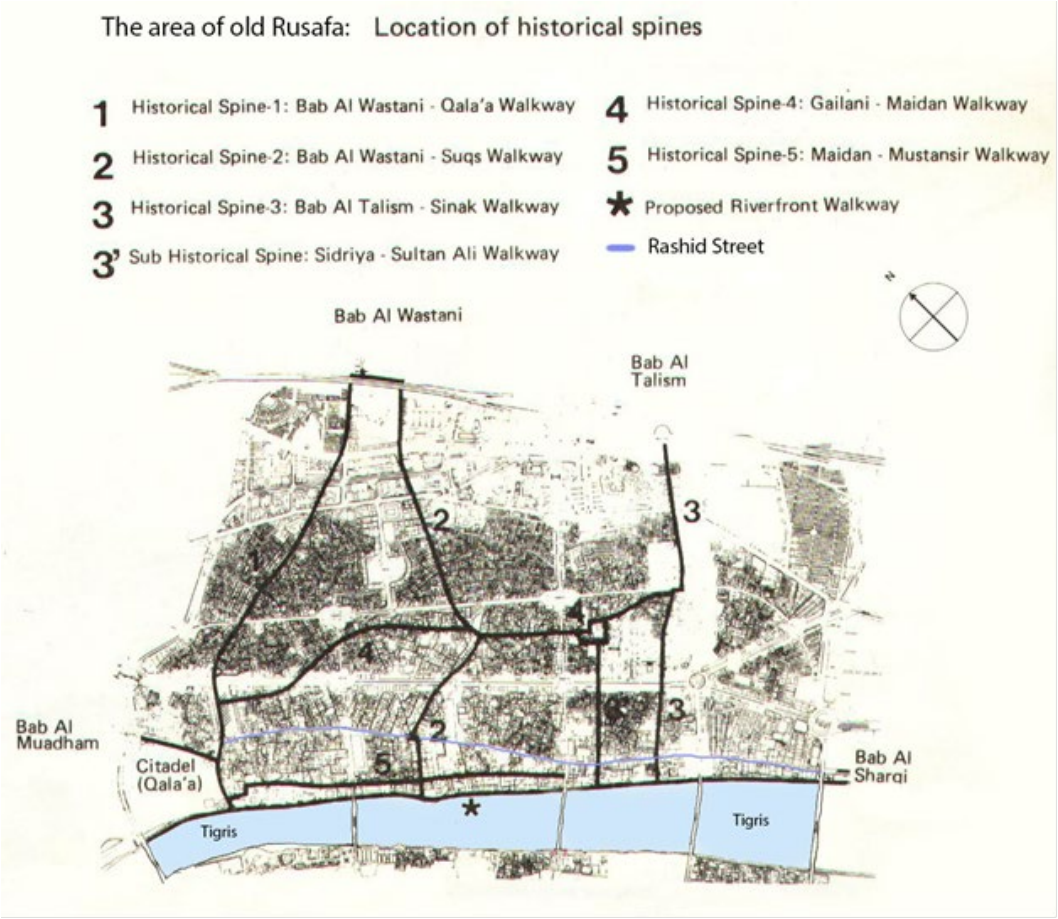


Figure 4: The Area of Old Rusafa, Location of Historical Spines
Source: (JCP 1984).

Figure 5: The Area of Old Rusafa, Listed Fabrics to Be Conserved
Source: (JCP 1984).

Figure 6: The Area of Old Rusafa, Building Structural Condition
Source: (JCP 1984).

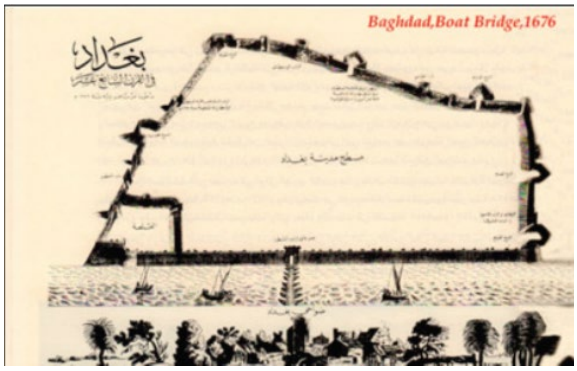
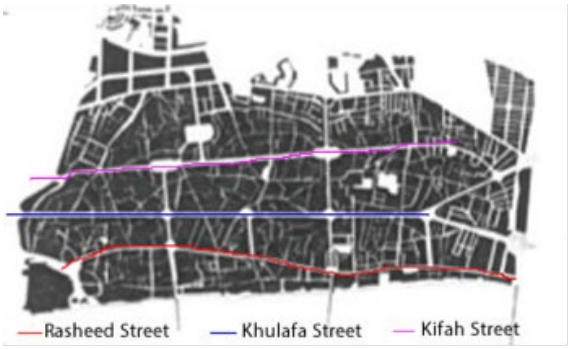


Figure 7: Baghdad in 17th Century
Source:(Sousa 1952).

Figure 8: Baghdad in 18th Century
Source: (Sousa 1952).

Westernization: 1800-1960



Old Rusafa

Reconstruction Boom: 1970

Urban Change 1983

Figure 9: Urban Transformation in Historic Part of Baghdad (Old Rusafa).
Source: (JCP 1984).

Determination of Problems in the historic part of Baghdad City

The historic areas in Baghdad city are suffering from many problems such as a low standard of infrastructure, poor environment, an absence of contemporary facilities, a lack of available conservation work, traffic congestion, functional disorder, deteriorating physical conditions and uncontrolled land use. Al-Akkam illustrated some of these main problems in the historic part of Old Ruasafa (Al-Akkam 2012) (Figure 10).

- Growth and Boundaries:

There is no clear vision for future growth and no plans to determine and organize the relationship between the real boundaries for the city centre with the other secondary centres. This has led to the interruption of the continuity and communication between these different centres.

- Land use:

There are huge differences in land uses (industrial, residential, commercial) in the traditional quarter, which is reflected in delayed traffic, few pedestrian walkways, an imbalance in standards of land use, noise pollution, visual pollution and low environmental standards. The main elements of land use problems are as follows:

Residential areas: the residential areas in Old Rusafa are in very poor conditions with lack of modern infrastructures, low environmental standards, and deterioration of the traditional Baghdadi houses, as well as increasing the rate of occupancy.

Commercial areas: most commercial buildings in the city centre have deteriorated, with an absence of basic standards for services and infrastructure standards such as sewage, clean water, and electricity.

Industrial areas: various problems are caused by these areas air pollution and crowding for example, and have negative impacts on the main services such as electricity, water supply, etc.

- Transportation:

There is an absence of a clear vision policy on public transportation for Old Rusafa. Which has led to traffic congestion, vehicular congestion, a lack of traffic control system, noise pollution and air pollution (Figure 11).

- The Riverfront:

There are many problems at the riverfront in the traditional city such as the absence of openness toward the river, open green areas and inadequacy in the connects between the two sides, and a lack of clear axes of pedestrian movement parallel to the river (Figure 12).

- Visual pollution:

There have been a massive visual pollution in many commercial streets in different areas of Baghdad city and particular in historic parts due to the lack of new building regulations, uncontrolled land uses and the use of new type of materials such as aluminum (Figure 13).

Figure 10: Selected photos of problems in the historic part of Baghdad.
Source: Author 2016

Figure 11: Transportation Problems in Old Rusafa
Source: Author 2016

Figure 12: River Front of Baghdad City Center
Source: Author 2016

Figure 13: Visual pollution.
Source: Author 2016

Towards Sustainable Urban Design in the historic part of Baghdad City

At the district scale, organic narrow alleys, with a homogeneous arrangement of housing plots, characterize the traditional urban fabric of Baghdad city. Rusafa, Karkh, Adhamiya and Kadhimiya are well defined by their unique urban fabric and surrounded by modern urban pattern and by modern roads, which replaced their walls (Figure 14). The features of the old urban fabric represent the main principles of environmental sustainability and shows us how individuals in the past built a sustainable environment to face the tough climate. They achieved by their design equity, clean environment, efficient use of resources, safety, low use of energy and low rate of pollution. Sustainable urban design should be able to provide appropriate solutions to regenerate the traditional fabric in terms of urban form, land use, local environment, transportation, and create a new vision to deal with the social and economic processes. Consequently, our challenge is to find a comprehensive theory that can serve as a platform to resolve the conflicting values of traditional urban form and modern design models, sourcing new sustainable technologies, the improving efficiencies of current technologies and the integration of the infrastructure systems.

Various proposals have emerged in recent years for the construction of the eco-cities such as Masdar City as an eco-city development in the United Arab Emirates. In contrast to the historical area in Baghdad city, which has evolved and transformed through complex processes (since its founding in 762 AD), Masdar City is planned as a model of urban environmental sustainability based on a master plan designed by the British firm Foster & Partners in 2007 (Figure 15). The reinvention of the traditional Arabic city is the main concept of Masdar City where the person, not the car is the essential element. According to Masdar City's official website Masdar City will house around 1,500 clean-tech companies, with 40,000 residents and 50,000 commuters and will cover an area about six square kilometers. It will provide a high quality of life by bringing together all of the functional aspects of a modern city and reducing the environmental impact through achieving zero waste, clean-tech cluster, powered by 100% renewable energy, being carbon neutral and fossil fuel free zone. Masdar City will be a base for the establishment of clean and sustainable technologies and will provide a platform for promoting technologies such as photovoltaics (PV) for producing energy and personal rapid transit (PRT transportation).

Despite being planned as one of the world's eco-cities, however, there are some fundamental obstacles and questions facing Masdar City in order to ensure the success of such an attempt. One of these inquiries who and why would people choose to live and work in this city? Are those residents able to afford the cost of living in Masdar City? 20% of Abu Dhabi's population are nationals and the rest are workers who come from all over the world to work in UAE. The income for these laborers is less than a third of national families, showing there are a big gap and inequality between the emirate's residents. Because of this gap and the lack of planning for affordable housing, only rich people will be able to live in Masdar and the rest as commuters who will come just to work, the second concern is how Masdar city will be effective in decreasing the UAE's greenhouse gas emissions as a whole. United Arab Emirates have the biggest per capita ecological footprint and the second highest per capita greenhouse gas emissions in the world (Stilwell and Lindabury 2008). Another significant concern is there are several firms, which have expressed interest in opening offices in Masdar City, which is driven by profiting from the short-term construction of the city, with no clear vision of maintaining a long-term presence. Therefore, any global financial crisis beside the stringent labor laws in the UAE will affect the long-term success of Masdar City (Reiche 2011). These flaws of the Masdar Initiative can be avoided in other initiatives and even if Masdar city as a whole is not a useful model for existing city it will be useful to model parts of the Masdar Initiative, such as the PRT system or the widespread deployment of solar and zero waste technologies for other cities like Baghdad. These technologies are in the process of development and if Masdar city shows that they will work and are cost effective, these technologies can then be implemented on a larger scale throughout the world (Stilwell and Lindabury 2008).

Figure 14: Urban Pattern in the Historic Part of Baghdad
Source: Author According to the Mayoralty of Baghdad 2016

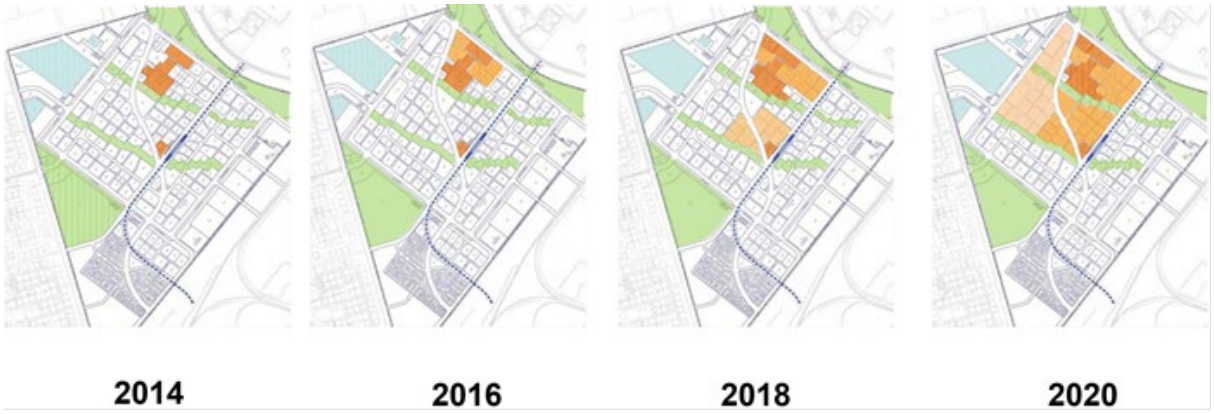


Figure 15: Masdar City – Growth Plans for a Sustainable Neighborhood
Source: (Wagle 2014).

Sustainability in Traditional urban fabric

The organic urban fabric in Old Rusafa was the first step for sustainable thinking. This was materialized in urban design and its components features such as compact urban fabric, unique design houses, narrow alleys, natural shading, privacy, mixed use, human scale, walkable and natural environment (Figure 16). The complex urban structure in the historic part of Baghdad provides a great example of how to avoid the hot and dry weather during summer, sand storms and to minimize the thermal load on the buildings envelopes especially houses (Figure 17). The main aim in these areas is to reduce the internal daytime temperature and to produce shaded exterior living space. The compact area of narrow alleys and traditional Baghdadi houses are oriented in a defensive posture against the wind-borne dust, and the direction of the sun must be determined for all hours of the day at all seasons also the direction of the prevailing winds, especially during the hot season (Al-Zubaidi 2007). Traditional compact urban fabric with attached traditional houses provided protection, privacy, a suitable and healthy environment for residents especially within the neighbourhood community. Privacy, comfortable environment and safety in traditional areas were preserved in many planning and design solutions as a neighbour main rights and this is the first stage to live in the sustainable urban area. The main features of the traditional urban fabric did not begin in the Abbasid period, but date back to the historic city of Ur in Mesopotamia 2000 BC (Figure 18) (Al-Silq 2008).

Sustainability in Traditional societies

Traditional societies in Old Rusafa have explored the concept of urban sustainability in the way of their living and they cleverly consider climate as an important element and become a part of their cultural environment in creating urban form. They have used materials available in their surroundings environment and achieved a sustainable urban form that has the ability to cope with climatic conditions and at the same time reduce the impact on the environment. These principles would cover a wide variety of issues including environmental, urbanism and energy-saving features. Kennedy emphasises that the traditional principles could be the base or the link to more environment-respected "A reconsideration of traditional architecture can provide a vital link to the future development of viable ecological building solutions to fit a range of urban and rural needs. Accessing the current knowledge of traditional builders is a key component in that link. By concentrating on cooperative efforts and reciprocal learning across cultural, economic, and political boundaries, it may be possible" (Kennedy 2004:7). The essence of sustainability in the traditional urban fabric of Old Rusafa is not because of the type of buildings, but it is a way of life. The connection between the three dimensions of sustainability (environment, society, and economy) and the principles of the traditional urban form (stable temperatures and natural ventilation with zero environmental impact) in the historic area of Baghdad have created a new way of thinking and acting responsibly towards the surrounding environment and cultural values. Bianca believes that there is an interaction between what people build and what they believe, mentioning that man structures his environment and is influenced by it in his attitudes as a result of interaction with it over time. "Where human activities were guided by distinct spiritual values which thus succeeded in permeating the whole built environment" (Bianca 2000:22).

Sustainability in Traditional Baghdadi houses

A dense grouping of courtyard houses with narrow alley have let to create urban sustainability in the traditional fabric. The main strategies in Baghdadi houses are privacy, protection, equity and efficient use of resources. These strategies affected the urban pattern, spatial relations, and the house layout. The Baghdadi houses derive light and air from their own internal open spaces and allow wall-to-wall to control the built environment in these traditional areas (Figure 19 A) (Ragette 2003:50). Courtyards play a fundamental role in controlling the internal and external environment, a thermal regulator that prevents direct sunlight in the daytime, this will allow the cool air to rise and leak out of the surrounding rooms. During this time, the courtyard now begins to act as a chimney, when the outside temperatures are highest. Afternoon convection currents are set up and the courtyard floor and the internal environment of the house get warmer. The narrow alley and courtyard are protected by shadows of adjacent structures during the late afternoon. In the sunsets, the courtyard will start to radiate rapidly to the clear night sky and the air temperature will fall rapidly. Then, the cool night air descends into the courtyard and fills the surrounding rooms and completing the cycle (Figure 19 B) (Al-Zubaidi 2007). Therefore, these processes and strategies have proved that urban sustainability can be achieved by using traditional principles and methods in order to reduce the impact on the environment.

Sustainability in Using Materials, Natural Ventilation and Basement as Thermal Mass Effect Cooling Strategy

Traditional houses materials brick, tree trunks, clay, and wood, for example, are natural and they are low in embodied energy and toxicity. These traditional materials are local and appropriate to climatic conditions and have the ability to make the comfortable internal environment in a natural way and obtain the potential of urban sustainability. Traditional houses materials are low embodied energy, recyclable, reusable, energy efficient and environmentally sustainable. Furthermore, they were perfect thermal insulators when utilized as thick walls with minimum external openings (Al-Zubaidi 2007).

Natural ventilation in the traditional urban fabric in old Rusafa one of the main cooling strategies was used to provide a suitable internal climate through evaporative cooling. Narrow alley and traditional Baghdadi houses are oriented with respect to dominant wind. Wind towers (badgirs) is the main natural ventilation features and play a fundamental role with basement “sirdab” and courtyard as a complementary natural ventilation system for traditional Baghdadi houses (Figure 20).

The basement as a thermal mass had been used in traditional houses of Old Rusafa for a long time to cope with the hot and dry environment. These houses contain subterranean air tunnels or streams connected to the basement by a vertical shaft to cool the internal spaces (Fathy, Shearer, and Sultān 1986:89). These strategies have utilized natural resources to achieve urban sustainability in the traditional urban fabric.

Figure 16: A Narrow Alley with Natural Shading in the Historic Part of Baghdad
Source: Author 2016

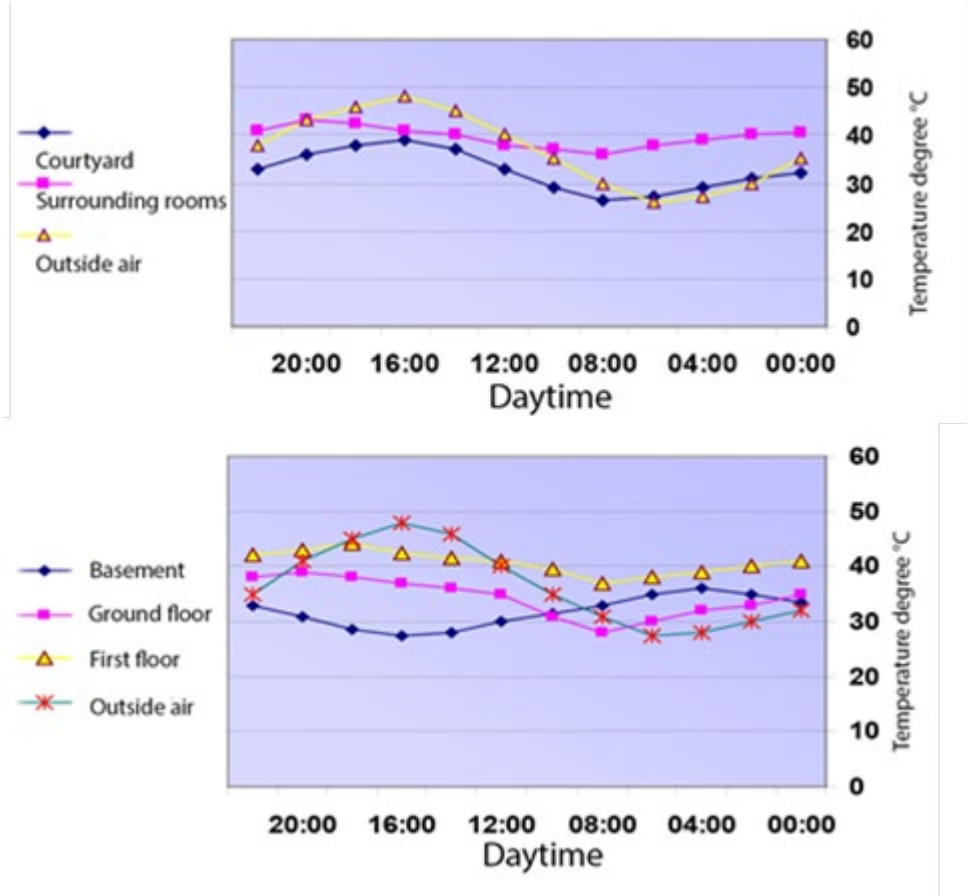


Figure 17: Temperature degree in traditional Baghdadi house
Source: (Al-Zubaidi and Shahin 2008).

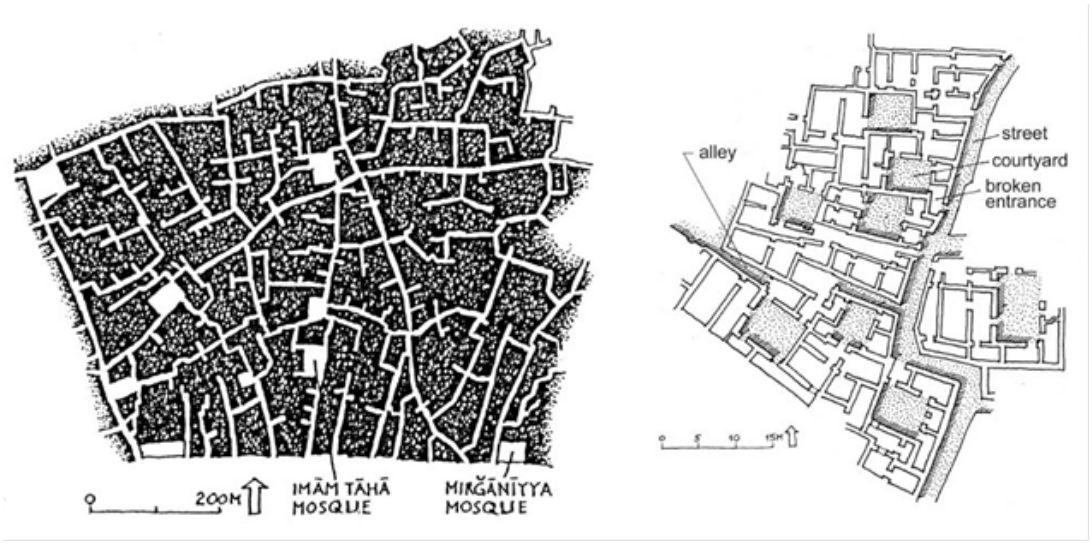


Figure18: Central part of Baghdad with neighbourhood squares, Neighbourhood in Ur, 2000 BC
Source: (Ragette 2003).

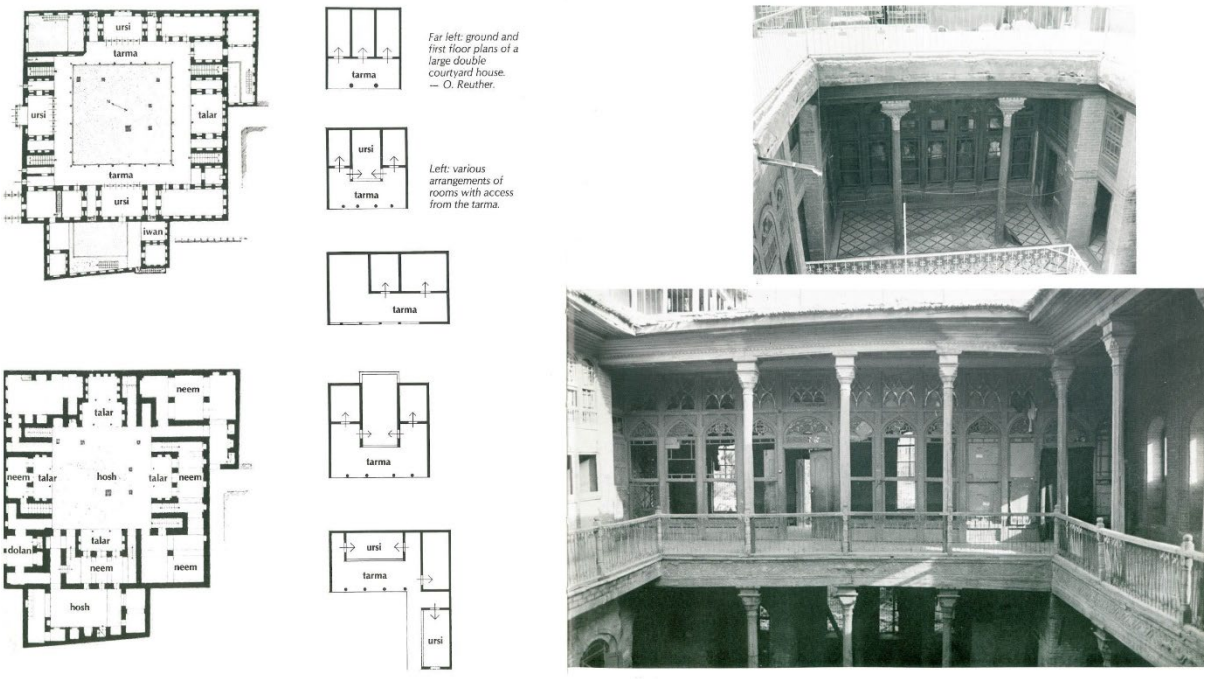


Figure19: A Central Open Courtyard as the Focal Point of the Family's Social Interactions (A Traditional house in Baghdad)
Source: (Warren and Fethi 1982:69).

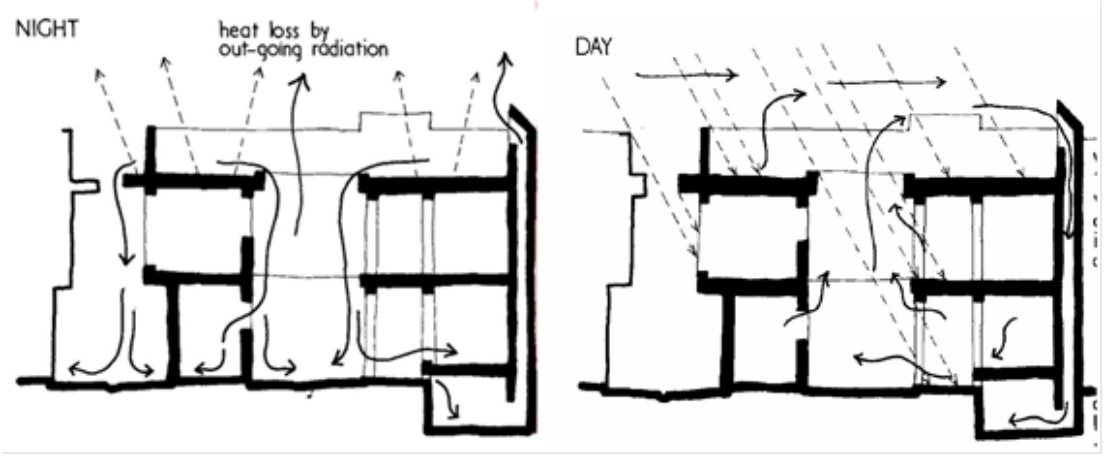


Figure 19: B Thermal Performance of the Courtyard in a Traditional House
Source: (Al-Zubaidi 2007).

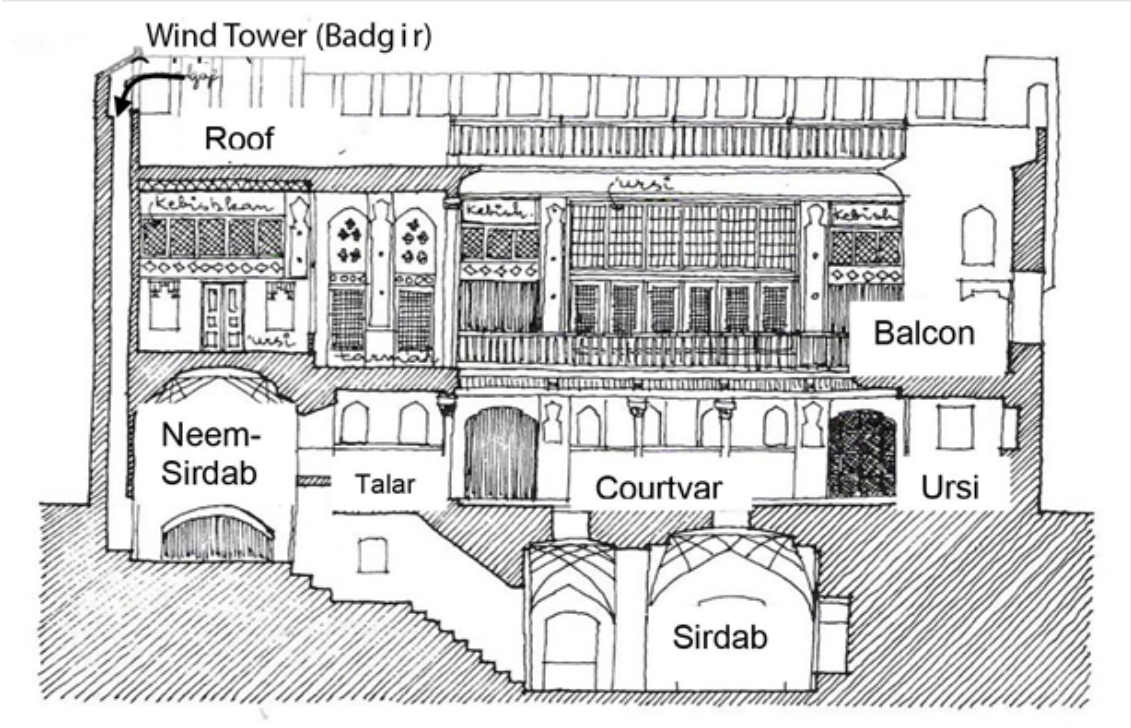


Figure 20: Cooling Strategy: Basement and Wind Tower (Badgir) - Traditional House in Baghdad
Source: (Al-Zubaidi 2007).

Urban Sustainability Framework
Environmental Framework

Many elements integrate to give the historic part of Baghdad one of the most extraordinary ecological contexts in the world. Fundamentally, it is a river city and the traditional urban fabric that give the Old Rusafa the most important economic resources in the entire city. This framework is predicated on the concept that this vital environment in the traditional urban fabric must be preserved. The best way to implement that is through redeveloping the traditional principle in the organic traditional core and the environmental standard. High performance green urban fabric and buildings will maximize resource efficiency and human comfort in the hot and dry climate. The level of land use allocation, green open spaces, riverfront, and the traditional urban fabric provide a framework that can accommodate both the needs of economic development and the needs of environmental preservation. Urban sustainability should be achieved by promoting environmental awareness and sense of responsibility. Furthermore, we can achieve it by using energy from renewable resources, green infrastructure, reducing waste by improving the way to recycle products and green transportation to minimize air pollution.

Land Use Framework

The Land Use Framework addresses the critical issues facing the traditional area of Old Rusafa through several strategic moves. Firstly, define the limits of growth for the city centre of Baghdad by providing a clear spatial identification for the activities, and minimize the horizontal extension of the city centre. Secondly, we need to organise new strategies of land use within the urban sustainability framework of greater Baghdad, transfer functions and replace them with other green facilities that promote the traditional values and health environment. Most important resolve the conflict between traditional principles and modern design model through identifying the policies and strategies that will conserve the traditional urban fabric under the light of urban sustainability. Finally, we should correct the balance of spatial distribution in Old Rusafa, and try to create livable and competitive historic centre.

Transportation Framework

The main problem in the historic centre is traffic congestion, by spreading traffic loads evenly through the roadway system, starts with a good land use plan. Creating a comfortable and efficient transportation scheme is the first stage of formulating effective and environmentally sound transportation systems. Walking and cycling are keys to the Transportation Framework. Most journeys begin and ends with a walk, so no matter what form of transportation people ultimately will choose. This will demand to increase the width of sidewalks, adding the shade of trees and shading devices, and comprehensively designing the entire public realm. Encouraging people to walk or to cycle, providing suitable ways to access to the centre and secondary centres and reducing the need for the car will reduce the impact on the environment and minimize air pollution. Promote movement linkages between two sides of Tigris River by using river transportation as a part of Transportation Framework of metropolitan Baghdad. A well-conceived transit network will help guide and phase development as Baghdad's population increases.

Traditional Urban Fabric Conservation Framework

There are many elements emphasize a unique urban fabric that makes the Old Rusafa so special such as traditional suqs, Rashid Street, khans, churches and significant mosques. Conserving these archaeological and cultural features will promote heritage values in Baghdad. Rescuing the Old Rusafa by regenerating its urban fabric, the five historical spines and Baghdadi courtyard houses will enhance the quality of life and achieve equity. Traditional urban fabric needs a green and new urban infrastructure that helps to reach the environmental and health standard. As a result, urban sustainability would be measured in terms of the long-term environmental and resources protection, including built environment.

Conclusion

The center of the whole of Baghdad is Rusafa, and due to that, its historic fabric has been under pressure from modern growth and has lost so much from its structure. The search for sustainable urban form today requires a reorientation of the search for a number of sustainable urban forms which respond to a variety of existing settlement patterns and contexts. The finding of this research provide insights into the cases that urban designers, policy-makers, technology companies and governments should consider in devising regeneration solutions and endeavours dealing with historic cities, aiming to integrate traditional principles with contemporary needs and provide a new vision for rethinking the way cities are designed, built, and managed. The primary implications are summarized in two outcomes, the implementation of the sustainable urban design in a historic environment and the degree of amenability of the historic center (Old Rusafa) for sustainable regeneration.

Traditional urban fabric in Old Rusafa had achieved urban sustainability by implementing natural environment through compact urban planning, narrow alleys and their orientation, shading passageways and attached buildings. Furthermore, urban sustainability in Old Rusafa had been achieved by utilising natural materials that have the ability to reuse it again, using renewable energy and natural ventilation. The natural environment of the Tigris River, where Old Rusafa is located, include a number of significant buildings, mosques, traditional suqs and private houses that emphasise the urban fabric identity and its urban sustainability. For a future vision, a big effort is required to regenerate urban heritage conservation principles under the light of the new principles of sustainable urban design. Finally, governments, planners, architects, urban designers, companies and professionals should improve urban design strategies, qualities codes, and building regulations towards urban sustainability, heritage values, and cultural environments. Encouraging people to participate in decision-making and increasing public awareness about urban sustainability.

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