بسم الله الرحمن الرحيم

قال تعالى

(يَا أَيُّهَا النَّاسُ إِنَّا خَلَقْنَاكُمْ مِنْ ذَكَرٍ وَأُنْثَىٰ وَجَعَلْنَاكُمْ شُعُوبًا وَقَبَائِلَ لِتَعَارَفُوا ۚ إِنَّ أَكْرَمَكُمْ عِنْدَ اللَّهِ أَتْقَاكُمْ ۚ إِنَّ اللَّهَ عَلِيمٌ خَبِيرٌ)

(الحجرات – 13)

Dedication

I am fortunate with a family and friend, being full dedication, no demands, and no complaints. They tell me what I need to hear, not what I want to hear and they are there for me in the good and bad times. Without them I have no idea where I would be and I know that their love is all I have.

Acknowledgment

Praise God for his grace for completing this dissertation.

I am grateful to Dr. Saleem Elzain Alhassan, my supervisor, for his useful discussions, suggestions, and his assistance throughout this research, he save no effort to help me with his knowledge and his time.

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To my family, and all my friends for their help and support to accomplish this work.

I have strengths, and I have weaknesses, I couldn't do this alone, so thanks to all those who have helped me.

Abstract

Throughout most of human history, the majority of human settlements developed as mixed-use environments. Walking was the primary way that people and goods were moved about, sometimes assisted by animals such as horses or cattle. Most people dwelt in buildings that were places of work as well as domestic life, and made things or sold things from their own homes. Most buildings were not divided into discrete functions on a room by room basis, and most neighborhoods contained a diversity of uses.

The purpose of this research is to show the importance of the mixed use neighborhood and if it exists, how to develop it to reduced distances between houses, workplaces, retail businesses, and other amenities, create more compact development, and land-use synergy (e.g. residents provide customers for retail which provide amenities for residents).

The analysis of Khartoum's neighborhoods show that Al-Taif and Al-Amaraat neighborhoods are already following the example of the mixed use neighborhoods; but some of these neighborhoods do not have all the basic services within them, so sometimes residents have to go outside the neighborhood to seek some of their needs that is not available within their neighborhood and that lead to a poor life style. These problems came as a result of two facts; the first and the very important one is the original plans from the ministry of planning, it doesn't follow the same standards in all neighborhoods plans, and sometimes the plan has more blocks than services areas, according to the population increase. And other reason is the original plans have all the services within, but when they come to the execution they replace the services blocks with residential blocks for the same reason (population increase) or they turn it to investment projects to the benefit of certain people not for the

neighborhood residents' benefit. The second reason is that the residents themselves use the blocks that were fixed for the services for other purposes. This research follows the methodology of descriptive analysis and questionnaire this research is trying to study the concept of mixed-use development of several aspects; economic, social, and environmental.

The comparison between the original plans by the ministry of planning and the existing situation for the two neighborhoods (Al-Taif block 24 and Al-A'marat) revealed that the areas of the services are not up to Khartoum state standards (Khartoum state follows the British standers). The spatial distribution and radius of catchment are also not up to the standards because all the services either at the center of the neighborhood or at the boundaries of the neighborhood. The lack of the essential services and the injustice in the spatial distribution for the existing services within the neighborhood force the residence of the neighborhood to seek them outside their neighborhood, this provides uncomfortable lifestyle and may affect the economic situation of the residents (transport). The most important recommendations are; the ministry of planning should apply the same standards for all the neighborhoods, and should stick to the original plans of the neighborhood, it should not change the planned spaces that were allocated for services for other purposes. Minimize the residential blocks to provide more services by changing the trend of the horizontal expansion in order to provide more space for services. For developing the mixed use services within the neighborhood; encouraging the residence to use a part of their houses for providing service (the services could be at the ground floor and the domicile on the upper floors), and promoting the handicrafts and small businesses would help to generate extra income to the family, and the services will be available.

المستخلص

نحو تطوير الاستعمالات المختلطة في المجاورات السكنية

عبر التاريخ البشري، تطورت غالبية المستوطنات البشرية كمستوطنات متعددة الاستخدامات، حيث كانت وسيلة نقل البضائع والحركة الرئيسية هي السير على الاقدام ، ويتم أحيانا بمساعدة الحيوانات مثل الخيول أو الأبقار. سكن معظم الناس في مباني مثلت مكان العمل والسكن معا، حيث استخداموا المنزل كمكان للتجارة والبيع والسكن ايضا. لم تقسم غرف المباني الي وظائف منفصلة، ومعظم المستوطنات كانت تتضمن مجموعة متنوعة من الخدمات.

الغرض من هذا البحث هو إظهار أهمية حي الاستخدام المختلط، وإذا كان موجودا كيفية تطويره لتقليل المسافات بين المنازل وأماكن العمل، والترفيه، وغيرها من المرافق، وتداخل استخدام الأراضي (على سبيل المثال يوفر السكان للعملاء الاماكن التي توفر وسائل الراحة للسكان).

اوضح تحليل أحياء الخرطوم (الطائف مربع 24 – العمارات) أنها تتبع مثال الأحياء متعددة الاستخدامات. ولكن بعض هذه الأحياء لا تتوفر بها جميع الخدمات الأساسية داخلها، لذلك في بعض الأحيان يضطر سكان الحي أن يذهبوا خارج الحي للحصول على بعض احتياجاتهم التي لا تتوفر داخل احيائهم، وهذا يؤدي إلى نمط حياة غيرمريح وغير سهل. جاءت هذه المشاكل نتيجة لسببين, أول وأهم سبب هو الخطط الأصلية من وزارة التخطيط، لا تتبع نفس المعايير في جميع خطط الأحياء، بعض الاحياء بها وحدات سكنية اكثر من وحدات الخدمات نتيجة لزيادة عدد السكان. سبب اخر وهو ان الخطط الأصلية بها كل الخدمات، ولكن عندما يتعلق الأمر بالتنفيذ تحل محل وحدات الخدمات وحدات سكنية لنفس السبب (زيادة السكان) أو أنها تحول إلى مشاريع استثمارية لصالح جهات معينة وليس لصالح سكان حي. والسبب الثاني هو أن السكان أنفسهم يستخداموا الوحدات المحددة للخدمات في أغراض أخرى. يتبع هذا البحث منهجية التحليل الوصفي والاستبيان الذي يحاول البحث فيه دراسة مفهوم الاستخدام المختلط من عدة جوانب، الاقتصادية والاجتماعية والبيئية.

كشفت المقارنة بين الخطط الأصلية لوزارة التخطيط والوضع القائم للحيين (الطائف 24 - العمارات) أن مناطق الخدمات لا ترقى إلى معايير ولاية الخرطوم, كما أن التوزيع

المكاني ونصف القطر لا يرقى إلى مستوى المعايير لأن جميع الخدمات إما في وسط الحي أو على حدود الحي. إن عدم توفر الخدمات الأساسية والظلم في التوزيع المكاني للخدمات الموجودة داخل الحي يجبر سكن الحي على البحث عن الخمات خارج الحي، مما يوفر نمط حياة غير مريح وقد يؤثر على الوضع الاقتصادي للسكان (النقل). من أهم التوصيات, يجب على وزارة التخطيط تطبيق نفس المعايير لجميع الأحياء، ويجب التمسك بالخطط الأصلية للحي، وليس الاستفادة من المساحات المخصصة للخدمات لأغراض أخرى. تقليل الوحدات السكنية لتوفير المزيد من الخدمات عن طريق تغيير ثقافة التوسع من التوسع الأفقي إلى التوسع الرأسي لتوفير مساحة أكبر للخدمة. ولتطوير الخدمات داخل الحي، تشجيع السكان لاستخدام جزء من منازلهم لتوفير خدمة (يمكن للخدمات أن تكون في الطابق الأرضي والمسكن في الطوابق العليا)، وتشجيع الحرف اليدوية و المشاريع الصغيرة تساعد على خلق دخل إضافي للأسرة، وتوفر الخدمات داخل الحي.

Table of Contents

List of figures

List of Maps

List of Tables

Chapter One - Introduction

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Introduction

1.1 Background

Throughout most of human history, the majority of human settlements developed as mixed-use environments. Walking was the primary way that people and goods were moved about, sometimes assisted by animals such as horses or cattle. Most people dwelt in buildings that were places of work as well as domestic life, and made things or sold things from their own homes. Most buildings were not divided into discrete functions on a room by room basis, and most neighborhoods contained a diversity of uses, even if some districts developed a predominance of certain uses, such as metalworkers, or textiles or footwear due to the socio-economic benefits of propinquity. People lived at very high densities because the amount of space required for daily living and movement between different activities was determined by walkability and the scale of the human body. This was particularly true in cities, and the ground floor of buildings was often devoted to some sort of commercial or productive use, with living space upstairs.

1.2 Problem Statement

Most of the neighborhoods require driving between home, work and recreation. People indicated that while the size of a home or yard does matter, most are willing to compromise size for a preferred neighborhood and less commuting. For example, people are willing to forgo a home

with a larger yard if it meant they could live within walking distance of schools, stores and restaurants.

1.3 Research Aim /objectives

show the important of the mixed use neighborhood and if its exist how to develop it to reduced distances between houses, workplaces, retail businesses, and other amenities, create more compact development, and land-use synergy (e.g. residents provide customers for retail which provide amenities for residents). And To study the possibility of achieving a greater housing variety and density, and more affordable housing (smaller units or low-cost units)

1.4 Research Methodology

Through the descriptive analysis and questionnaire this research is trying to study the concept of mixed-use development of several aspects; economic, social, and environmental.

1.5 Research Hypothesis

Is the concept of mixed-use neighborhood development favorable and applicable in Sudan? Are people going to choose the walkability, easy transit to work, and all the amenities over the space? Do the existing neighborhoods match the theories of the mixed use neighborhood? Is there any possibility of transforming those neighborhoods into mixed-use neighborhoods?

1.6 Research Scope

The scope of this research is through the literature review, examples and taking two neighborhoods of Khartoum neighborhoods at the present time as a case study, studying the current situation.

Chapter Two, Theoretical Background

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2.1 Overview

This chapter is discussing the neighborhoods history, types, critics, benefits, and the contemporary types of the mixed use. Also the theories that have affected the mixed use neighborhood and its development, and demonstrate the previous studies about the mixed use neighborhood development.

2.2 Definitions of the Neighborhood

Neighborhood is a geographically localized community within a larger city, town, suburb or rural area. Neighborhoods are often social communities with considerable face-to-face interaction among members. Another definition of the neighborhood is generally defined spatially as a specific geographic area and functionally as a set of social networks.

Then, neighborhoods are the spatial units in which face-to-face social interactions occur—the personal settings and situations where residents seek to realize common values, socialize youth, and maintain effective social control.

2.3 History

Most of the earliest cities around the world as excavated by archaeologists have evidence for the presence of social neighborhoods. Neighborhoods are typically generated by social interaction among people living near one another. In this sense they are local social units larger than households not directly under the control of city or state officials. In some preindustrial urban traditions, basic municipal functions such as protection, social regulation of births and marriages, cleaning and

upkeep are handled informally by neighborhoods and not by urban governments; this pattern is well documented for historical Islamic cities.

Neighborhoods in preindustrial cities often had some degree of social specialization or differentiation. Ethnic neighborhoods were important in many past cities and remain common in cities today. Economic specialists, including craft producers, merchants, and others, could be concentrated in neighborhoods, and in societies with religious pluralism neighborhoods were often specialized by religion. One factor contributing to neighborhood distinctiveness and social cohesion in past cities was the role of rural to urban migration. This was a continual process in preindustrial cities, and migrants tended to move in with relatives and acquaintances from their rural past.

Neighborhoods, as a core aspect of community, also are the site of services for youth, including children with disabilities and coordinated approaches to low-income populations. Community and economic development activists have pressured for reinvestment in local communities and neighborhoods. In the early 2000s, Community Development Corporations, Rehabilitation Networks, Neighborhood Development Corporations, and Economic Development organizations would work together to address the housing stock and the infrastructures of communities and neighborhoods (e.g., community centers). Community and Economic Development may be understood in different ways, and may involve "faith-based" groups and congregations in cities.

Urban sociology even has a subset termed neighborhood sociology which supports the study of local communities and the diversity of urban neighborhoods. Neighborhoods are also used in research studies from zip codes and health disparities, to correlations with school dropout rates or

use of drugs. Central yet today are "community values" which have changed dramatically in larger cities; these values are reflected and shaped in part by the media bridging the gap between citizens and government. Neighborhoods have several advantages as areas for policy analysis as well as an arena for social action:

1. Neighborhoods are common, and perhaps close to universal, since most people in urbanized areas would probably consider themselves to be living in one.

2. Neighborhoods are convenient, and always accessible, since you are already in your neighborhood when you walk out your door.

3. Successful neighborhood action frequently requires little specialized technical skill, and often little or no money. Action may call for an investment of time, but material costs are often low.

4. With neighborhood action, compared to activity on larger scales, results are more likely to be visible and quickly forthcoming. The streets are cleaner; the crosswalk is painted; the trees are planted; the festival draws a crowd.

5. Visible and swift results are indicators of success; and since success is reinforcing, the probability of subsequent neighborhood action is increased.

6. Because neighborhood action usually involves others, such actions create or strengthen connections and relationships with other neighbors, leading in turn to a variety of potentially positive effects, often hard to predict.

7. Over and above these community advantages, neighborhood activity may simply be enjoyable and fun for those taking part; and

can often tighten security for those partaking in neighborhood watch communities.

In addition to these benefits, considerable research indicates that strong and cohesive neighborhoods and communities are linked—quite possibly causally linked—to decreases in crime, better outcomes for children, and improved physical and mental health. The social support that a strong neighborhood may provide can serve as a buffer against various forms of adversity.

2.3.1 Neighborhood Concept

Clarence Perry's conceptualization of the neighborhood unit evolved out of an earlier idea of his, to provide a planning formula for the arrangement and distribution of playgrounds in the New York region. The necessity for a formula such as this was attributed to the rise of the automobile in the early 20th century. During a period where road sense had not yet amalgamated with the social conscious, and many of the urban tools we now use to manage the threat posed by vehicular traffic did not exist, or were not in abundance (such as pedestrian crossings, traffic lights and road signs), developing cities such as New York, which embraced the motor car, suffered street fatality rates in excess of one child a day.

Clarence Perry conceived of neighborhoods in this time period as islands locked amidst a burgeoning sea of vehicular traffic, a dangerous obstacle which prevented children (and adults) from safely walking to nearby playgrounds and amenities. Perry's neighborhood unit concept began as a means of combating this obstacle. Ultimately, however, it evolved to serve a much broader purpose, of providing a discernible identity for the concept of the "neighborhood", and of offering to designers a framework for disseminating the city into smaller subareas (suburbs).

While there is evidence that the concept of the neighborhood unit emerged as early as 1923, at a joint meeting of the National Community Center Association and the American Sociological Society in Washington, D.C., it was the publication of Clarence Perry's paper, in the 1929 Regional Plan of New York and Its Environs, which led to its promotion as a planning tool. Titled, "The Neighborhood Unit, a Scheme for Arrangement for the Family-Life Community", Clarence Perry's monograph offered in concrete terms a diagrammatic model of the ideal layout for a neighborhood of a specified population size. This model provided specific guidelines for the spatial distribution of residences, community services, streets and businesses.

Perry's concept of the neighborhood unit employed a variety of institutional, social and physical design principles, influenced by such popular notions in the 1920s as the separation of vehicular and pedestrian traffic, and arterial boundaries demarcating the inwardly focused neighborhood cell from the greater urban lattice. The cellular nature of the neighborhood unit allowed it to be utilized as a building block in the development of neighborhood arrays, leading to its systematic modular usage during periods of rapid residential expansion in many countries across the globe.

While Perry's name is most commonly associated with the notion of the neighborhood unit, the idea of "re-defining and re-planning the city of the basis of neighborhoods'" was not Perry's in isolation. In a paper on the Neighborhood Unit, Lewis Mumford considers the neighborhood as it is organically experienced as well as the various – theoretical and practical - influences that lead to Perry's formalization of the neighborhood unit as an urban planning mechanism. Mumford credits Perry as taking: "the fact of the neighborhood; and showing how, through deliberate design, it

could be transformed into what he called a neighborhood unit, the modern equivalent of a medieval quarter or parish: a unit that would now exist, not merely on spontaneous or instinctual basis."

The neighborhood unit was conceived of as a comprehensive physical planning tool, to be utilized for designing self-contained residential neighborhoods which promoted a community centric lifestyle, away from the "noise of the trains, and out of sight of the smoke and ugliness of industrial plants" emblematic of an industrializing New York City in the early 1900s. The core principles of Perry's Neighborhood Unit were organized around several physical design ideals [1]:

- **Centre the school** in the neighborhood so that a child's walk to school was only about one-quarter of a mile and no more than one half mile and could be achieved without crossing a major arterial street. Size the neighborhood to sufficiently support a school, between 5,000 to 9,000 residents, approximately 160 acres at a density of ten units per acre. Implement a wider use of the school facilities for neighborhood meetings and activities, constructing a large play area around the building for use by the entire community.

- **Place arterial streets along the perimeter** so that they define and distinguish the "place" of the neighborhood and by design eliminate unwanted through-traffic from the neighborhood. In this way, major arterials define the neighborhood, rather than divide it through its heart.

- **Design internal streets** using a hierarchy that easily distinguishes local streets from arterial streets, using curvilinear street design for both safety and aesthetic purposes. Streets, by design, would

discourage unwanted through traffic and enhance the safety of pedestrians.

- **Restrict local shopping areas to the perimeter** or perhaps to the main entrance of the neighborhood, thus excluding nonlocal traffic destined for these commercial uses that might intrude on the neighborhood.

- **Dedicate at least 10 percent of the neighborhood land area to parks and open space**, creating places for play and community interaction"

The neighborhood unit was embraced for its community idealism, and many of the public sectors in those countries which were exposed to the theorem have since adopted its purpose; of protecting and promoting the public health and of considering the safety and welfare of citizens. Furthermore, private developers and investors continue to construct and fund planned communities based upon many of the concepts tenets, due to consumer demand for the idealistic community intimacy associated with living with heteronormative homo reciprocals of similar socioeconomic status.
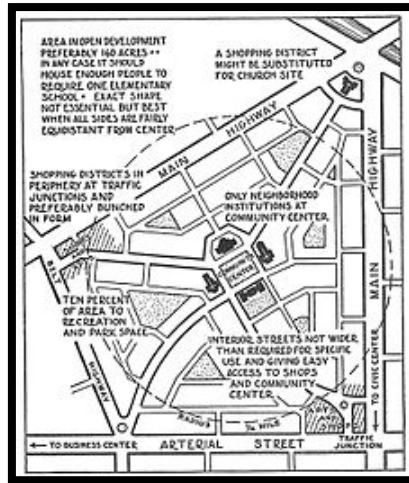
Map 1 A diagram of Clarence Perry's neighborhood unit, illustrating the spatiality of the core principles of the concept.

Map 2 and 3 show contemporary adaptation to the neighborhood unit theory to new development. Figure 4 shows elements of the theory applied to an existing gridiron development.
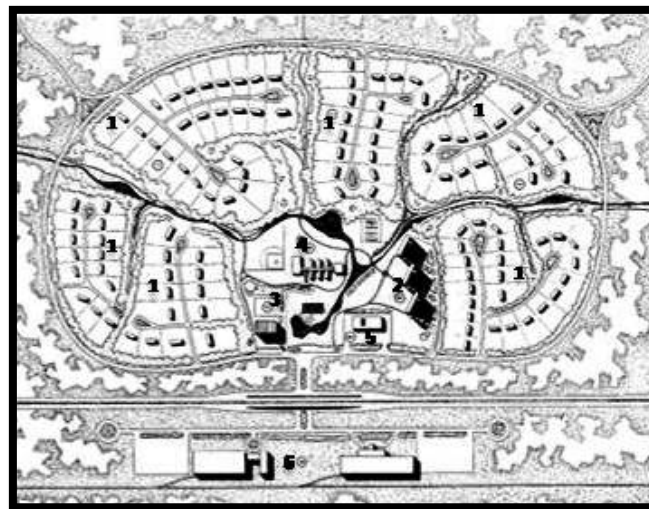
Map 2 Neighborhood Design [13]

Legend

1 Single-family dwelling   4 School

 2 Multi-story apartments   5 Shopping center

 3 Church   6 Industries
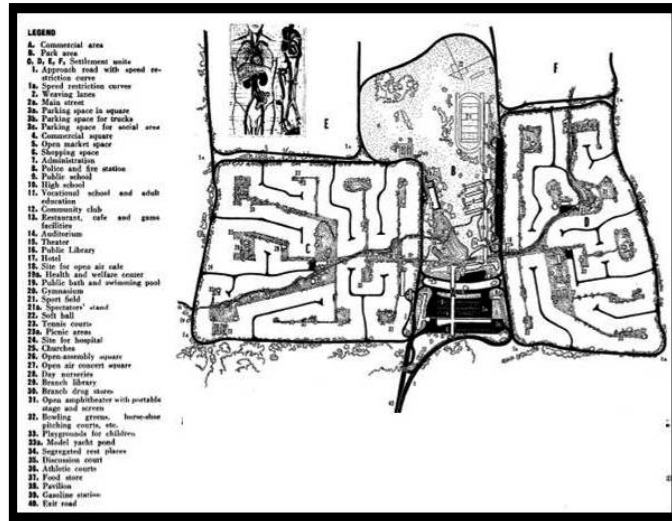
Map 3 Scheme for a settlement of 5,000 people illustrating the organization of social spaces and the principles of circumferential traffic [13]
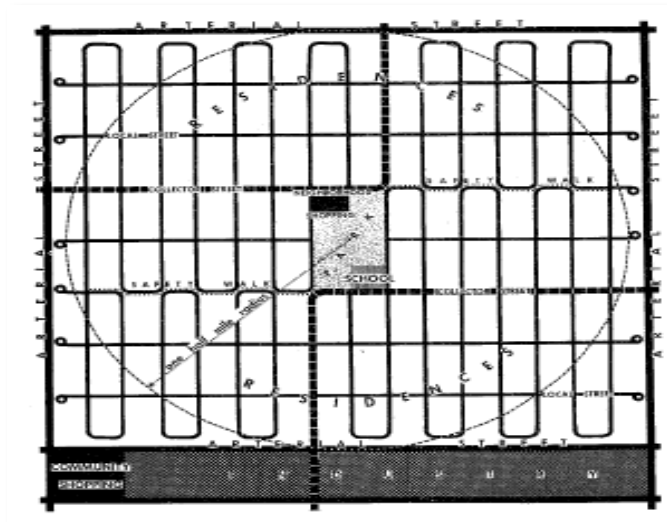
Map 4 The neighborhood idea.

A sound area for living with [13]:

1. Adequate school and parks within a half mile walk.

2. Major Street around rather than through the neighborhood.

3. Separate the residential and nonresidential district.

4. Population large enough to support an elementary school, usually 5,000 to 10,000 people.

5. Same neighborhood stores and services.

This concept is a notable aspect of designs of the new town movement. The neighborhood unit seems to have an uneasy relationship to the Garden City Movement of the same period – consider garden suburbs. Raymond Unwin – an architect working for Ebenezer Howard – was an advocate of the neighborhood unit. Mumford observes a bidirectional relationship between the neighborhood unit realtor's residential subdivision models. It should be noted that Clarence Perry in fact resided within Forest Hills Gardens at the time he presented his treatise on neighborhoods 1923. While spatial elements of neighborhoods such as Forest Hills Gardens or Westwood Highlands are in keeping with those championed by reformers and progressive planners, these suburbs do not have common ideological origins. Instead realtors playing the role of 'community builder' had quite insidious consequences for ideas about public space, community inclusion and political agency.

The use of deed restrictions by neighborhood corporations wanting to control undesirable externalities in the early 1900s (and beyond) has been linked to ongoing racial segregation in the United States. The use of the 'neighborhood unit' in this way emphasizes exclusion rather than inclusion as initially intended. Traces of the exclusion remain evident within the streetscape of neighborhoods such as Forest Hill Gardens with signs delineating the ownership of commonly considered public space. In contemporary Melbourne, Australia, the Owners Corporations Act 2006 enables access restrictions upon facilities generally considered public. Western Leisure Management makes this explicit on their website relating to use of facilities within the 'un-gated' neighborhoods they manage; "These estates are part of an Owners Corporation and the

facilities within are accessible by Residents Only and are not open to the general public."

The concept of the neighborhood unit historically corresponds to activities of American wave of school of urban studies and ecology called *Chicago school*, operating mostly in the 1920s and 1930s. It is closely linked to activities of Jane Jacobs, American urbanist and humanist in the field of migrant integration and child labor force [2].

The schema of neighborhood unit further refers to Charles Horton Cooley´s theory of primary groups and to the concept of neighborhood as a type of a residential community.

The concept should have enhanced the feeling of identification with the environment for the incomers, support their spatial integration, foster social cohesion and avoid social pathology, taking the form of alienation and civic indifference [3].

But several major criticisms of neighborhood unit have been mentioned in the planning literature. In the late 1940s the neighborhood unit concept came under attack from Reginald Isaacs, then Director of Planning for Michael Reese Hospital in Chicago. Isaacs believed that the overwhelming endorsement of the neighborhood unit, as a "panacea for all urban ills" [4], was misguided; suggesting that the mystical powers ascribed to the concept by its most enthusiastic adherents engendered a dangerously sectarian discourse surrounding its application. Isaac's critical commentary of the neighborhood unit centered on its (miss) use as an instrument for the segregation of racial, ethnic, religious and economic groups by private developers willing to utilize the gated-community aspects of the neighborhood units physical design for this purpose. Supporting this argument, Isaacs pointed to examples of promotional material for new pre-planned neighborhoods, as well as

excerpts from government planning reports and information provided by social scientists – all championing the neighborhood unit as a bastion for the gentry, keeping the undesirables, as well as through-traffic, out.

Isaac's argument became a rallying point for the collective opposition of the neighborhood unit, as planners began to question the unintended consequences of its repeated use, its socially divisive nature and its emphasis on the physical environment as the sole determinant of wellbeing. In developed countries across the globe, the spread of urban systems which embrace obsolete or impractical uses of space in order to manifest a synthetic 'rural' community lifestyle is increasingly viewed as blight upon attempts to achieve sustainable metropolitan growth.

In the past, Isaac's argument was weakened through its inability to provide an alternative framework for community planning, in the present, planning bodies internationally, both private and public as of 2009, continue to adapt and make modular use of the neighborhood unit when planning new communities. It is becoming increasingly difficult however, to mask the problems associated with the continued and ubiquitous use of variations on this model, and Urban Sprawl is proving to be one such problematic consequence of this usage facing many developed cities. It is becoming increasingly apparent that a rethinking of the current heteronormative approach to planning new communities on the urban fringe, or in the redevelopment of existing neighborhoods, is required to meet density goals and forge sustainable growth.

neighborhoods began with the Single-use zoning, also known as Euclidean zoning in the preindustrial era, but through time problems of walking distance, expenses of transit, lack of flexibility, and other problems began to appear, plus the massive migrations of people from rural areas to cities drawn by work in factories and the associated

businesses and bureaucracies that grew up around them. These influxes of new workers needed to be accommodated and many new urban districts arose at this time with domestic housing being their primary function.

2.4 Single-Use Zoning

2.4.1 History

Single-use zoning, also known as Euclidean zoning, is a practice of urban planning where every day uses are separated from each other, and where land uses of the same type are grouped together. Shops are concentrated in one area, housing in another area, industry in another. Euclidean zoning is preferred by many municipalities, due to its relative effectiveness, ease of implementation (one set of explicit, prescriptive rules), long-established legal precedent, and familiarity to planners and design professionals. Euclidean zoning has received heavy criticism, however, for its lack of flexibility and institutionalization of now-outdated planning theory. Separation of uses contributes to wasteful sprawl development, loss of open space, heavy infrastructure costs, and reliance on the automobile.

In the 1920s, the U.S. National Zoning Enabling Act of 1923 and a series of National Subdivision and planning acts in English-speaking countries first set forth standards and practices of single-use zoning to be adopted by every municipality, which soon became the standard for all post-World War II development. These laws enforced and codified standards for modern suburban design as it is known today, which have been exported to many other countries through planning professionals and transportation engineers. The resulting bills progressively included restrictions on alleyways, minimum road widths, restrictions on cross streets for major arteries, buffer zones between separate areas, and

eliminating mixed-use in all new developments, resulting in a moratorium on traditional urban development which remains in place in most areas that are not specifically zoned as "mixed use" or "general urban development", a common term for grandfathered urban areas [5].

2.4.2 Types of Single-Use Zoning

Zoning codes have evolved over the years as urban planning theory has changed, legal constraints have fluctuated, and political priorities have shifted [6]. The various approaches to zoning may be divided into four broad categories: Euclidean, Performance, Incentive, and Form-based.

Euclidean (Conventional)

Named for the type of zoning code adopted in the town of Euclid, Ohio, Euclidean zoning codes are by far the most prevalent in the United States, being used extensively in small towns and large cities alike.
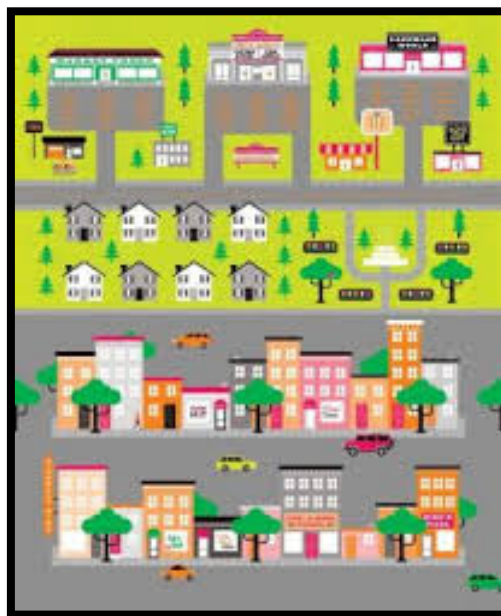
Figure 1 Euclidean type [14]

Standard Euclidean

Also known as "Building Block" zoning, Euclidean zoning is characterized by the segregation of land uses into specified geographic districts and dimensional standards stipulating limitations on the magnitude of development activity that is allowed to take place on lots within each type of district. Typical types of land-use districts in Euclidean zoning are: *residential (single-family), residential (multi-family), commercial, and industrial*. Uses within each district are usually heavily prescribed to exclude other types of uses (residential districts typically disallow commercial or industrial uses). Some "accessory" or "conditional" uses may be allowed in order to accommodate the needs of the primary uses. Dimensional standards apply to any structures built on lots within each zoning district, and typically, take the form of setbacks, height limits, minimum lot sizes, lot coverage limits, and other limitations on the building envelope.

The zoning ordinance of Euclid, Ohio was challenged in court by a local land owner on the basis that restricting use of property violated the Fourteenth Amendment to the United States Constitution. Although initially ruled unconstitutional by lower courts.

Euclidean zoning is preferred by many municipalities, due to its relative effectiveness, ease of implementation (one set of explicit, prescriptive rules), long-established legal precedent, and familiarity to planners and design professionals. Euclidean zoning has received heavy criticism, however, for its lack of flexibility and institutionalization of now-outdated planning theory. Separation of uses contributes to wasteful sprawl development, loss of open space, heavy infrastructure costs, and reliance on the automobile.

Euclidean II

Euclidean II Zoning uses traditional Euclidean zoning classifications (industrial, commercial, multi-family, residential, etc.), but places them in a hierarchical order "nesting" one zoning class within another similar to the concept of Planned Unit Developments (PUD) mixed uses, but now for all zoning districts.

For example, multi-family is not only permitted in "higher order" multi-family zoning districts, but also permitted in high order commercial and industrial zoning districts as well. Protection of land values is maintained by stratifying the zoning districts into levels according to their location in the urban society (neighborhood, community, municipality, and region). Euclidean II zoning also incorporates transportation and utilities as new zoning districts in its matrix dividing zoning into three categories: public, semi-public and private. In addition, all Euclidean II Zoning permitted activities and definitions are tied directly to the state's building code, Unicode, and the North American Industry Classification System (NAICS) assuring statewide uniformity. Euclidean II zoning fosters the concepts of mixed use, new urbanism and "highest and best use" and, simplifies all zoning classifications into a single and uniform set of activities. It is relatively easy to make a transition from most existing zoning classification systems to the Euclidean II Zoning system.

Smart zoning

Smart zoning (or smart coding) is an alternative to Euclidean zoning. There are a number of different techniques to accomplish smart zoning. Floating zones, cluster zoning, and planned unit development (PUDs) are possible even as the conventional Euclidean code exists, or the conventional code may be completely replaced by a smart code, as the city of Miami is proposing. The following three techniques may be used

to accomplish either conventional separation of uses or more environmentally responsible, traditional neighborhood development, depending on how the codes are written.

For serious reform of Euclidean zoning, traditional neighborhood development ordinances such as form-based codes or the Smart Code are usually necessary.

Floating zones involve an ordinance that describes a zone's characteristics and requirements for its establishment, but its location remains without a designation until the board finds that a situation exists that allows the implementation of that type of zone in a particular area. When the criterion of a floating zone is met the floating zone ceases "to float" and is adopted by a zoning amendment. Some states allow this type of zoning, such as New York and Maryland, while states such as Pennsylvania do not, as an instance of spot zoning. To be upheld, the floating zone the master plan must permit floating zones or at least they should not conflict with the master plan. Further, the criteria and standards provided for them should be adequate and the action taken should not be arbitrary or unreasonable. Generally, the floating zone is more easily adoptable and immune from legal challenges if it does not differ substantially from zoned area in which it is implemented.

Cluster zoning permits residential uses to be clustered more closely together than normally allowed, thereby leaving substantial land area to be devoted to open space.

Planned unit development is cluster zoning, but allows for mixed uses. They include some commercial and light industrial uses in order to blend together a traditional downtown environment, but with at a suburban scale. Some have argued, however, that such a planned unit development

may be a sham for the purpose of bringing in commercial and industrial uses forbidden by the state's zoning law.

Performance

Known also as "effects-based planning", performance zoning uses performance-based or goal-oriented criteria, to establish review parameters for proposed development projects in any area of a municipality. Performance zoning often utilizes a "points-based" system whereby a property developer may apply credits toward meeting established zoning goals through selecting from a 'menu' of compliance options (some examples include: improvement of environmental impacts, providing public amenities, building affordable housing units, etc.). Additional discretionary criteria may be established also as part of the review process.

The appeal of performance zoning lies in its high level of flexibility, rationality, transparency, and accountability. Performance zoning avoids the arbitrary nature of the Euclidean approach, and better accommodates market principles and private property rights with environmental protection, however, performance zoning can be extremely difficult to implement and can require a high level of discretionary activity on the part of the supervising authority. For this reason performance zoning has not been adopted widely in the USA, and is usually limited to specific categories within a broader prescriptive code when found.

New Zealand's planning system, however, is grounded in effects-based performance zoning under the Resource Management Act 1991.

Incentive

First implemented in Chicago and New York City, incentive zoning is intended to provide a reward-based system to encourage development

that meets established urban development goals. Typically, a base level of prescriptive limitations on development will be established and an extensive list of incentive criteria will be established for developers to adopt or not, at their discretion. A reward scale connected to the incentive criteria provides an enticement for developers to incorporate the desired development criteria into their projects. Common examples include (floor-area-ratio) bonuses for affordable housing provided on-site and height limit bonuses for the inclusion of public amenities on-site. Incentive zoning has become more common throughout the United States during the last 20 years.

Incentive zoning allows for a high degree of flexibility, but may be complex to administer. The more a proposed development takes advantage of incentive criteria, the more closely it has to be reviewed on a discretionary basis. The initial creation of the incentive structure in order to best serve planning priorities also may be challenging and often, requires extensive ongoing revision to maintain balance between incentive magnitude and value given to developers.

Form-based

Form-based zoning relies on rules applied to development sites according to both prescriptive and potentially discretionary criteria. Typically, these criteria are dependent on lot size, location, proximity, and other various site- and use-specific characteristics. For example, in a largely suburban single family residential area, uses such as offices, retail, or even light industrial could be permitted so long as they conformed (setback, building size, lot coverage, height, and other factors) to other existing development in the area.

Form based codes offer considerably more flexibility in building uses than do Euclidean codes, but, as they are comparatively new, may be

more challenging to create. Form-based codes have not yet been widely adopted in the United States. When form-based codes do not contain appropriate illustrations and diagrams, they have been criticized as being difficult to interpret.

Each form district intends to recognize that some areas of the city are more sub-urban in nature, while others are more urban. Building setbacks, heights, and design features vary according to the form district.

One version of form-based or "form integrated" zoning uses a base district overlay method or "composite" zoning. This method is based on a Euclidian framework and includes three district components - a use component, a site component, and an architectural component.

The use component is similar in nature to the use districts of Euclidian zoning. With an emphasis on form standards, however, use components are typically more inclusive and broader in scope. The site components define a variety of site conditions from low intensity to high intensity such as size and scale of buildings and parking, accessory structures, drive-through commercial lanes, landscaping, outdoor storage and display, vehicle fueling and washing, overhead commercial service doors, etc. The architectural components address architectural elements and materials.

This zoning method is more flexible and contextually adaptable than standard Euclidian zoning while being easier to interpret than other form-based codes. It has been utilized primarily for contemporary "conventional" standards and has not yet been fully developed for traditional standards.

Putting everyday uses out of walking distance of each other leads to an increase in traffic since people have to get in their cars and drive to meet

their needs throughout the day. Single zoning and urban sprawl have also been criticized as making work–family balance more difficult to achieve, as greater distances need to be covered in order to integrate the different life domains.

Quite opposite approaches to urban planning include mixed-use development and the compact city model.

2.5 Mixed-Use Zoning

2.5.1 History

Mixed-use development is—in a broad sense—any urban, suburban or village development, or even a single building, that blends a combination of residential, commercial, cultural, institutional, or industrial uses, where those functions are physically and functionally integrated, and that provides pedestrian connections. The term ("a mixed-use development") may also be used more specifically to refer to a mixed-use real estate development project—a building, complex of buildings, or district of a town or city that is developed for mixed-use by a private developer, (quasi-) governmental agency, or a combination thereof.

Traditionally, human settlements have developed in mixed-use patterns. However, with industrialization as well as the invention of the skyscraper, governmental zoning regulations were introduced to separate different functions, such as manufacturing, from residential areas. In the United States, the heyday of separate-use zoning in the U.S. was after World War II, but since the 1990s, mixed-use zoning has once again become desirable as the benefits are recognized.

The historical mixed-used pattern of development declined during industrialization in favor of large-scale separation of

manufacturing and residences in single-function buildings. This period saw massive migrations of people from rural areas to cities drawn by work in factories and the associated businesses and bureaucracies that grew up around them. These influxes of new workers needed to be accommodated and many new urban districts arose at this time with domestic housing being their primary function. Thus began a separating out of land uses that previously had occurred in the same spaces. Furthermore, many factories produced substantial pollution of various kinds. Distance was required to minimize adverse impacts from noise, dirt, noxious fumes and dangerous substances. Even so, at this time, most industrialized cities were of a size that allowed people to walk between the different areas of the city.

These factors were important in the push for Euclidean or single-use zoning premised on the compartmentalization of land uses into like functions and their spatial separation. In Europe, advocates of the Garden City Movement were attempting to think through these issues and propose improved ways to plan cities based on zoning areas of land so that conflicts between land uses would be minimized.

In the United States, another impetus for Euclidean zoning (single-use zoning) was the birth of the skyscraper. Fear of buildings blocking out the sun led many to call for zoning regulations, particularly in New York City, but eventually called for separations of uses. This was largely meant to keep people from living next to polluted industrial areas. This separation, however, was extended to commercial uses as well, setting the stage for the suburban style of life that is common in America today. This type of zoning was widely adopted by municipal zoning codes.

Throughout the late 20th century, it began to become apparent to many urban planners and other professionals that mixed-use development

had many benefits and should be promoted again. As American, British, Canadian and Australian cities deindustrialized, the need to separate residences from hazardous factories became less important. Completely separate zoning created isolated "islands" of each type of development. In most cases, the automobile had become a requirement for transportation between vast fields of residentially zoned housing and the separate commercial and office strips, creating issues of Automobile dependency. Jane Jacobs' influential The Death and Life of Great American Cities argued that a mixture of uses is vital and necessary for a healthy urban area.

Zoning laws have been revised accordingly and increasingly attempt to address these problems by using mixed-use zoning. A mixed-use district will often serve as the "downtown" area of a local community, ideally associated with public transit nodes in accordance with principles of transit-oriented development and new urbanism. Mixed-use guidelines often result in residential buildings with street front commercial space. Retailers have the assurance that they will always have customers living right above and around them, while residents have the benefit of being able to walk a short distance to buy groceries and household items or see a movie.

2.5.2 Benefits

Benefits of mixed-use development include:-

1. Greater housing variety and density, more affordable housing (smaller units), life-cycle housing (starter homes to larger homes to senior housing).
2. Reduced distances between housing, workplaces, retail businesses, and other amenities and destinations.

3. Better access to fresh, healthy foods (as food retail and farmers markets can be accessed on foot/bike or by transit).

4. More compact development, land-use synergy (e.g. residents provide customers for retail which provide amenities for residents).

5. Stronger neighborhood character, sense of place.

6. Walkable, bike-able neighborhoods, increased accessibility via transit, both resulting in reduced transportation costs.

Mixed use development is often seen as too risky by many developers and lending institutions because economic success requires that the many different uses all remain in business. Most development throughout the mid to late 20th century in the United States was single-use, so many development and finance professionals see this as the safer and more acceptable means to provide construction and earn a profit. *Christopher B. Leinberger* notes that there are 19 standard real-estate product types that can obtain easy financing through real estate investment trusts. Each type is designed for low-density, single-use zoning. Another issue is that short-term discounted cash flow has become the standard way to measure the success of income-generating development, resulting in "disposable" suburban designs that make money in the short run but are not as successful in the medium to long term as walkable, mixed-use environments.

Mixed-use commercial space is often seen as being best suited for retail and small offices. This precludes its widespread adoption by large corporations and government facilities. Construction costs for mixed-use development currently exceed those for similarly sized, single-use buildings; challenges include fire separations, sound attenuation, ventilation, and egress.

Additional costs arise from meeting the design needs. In some designs, the large, high-ceilinged, columnless lower floor for commercial uses may not be entirely compatible with the smaller scale of the walled residential space above.

Single-use developments are commonplace at high, medium, and low urban density, but low-density mixed-use developments are rare. Where density is high and transport is by automobile, parking space requirements (often mandated by the same subdivision act requirements that restrict mixed-use) are likely to exceed those of low density residential development, and the large number of parking spaces may be difficult to finance. Note that this is equally true for any other higher-density development remote from public transport; however, compared to residential zones, this may be a drawback due to the required higher initial investment that only amortizes over the medium and long term. On the other hand, in denser areas, owning an automobile might be considered a luxury rather than a necessity, especially where there is good public transport. Therefore, others argue that mixed-use neighborhoods need fewer parking spaces and are more efficient.

2.5.3 Types of Contemporary Mixed-Use Zoning [7]

1. **Neighborhood commercial zoning**; convenience goods and services, such as convenience stores, permitted in otherwise strictly residential areas.
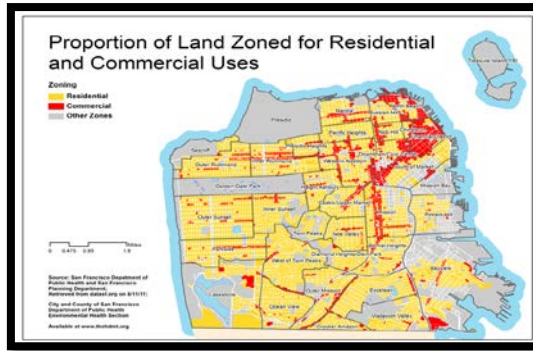
Map 5 Neighborhood residential and commercial zoning [15]

http://www.sfindicatorproject.org/indicators/view/259, 2011.

2. **Main Street residential/commercial**; two to three-story buildings with residential units above and commercial units on the ground floor facing the street.

Figure 2 Neighborhood commercial zoning [16]

3. **Urban residential/commercial**; multi-story residential buildings with commercial and civic uses on ground floor.
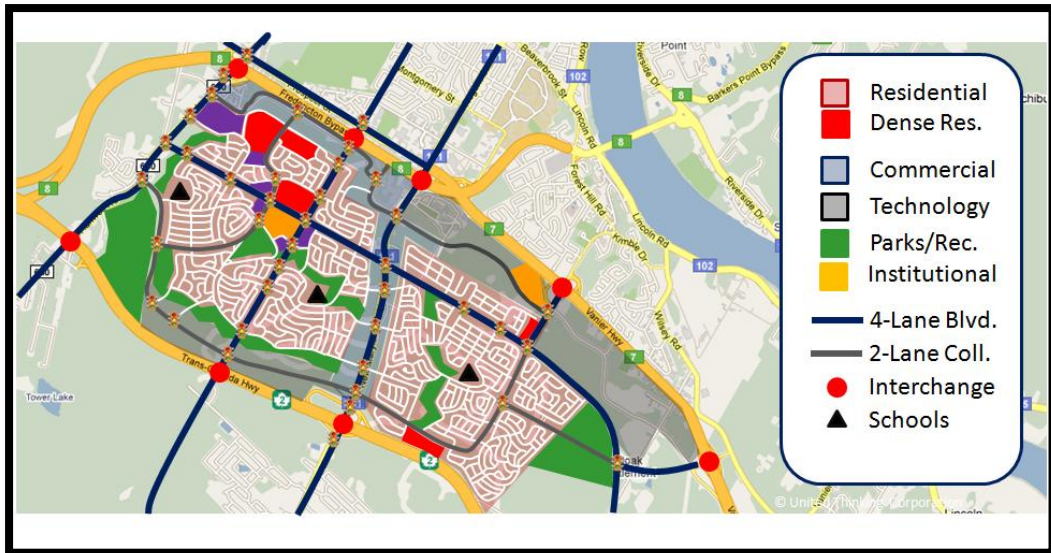
Map 6 Urban residential/commercial (17)

http://forum.skyscraperpage.com/showthread.php?p=4885441

4. **Office convenience**; office buildings with small retail and service uses oriented to the office workers.

5. **Office/residential**; multi-family residential units within office building(s).

6. **Shopping mall conversion**; residential and/or office units added (adjacent) to an existing standalone shopping mall.

7. **Retail district retrofit**; retrofitting of a suburban retail area to a more village-like appearance and mix of uses.

8. **Live/work**; residents can operate small businesses on the ground floor of the building where they live.

Figure 3 Live/work [18]

http://www.berkeleyrep.org/support/img/createinnovate-harrison1lrg.jpg, 2012.

9. **Studio/light industrial**; residents may operate studios or small workshops in the building where they live.

10. **Hotel/residence**; mix hotel space and high-end multi-family residential.

11. Parking structure with ground-floor retail.
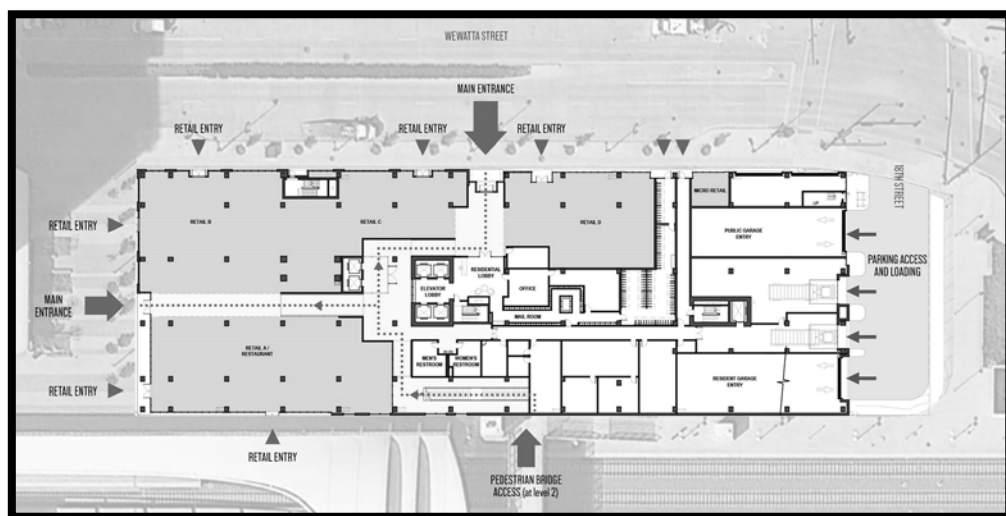
Figure 4 Parking structure with ground-floor retail [19]

12. Single-family detached home district with standalone shopping center.

2.6 Garden City Movement

The neighborhood unit has an uneasy relationship to the *Garden City Movement*; it is a method of urban planning that was initiated in 1898 by Sir Ebenezer Howard in the United Kingdom. Garden cities were intended to be planned, self-contained communities surrounded by "greenbelts", containing proportionate areas of residences, industry, and agriculture.

Inspired by the utopian novel Looking Backward and Henry George's work Progress and Poverty, Howard published his book To-morrow: a Peaceful Path to Real Reform in 1898 (which was reissued in 1902 as Garden Cities of To-morrow). His idealized garden city would house 32,000 people on a site of 2,400ha, planned on a concentric pattern with open spaces, public parks and six radial boulevards, 37m wide, extending from the centre. The garden city would be self-sufficient and when it reached full population, another garden city would be developed nearby. Howard envisaged a cluster of several garden cities as satellites of a central city of 250,000 people, linked by road and rail [8].
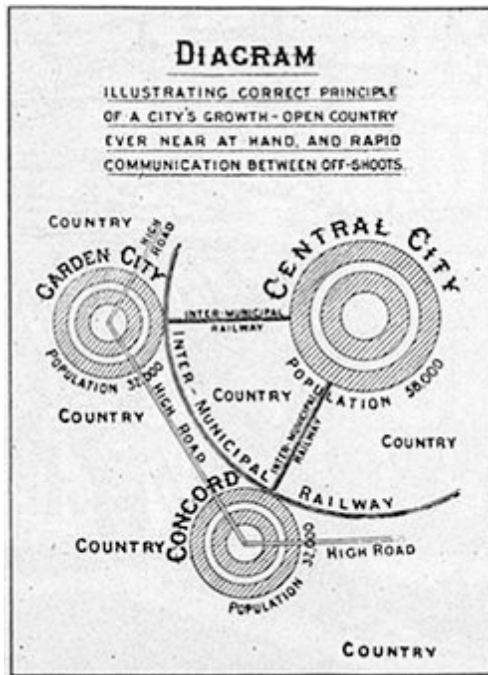
Figure 5 Garden cities

were intended to be planned, self-contained communities surrounded by "greenbelts", containing proportionate areas of residences, industry, and agriculture [20]
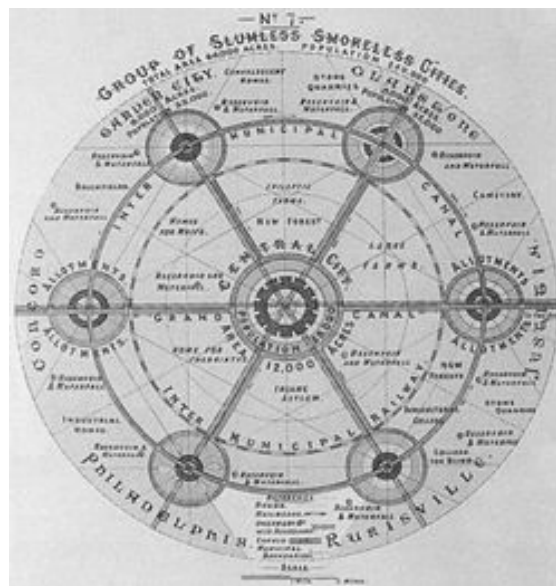
Figure 6 Early development of Garden cities [20]

2.7 Chicago school

The neighborhood unit also has a relationship with *Chicago school*; best known for the Subculture Theories of Thrasher, Frazier, and Sutherland, and for applying the principles of ecology to develop the Social Disorganization Theory which refers to consequences of the failure of:

- Social institutions or social organizations including the family, schools, church, political institutions, policing, business, etc. in identified communities and/or neighborhoods, or in society at large.
- Social relationships that traditionally encourage co-operation between people.

Thomas defined social disorganization as "the inability of a neighborhood to solve its problems together" which suggested a level of social pathology and personal disorganization, so the term, "differential social organization" was preferred by many, and may have been the source of Sutherland's (1947) Differential Association Theory. The researchers have provided a clear analysis that the city is a place where life is superficial, where people are anonymous, where relationships are transitory and friendship and family bonds are weak. They have observed the weakening of primary social relationships and relate this to a process of social disorganization (comparison with the concept of anomie and the Strain Theories is instructive).

In her book *the Death and Life of Great American Cities, Jane Jacobs* bristles at the orthodox conception of a city neighborhood as a modular, insulated grouping of roughly 7,000 residents, the estimated number of persons to populate an elementary school and support a neighborhood market and community center. *Jacobs* believes this definition provincial

and arbitrary; a feature of a great city is the mobility of residents and fluidity of use across diverse areas of varying size and character, not modular fragmentation [2].

Jacobs' alternative is to define neighborhoods at three levels of geographic and political organization:

1. City-level.
2. Street-level.
3. District-level.

The city of New York as a whole is itself a neighborhood, the parent community from which public money flows, administrative and policy decisions are made, and conflicts of general welfare are resolved on behalf of districts. Civic associations and special interest groups - from opera societies to public unions - are often formed at the city level, creating like-minded communities of interest that coordinate local activities. At the opposite end of the scale, individual streets - such as Hudson Street in Greenwich Village - can also be characterized as neighborhoods. Street-level city neighborhoods, as argued elsewhere in the book, should aspire to have a sufficient frequency of commerce, general liveliness, use and interest so as to sustain public street life. They are not discrete units of fixed length, but economic and social continuities of all proximate street-level neighborhoods.

The district of Greenwich Village is itself neighborhood, with a shared functional identity and common fabric. The primary purpose of the district neighborhood is to intermediate between the needs of the street-level neighborhoods and the resource allocation and policy decisions made at the city-level. *Jacobs* estimates the maximum effective size of a city district to be 200,000 people and 1.5 square miles, but prefers a functional definition over a spatial definition: "big enough to fight city

hall, but not so big those street neighborhoods are unable to draw district attention and to count." District boundaries are fluid and overlapping, but are sometimes defined by physical obstructions such as major roadways and landmarks.

Jacobs recommends four pillars of effective city neighborhood planning:

- To foster lively and interesting streets.
- To make the fabric of the streets as continuous a network as possible throughout a district of potential sub city size and power.
- To use parks, squares, and public buildings as part of the street fabric, intensifying the fabric's complexity and multiple uses rather than segregating different uses.
- To foster a functional identity at the district level.

Jacobs ultimately defines neighborhood quality as a function of how well it can govern and protect itself over time, employing a combination of residential cooperation, political clout, and financial vitality.

"A successful city neighborhood is a place that keeps sufficiently abreast of its problems so it is not destroyed by them. An unsuccessful neighborhood is a place that is overwhelmed by its defects and problems and is progressively more hapless before them."

2.8 Previous studies

2.8.1 "The impact of planning theories in the urban form of the Sudanese cities, greater Khartoum case study" Rashed Kamal

In his theses he compared and evaluated the merits of different planning ideas and strategies, with awareness to the reality and the role of the state in facilitating planning to achieve welfare for the Sudanese people. He discussed the urbanization and the growth in Greater Khartoum as a result of the new directions and the new reality compelled by economical impulses. After independence the preliminary experience was weak from the beginning. Factionalism and the failure of government in confronting development crises led to a popular disappointment and fluctuation. The most serious problem was the housing crises. The city was, and still suffering from a rapid growth of population as a result of immigration from the lagging regions that suffered from the civil war, marginization and disasters. Another problem faced the city is the urban poverty which causes a series of other problems like crimes, prostitution, squatter housing and homelessness. The deformation of the urban form is embodied in the single identity of the Greater Khartoum or the monoculturalism in term. The other face of the urban form deformation is in the absence of public participation. The research concluded that the general situation of Khartoum urban form is not satisfied. It is an ethical obligation for the state to reconsider the development plan and rebalance the disparities between regions. It is also important to reactivate the public participation and throw lights on the environmental issues. It is very essential to state activated strategies in housing sector and spread the peace culture [32].

2.8.2 "Socio-economic factors affecting urban land use, Application on the territory of greater Khartoum" Nidal Mohammed Bakheet Ahmed

In her paper she studies the socio-economic and political factors affecting urban land use Greater Khartoum province by tracking organization charts and maps from the chart's and which identify the various land use patterns. These factors are explained in the policy framework and the historic, political and social development of the territory since

2005 for direct influence factors of civil war, famine, drought, desertification, poor – 1956 Rural development and population growth and urbanization befell a farmsteads. The paper aimed reveal a changing a rate that occurred in different land use patterns and causes

True to the dominance of certain uses without the other, and influenced by factors such as value, quality To use, the site, the values of a community response, their needs, their desires and shape of family. And Assumed that there is a dominance of the bitterest rash pattern of residential land use, limited uses SOA, Industrial, Els a diocese. It also assumes that there are not keeping up with the policies and planning authorities to address Problems resulting from the steady increase of population of Khartoum and land uses functionality required demonstrating On urban degradation in Khartoum is synesthesia being a dominant first city in Sudan.

The conclusion of the paper is the urban land use for housing is dominant on the Other uses functional (agriculultural, industrial, recreational, service), with no compatible expansion -to cover the needs of the reidence- as it is in residential use. It concludes that the planning policies affected by the powers and the nature of the State, the prevailing regime,

trends and policies towards the land and how to invest it,and it isProtects those trends with appropriate legislation.

The paper reached to a significant result that Khartoum has no structural plannig and that planning authorities i Khartoum works without having a significant plan for land uses which it is subjected to the planning process at a time or to the planning mechanisms (engineers) and the willingness of decision makers [33].

2.8.3 City of Hercules, California, US
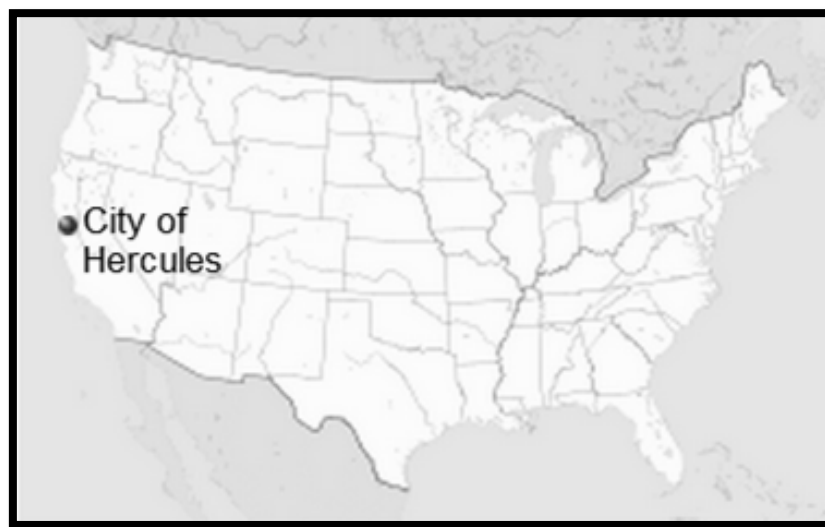
Figure 7 City of Hercules, California, US [21]

Table 1 - City of Hercules information[21]

Area	
• Total	18.179 sq mi (47.084 km2)
• Land	6.205 sq mi (16.072 km2)
• Water	11.974 sq mi (31.012 km2) 65.87%
Population (2010)	
• Total	24,060
• Density	1,300/sq mi (510/km2)

- **Background**

   Hercules is a city in western Contra Costa County, California. Situated along the coast of San Pablo Bay, it is located in the eastern region of the San Francisco Bay Area.

   Hercules contributed significantly to the production of explosives during both World Wars. By the Second World War, the plant had diversified to produce fertilizers and other chemical products. However, by this time the surrounding area was experiencing rapid growth as the commuter belt moved further outward from San Francisco.

   Study has been made of upper layer soil contamination from prior emissions of the California Powder Works operations.[10] Eventually the facility was out-competed by foreign manufacturers, and the plant was closed in 1976. By the mid-1970s Centex Homes and other developers began to build new subdivisions and changed Hercules into a residential suburb.

- **Geography**

   Hercules is located at the southeast shore of the San Pablo Bay. According to the United States Census Bureau, the city has a total area of 18.2 square miles (47 km2), of which, 6.2 square miles (16 km2) of it is land and 12.0 square miles (31 km2) of it (65.87%) is water.

- **Demography**

Table 2 - City of Hercules Demographics [21]

Census	Pop.	%±
1910	279	—
1920	373	33.7%
1930	392	5.1%
1940	343	−12.5%
1950	343	0.0%
1960	310	−9.6%
1970	252	−18.7%
1980	5,963	2,266.3%
1990	16,829	182.2%
2000	19,488	15.8%
2010	24,060	23.5%
Est. 2014	25,086	4.3%

- **Economy**

According to the City's 2009 Comprehensive Annual Financial Report, the top employers in the city are:

Table 3 - City of Hercules Economy [21]

	Employer	of Employees
1	Bio-Rad Laboratories	1,717
2	Mechanics Bank	250
3	Hercules Middle/High School	150
4	City of Hercules	135

- **Infrastructure (Transportation)**

Public transportation is available through the West Cat bus system. The operator provides local and school buses throughout Hercules and to the neighboring cities of Rodeo, Pinole, and Richmond among other areas. West Cat also offers express buses to the county seat at Martinez, the El Cerrito del Norte BART station and the San Francisco Trans bay Terminal. Its major hub is Hercules Transit Center. This had been the proposed location of a future Bay Area Rapid Transit station in BART's 20-year plan, but Hercules Mayor John Delgado and city council declined BART's request to fund a study, precluding the possibility of a BART stop.

- **New development**

In 2000, the City of Hercules chartered an urban-design-based land use planning effort. This plan attempted to balance the preservation of the city's undeveloped land against continued suburban sprawl and to redevelop the city's formerly industrial waterfront.

The resulting plan directs that Hercules be turned into a transit-oriented, pedestrian-friendly, mixed-use town.

On May 23, 2006, the Hercules city council voted unanimously to use its power of eminent domain to prevent Wal-Mart from building a store on an undeveloped 17-acre (69,000 m2) property overlooking San Pablo Bay which it deemed incompatible with the industrial waterfront redevelopment project. In 2009 the city purchased the land back from Wal-Mart.

Chapter Three, Case Study (Khartoum evolution)

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3.1 Preview

This chapter takes Khartoum neighborhoods at the present time and studies the current situation; houses distribution, services availability, and the walkability around the neighborhood. This chapter also considers the possibility of transforming those neighborhoods into mixed-use neighborhoods, and suggests an ideal neighborhood layout (houses and services) as an example to follow.

Map 7 Khartoum State [22]

3.2 Background

Khartoum is the capital and second largest city of Sudan and Khartoum state. It is located at the confluence of the White Nile, flowing north from Lake Victoria, and the Blue Nile, flowing west from Ethiopia.

Latitude: 15.5007° N, 32.5599° E

Area: 11,583 mi²

**Weather**: 84°F (29°C), Wind N at 11 mph (18 km/h), 37% Humidity

Khartoum city is located in the heart of Sudan at the confluence of the White and Blue Niles where both rivers form the River Nile [9].

Table 4 - Changes in Khartoum during time [9]

| Year	Circumstances	Consequences
1821	Founded by Muhammad Ali, the ruler of Egypt, as a military post controlling Sudan.	Origins as the capital of Turkish, settlement started to grow as a regional center of trade
1884	Khartoum comes under siege by El Mahadi,	the capital transit to Omdurman and Khartoum became ruined
1898	Sudan conquered by the British under the leadership: H. H. Kitchener.	Khartoum became the capital of Anglo-Egyptian Sudan.
1956	the independence of Sudan,	Khartoum became the capital of the independent country.
2011	Separation between northern and southern Sudan in two countries.	Khartoum became the capital of Sudan (the northern half of Sudan)

3.3 Khartoum city planning

The capital Khartoum in 1823 and started to widen where the Grand Mosque was established and been used in the construction of red brick buildings instead of green bricks and straw and succession planning and the city divided into districts (Gmadarih- neighborhood mosque District - district staff).
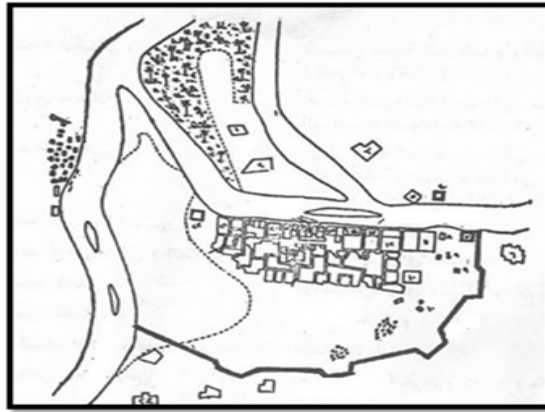
Map 8 Planning in the Turks time [9]

In 1898 the city was assigned for first time as a capital city for Sudan by Lord Kitchener the Governor General of Sudan. The city was planned to occupy **50,000** populations in the first master plan for the city. After independence; the population of Greater Khartoum reached **253,111** according to the 1955/1956 census forming the largest urban center in Sudan.
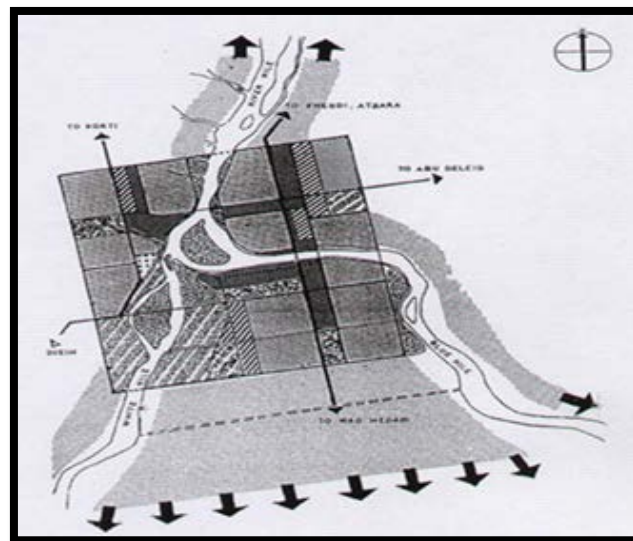

Map 9 Doxiadis plan (1958) [9]

Doxiadis plan equally included the three cities, but with some distinction in the urban functions of each. Khartoum city was primarily administrative, Khartoum north was industrial and finally Omdurman

gained a cultural function and remained as national native city. The plan took a solid geometric pattern and a gridiron shape. Surprisingly, the plan was drawn in a form of slightly rotated solid square shape fitted to cover the three towns without satisfactory consideration of the location and site limitations and without taking into account the distinctive natural setting of the region.

The housing issues were not highly emphasized in the Doxiadis plan but the main emphasis was drawn upon the city structure and its mode of expansion and the distribution of the main functions.
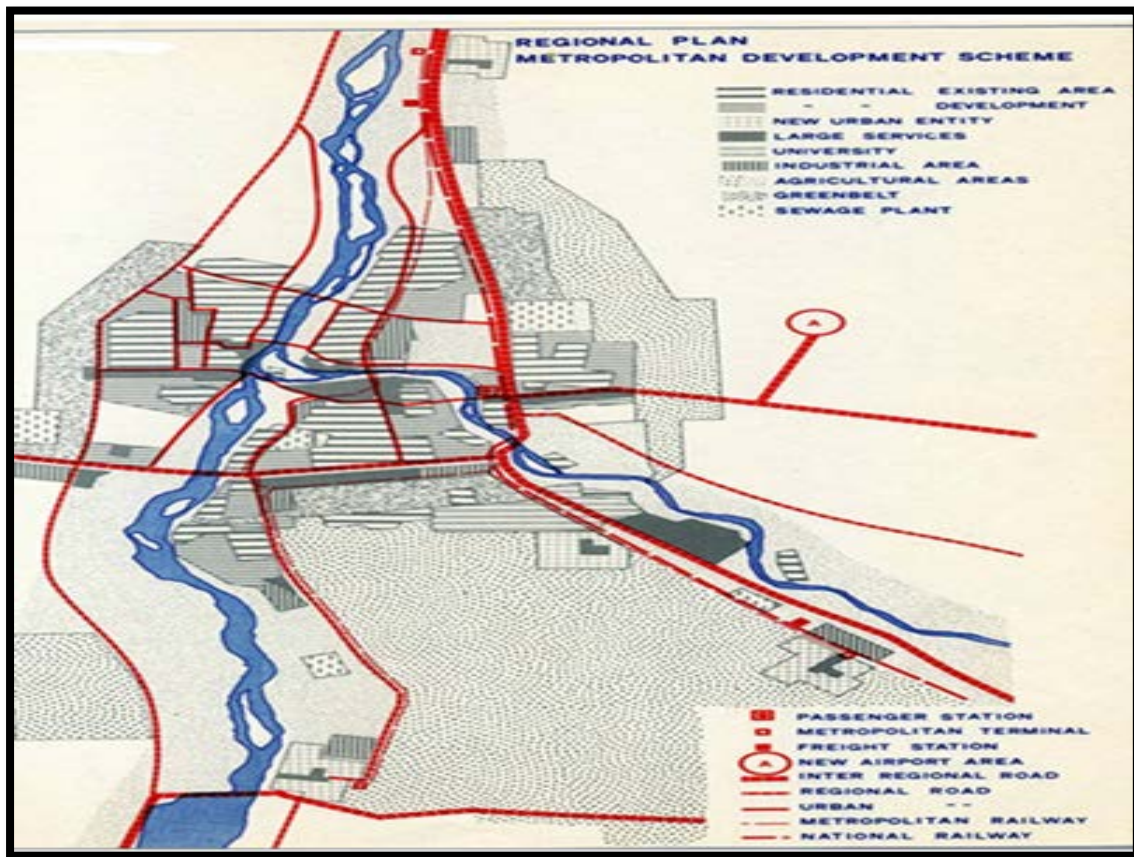
Map 10 MEFIT Plan (1974)[9]
Khartoum state master plan, 2010.

MEFIT Plan covered three levels; the regional level, the urban level and a beautification program which was primarily an urban design. The

plan included an analysis of the built form of the different housing class zones through physical, socio-cultural, and visual surveys with a special focus on beautification and urban design.
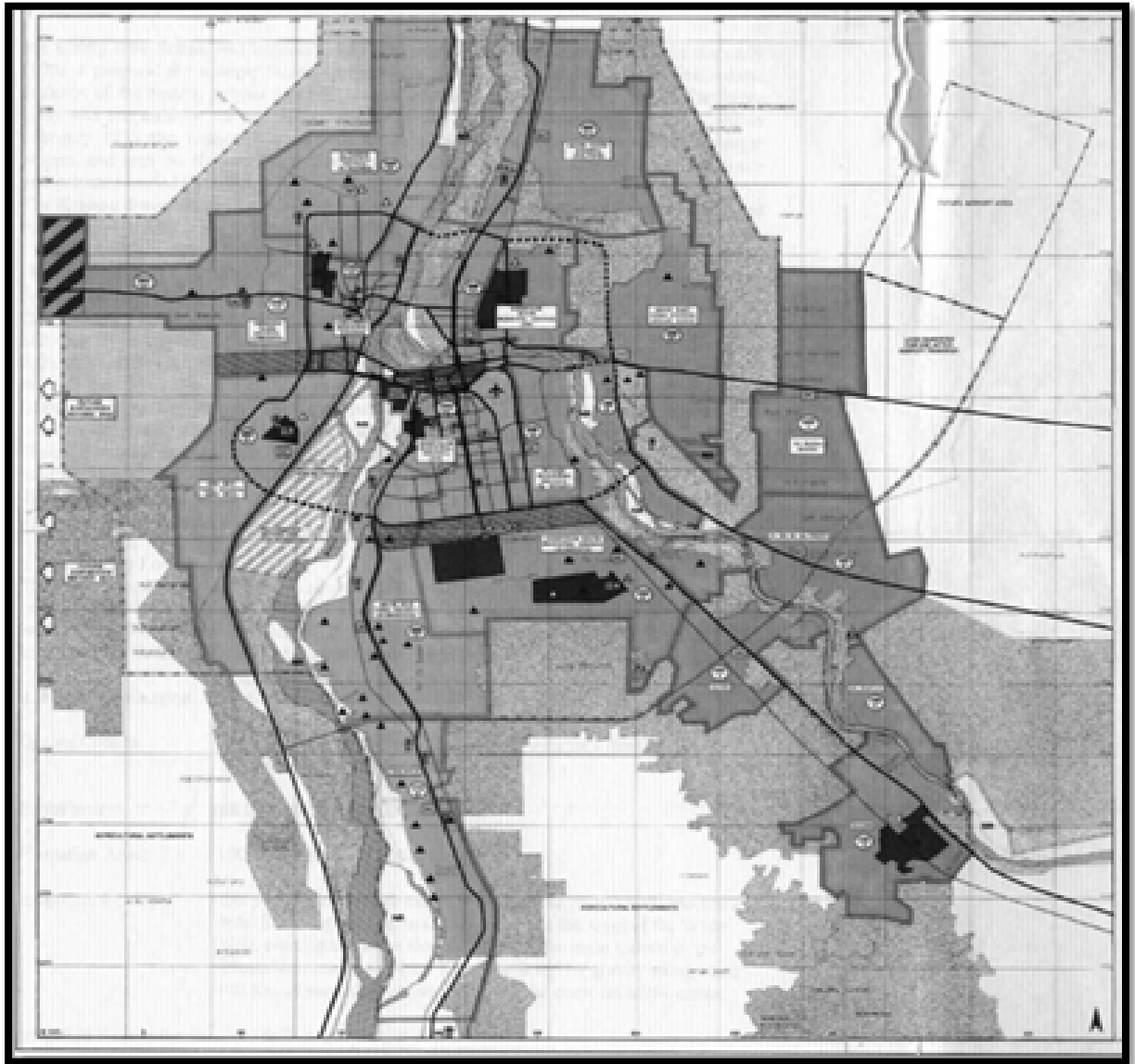
Map 11 Doxiadis and Mustafa plan (1991) [9]

The plan methodology is rather a simplified method for structure plans based upon different scenarios of population growth. It reflected the predicted expansion of greater Khartoum. The plan dependably admitted the housing classification system as a tool for the subdivision of housing land linked with the income level of the people and accordingly the

structural plan was developed depending on the resulting forecast of them.

Map 12 Khartoum structural plan 2008 [9]
Khartoum state master plan. 2010.
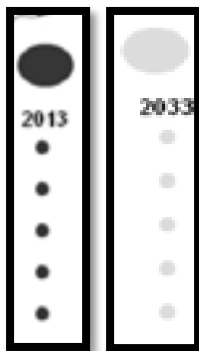
The treatment of squatter settlements by the engagement into the urban fabric, lighten overcrowding and congestion as a major goal of protecting and improving the environment. This was either removable in the case of non-alignment, planning or merger if the distortions are limit.

3.4 Demography

Figure 8 Khartoum Population over the years [9]

Figure 9 Khartoum State Population 5 Member Household 2013 [9]
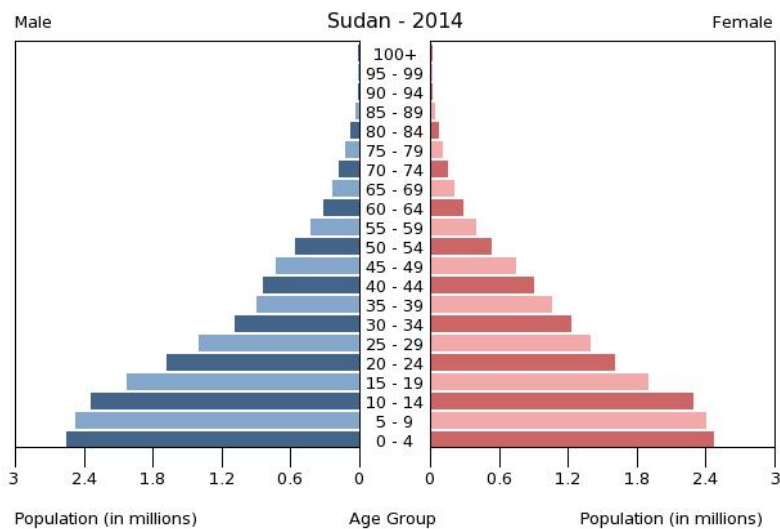
Figure 10 Khartoum age pyramid [9]

3.5 Services

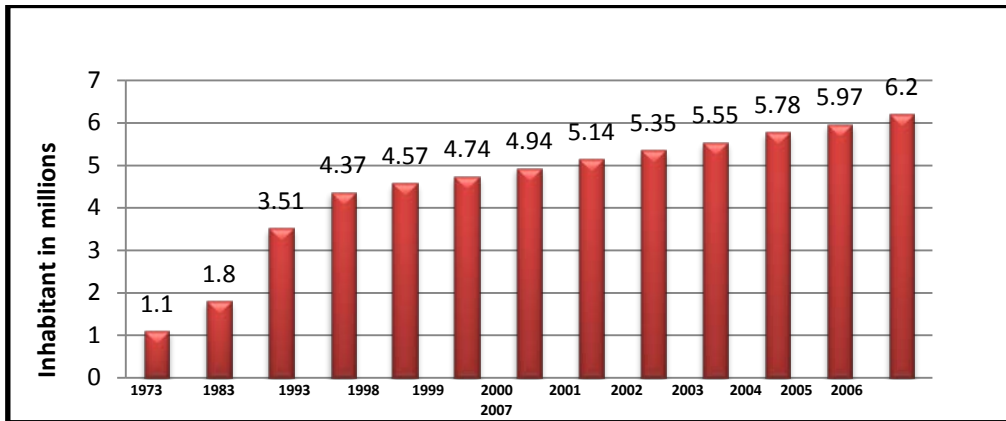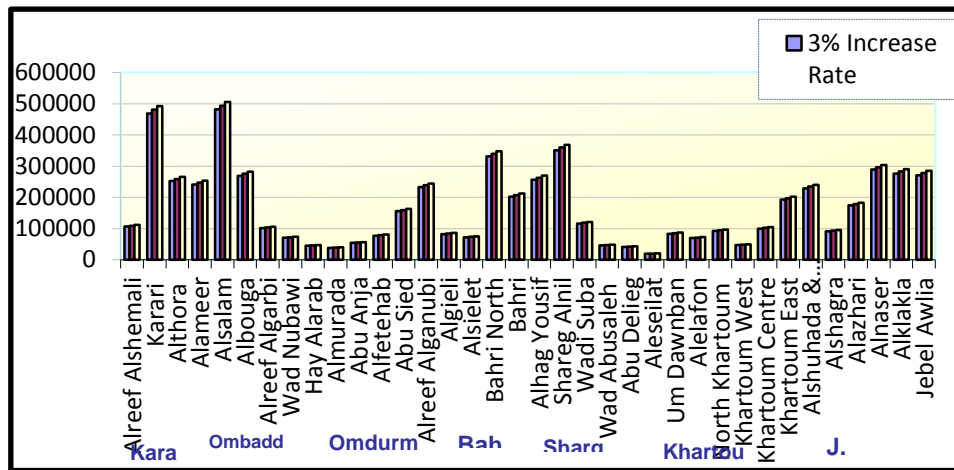### 3.5.1 Health facilities

population	kharto um	Jebel Awlia	Omdur man	Karari	Ombad da	Bahri	Shareg Alneil
Population	1027829	1382380	922555	1032453	1494707	940019	1343955
Hospitals beds	720	968	646	723	1047	658	941
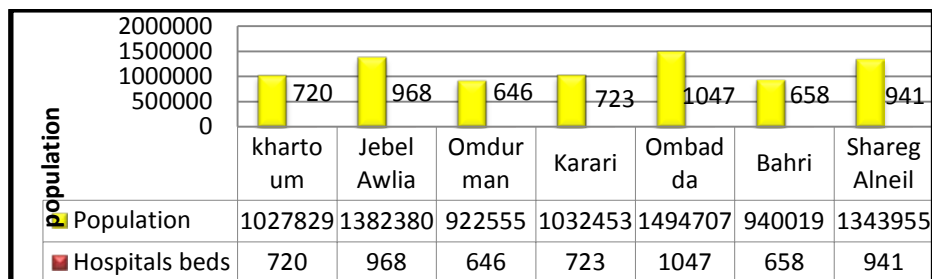
Figure 11 Health services (Hospital Beds) 2013 [9]

3.5.2 Education

population	Kharto um	Jebel Awlia	Omdur man	Karari	ombed a	Bahri	Shareg Alneil
population	1027829	1382380	922555	1032453	1494707	940019	1343955
Kindergartens	378	508	339	379	549	345	494
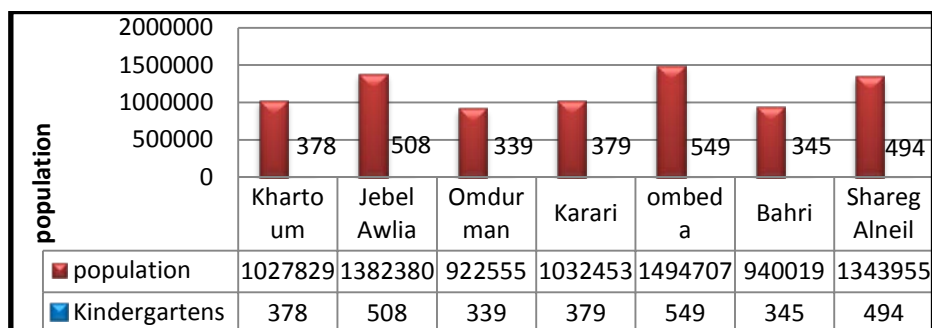
Figure 12 Education Services (Kindergartens) 2013 [9]

population	Kharto um	Jebel Awlia	Omdur man	Karari	ombed a	Bahri	Shareg Alneil
population	1027829	1382380	922555	1032453	1494707	940019	1343955
Basic	424	541	361	404	585	368	526
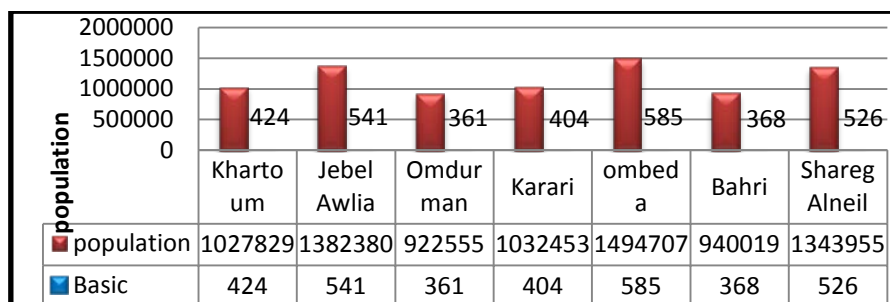
Figure 13 Education Services (Basic) 2013 [9]

population	Kharto um	Jebel Awlia	Omdur man	Karari	ombed a	Bahri	Shareg Alneil
population	1027829	1382380	922555	1032453	1494707	940019	1343955
Secondary	210	283	189	211	306	192	275
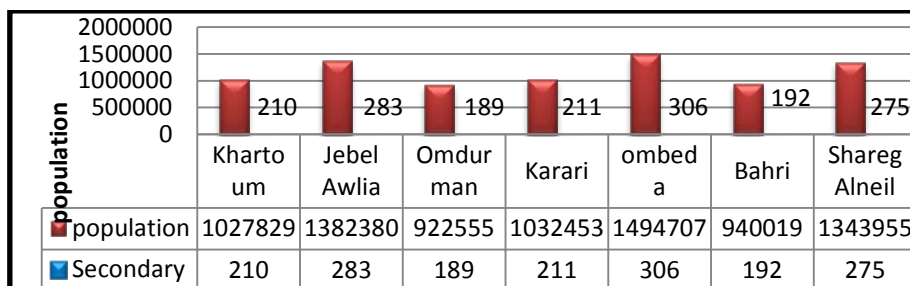
Figure 14 Education Services (Secondary) 2013 [9]

3.5.3 Total Areas of Main Urban Functions
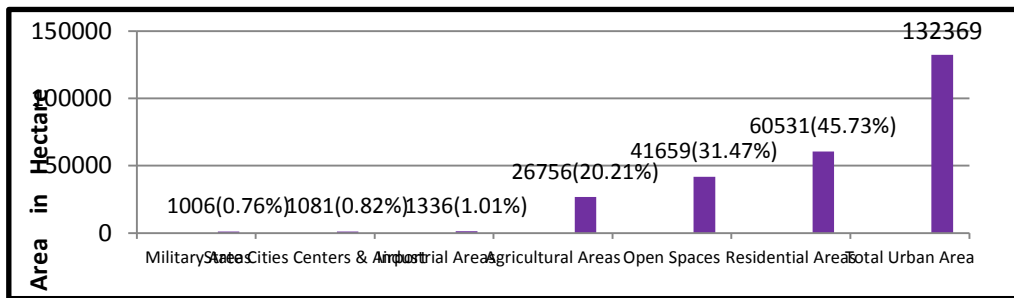
Figure 15 Total Areas of Main Urban Function [9]

3.6 Khartoum Land Use
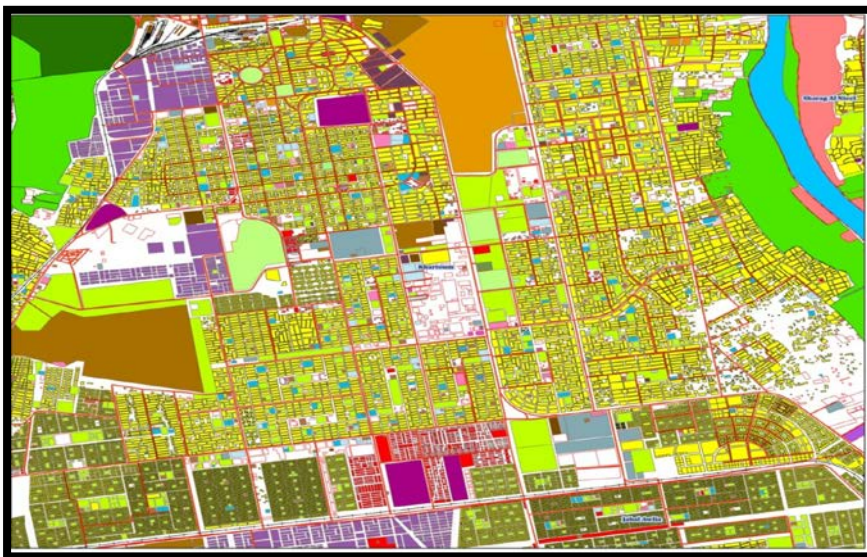
Map 13 Khartoum land use [9]

Legend

This plan shows the land use in Khartoum, most of the land used as residential area; divided into neighborhoods separated by main streets, and inside the neighborhood sub streets. The planning of the neighborhoods follow the *Neighborhood Theory* (each neighborhood has a primary school), but there is a lack of other important services such as market, club, open area, workshops, bank or ATM… etc. so the residence require a driving between home, work and recreation which is not considered as a good life style for the residence.

3.7 Case Study (Khartoum neighborhoods; Al-Taif and Al-A'marat)

The researcher selected two of Khartoum neighborhoods and studied them at the present time as a case study, analyzing the current situation and comparing it with the original plans prepared by the ministry of planning of Khartoum through three parameters; *(planning typology - spatial distribution and service availability – and radius of catchment)* - those parameters have the greatest impact on the neighborhood livability and creation of an easy lifestyle – planning typology affect the privacy, the services locations and shapes, spatial distribution and availability show the area of the services and how the life style would be in the neighborhood and if the geographical justice is achieved which create the harmonious, and finally the radius of catchment affect the neighborhood walkability and the accessibility to the services to create an easy daily life for the residence.

3.7.1 Planning typology

Typology (in urban planning and architecture) is the systematic classification (usually physical) of characteristics commonly found in buildings and urban places, according to their association with different categories, such as intensity of development (from natural or rural to highly urban), degrees of formality, school of thought, and Individual characteristics form patterns. Patterns relate elements hierarchically across physical scales.

The relationship between the physical pattern of neighborhoods and the type of life, consider a simple intersection of roads - houses have often emerged at crossroads - there is no much interest about this intersection, other than the accessibility by everyone that passes through these roads, a place of meetings and exposure which reduce the privacy. This place may

lead to a decision to locate certain economic activities, as a result of such decisions, people start to shape the built environment – they create buildings at the crossroads to house their activities, but where these activities are placed is affected by the initial geometry of roads. By placing their activities in the environment, people not only shape the houses, but also helps shape people's decisions and behavior.

Urban pattern can also influence the economies of cities through the relationship between gross domestic product (GDP) and urban pattern in the world; which increases the opportunities of the resident's economy.

- Providing market area for small business which could survive in a small neighborhood.

- A good planned pattern reduces transportation costs and increases the interaction between the residents. A concentration of people and firms within close proximity allows doing activities with less time, and helps to expand the well reach beyond the physical boundaries of neighborhood to other neighborhood, further increasing the choice of opportunities and reducing the communication costs of reaching them.

All aspects of the atmosphere must be taken into account to provide the best conditions of well-being and health for the residence of urban areas; thermal, ventilation and air quality factors are the main atmospheric components modified in a city, although other factors like noise should also be considered. In regions where floods are likely to occur, precipitation intensity must be studied in detail; however, "it is widely accepted that the question 'which urban forms make the best use of land?' cannot have an absolute answer. There are too many parameters to consider, each of which will have an effect. Moreover, when a large number of environmental variables are taken into account, conflicts

among them are likely to emerge and so terms such as 'best' and 'optimum' best describe decisions ultimately made.
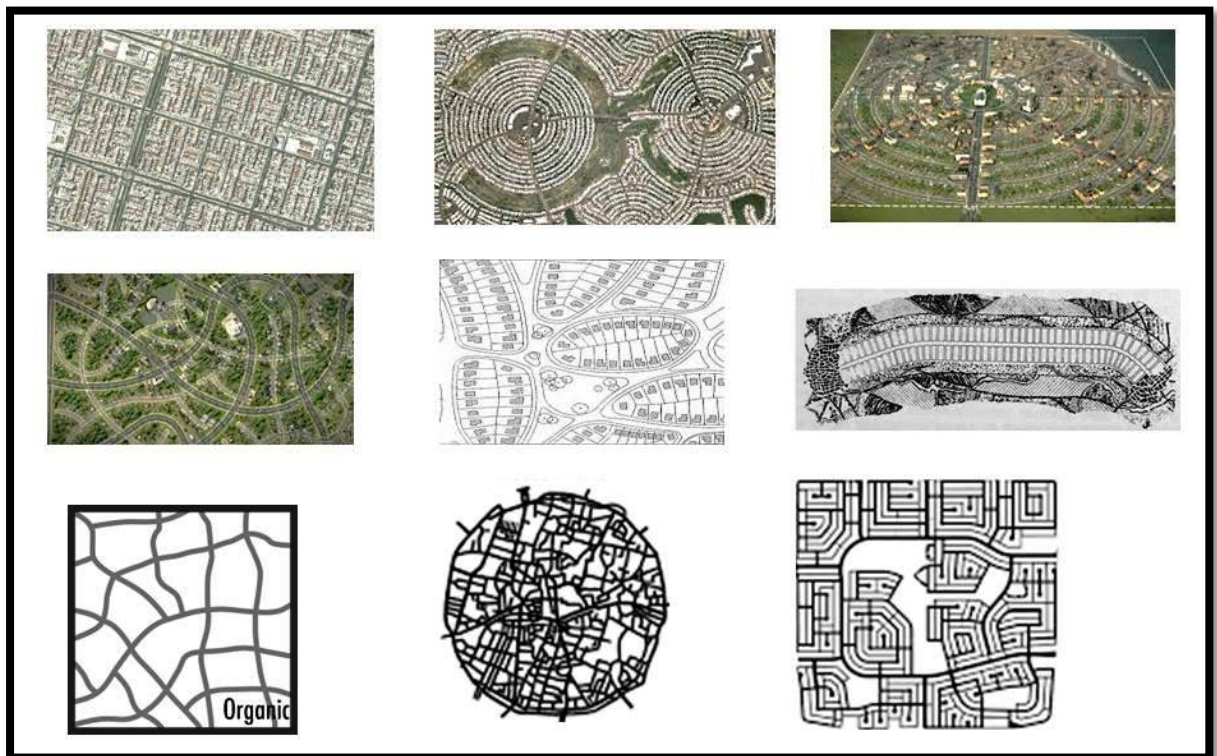
Map 14 different types of planning [31]

https://www.google.com/different cities planning shapes, cities planning types, 2010.

The urban climates should be considered in land use planning processes. The city's macroclimate highlight which aspects of urban climate should be mitigated through town planning, climates will be classified very simply as "Hot climates" (subdivided into "Hot humid climates" and "Hot arid climates"), "Cold climates" and "Others". Examples of "other" climates are regions with more than one type of stressful season.
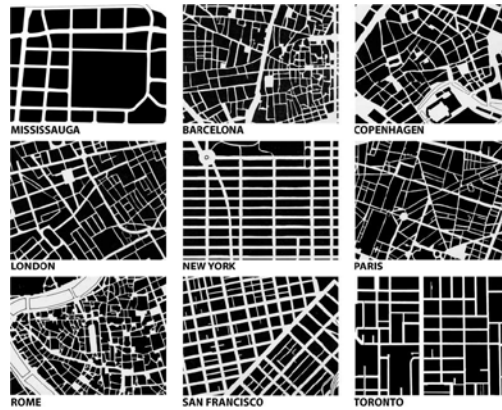
Cold climates

This characterized by low temperatures all year, including a cool summer and strong winds, are considered. A weak heat island occurs all day in winter, a consequence of extra energy from geothermic pavement heating

and above ground hot water tanks and pipelines. In summer, however, the urban area is cooler (a cool island) during daytime due to shadowing of the urban sites because of low solar altitude. Valley bottom locations are typically unsuitable for developing new neighborhoods because of cold air drainage and accumulation. Although wind speed is drastically reduced within the densely built-up area, certain buildings cause "erratic gusts" in the city center, creating very unpleasant microclimates especially when wind chill factors are concerned. In terms of modern buildings, the main measures to minimize climate in cold areas stress are the following:

- A dense urban fabric will contribute to minimize short-wave radiation reflection and minimize heat loss.

- To favor of the UHI (Urban Heat Island), as its effect is positive. This can be achieved by minimizing heat loss.

- Minimize wind exposure all the year round, except in neighborhoods where windy conditions are necessary to improve air quality. The need for more appropriate design in coastal areas, which are characterized by windy conditions and plentiful of rain.

Zrudlo (1988) presents a methodology for town planning in the Cold areas each specialist would be assigned the task of producing a plan for each climatic factor to be controlled within cold climates: sun, wind and snow. Solar factors, wind-protection requirements and snow accumulation control would be mapped separately. The next step involves the identification of conflicting requirements between plans. Consultation and negotiation are then necessary to produce a compromise. The final result is produce a plan offering maximum solar advantage and wind protection and minimum snow-drifting, thus contributing to the general well-being, both physically and psychologically, of the inhabitants.

The same methodology can also be applied elsewhere, provided that the climatic factors to be controlled are chosen according to site macroclimates.

Map 15 cold climate cities planning [28]

Climates with contrasting seasons

"Regions with more than one stressful season present a special challenge to climatologists, planners and architects because one season can often require conflicting design solutions to the other seasons", Included in this category are different types of climates, such as temperate climates with contrasting thermal and rainfall seasons (both western and eastern parts of the continents), and dry climates with alternating extreme temperatures. A compromise between different the design solutions discussed is often required. If the common favorable winds (for example, fresh/cool summer wind) blow from a different direction than those with negative consequences (for example, cold winter winds), then planners or architects can easily "accomplish a successful design that encompasses both seasonal strategies". Problems arise if favorable and negative winds blow from the same direction.

With "temperate" climates, which have contrasting seasonal climates, the UHI (Urban Heat Island) is favorable in winter but threatens human comfort and health in the summer. In urban areas in eastern continental parts of extra tropical regions, wind chills and heavy storm events

combined with freezing rain during winter can be quite miserable for inhabitants. As one reaction to these weather events, however, very few urban communities can afford solutions like this one. In the summer, residence of these same areas often have to fight against very hot and moist weather and frequent heat waves, too, besides the economic consequences. Situations under global warming regimes are projected to be even worse in cities with increasing UHI; difficult decision will have to be made whether or not to mitigate urban heat islands.

Map 16 Montreal city streets planning [29]

Legend

Route Locale
Local Road

Route Collectrice Mineure
Minor Collector Road

Route Collectrice Majeure
Major Collector Road

Route Artérielle
Arterial Road

Hot climates

In cities with hot climates, the UHI (Urban Heat Island) is one of the most negative factors, not only with respect to human comfort and heat stress but also to human health. Moreover, they have negative effects on energy use (more demand for air-conditioning), water use, air pollution

meteorology (increased recirculation/ smoke effects), air pollution chemistry (secondary transformation), and possibly on rainfall. Therefore, reduction of the effects of UHI (Urban Heat Island) is profitable for human health and economy.
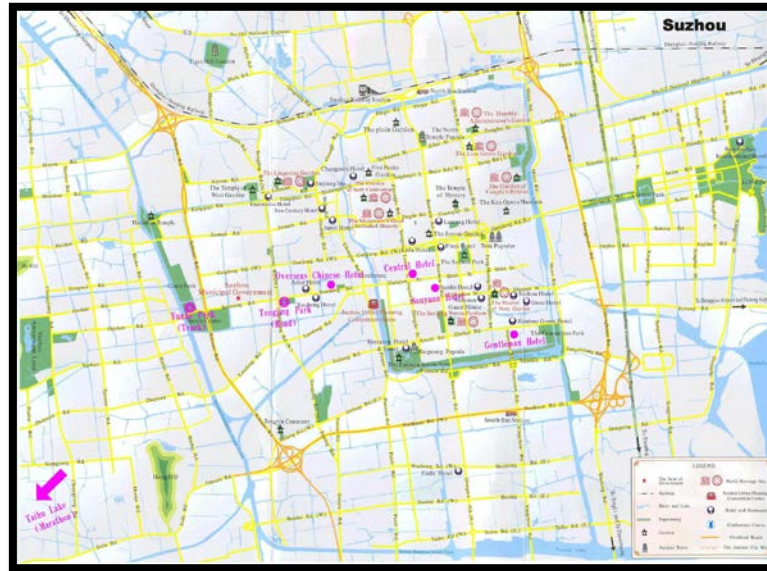

Figure 16 Suzhou city (Eastern China) streets planning [30]

Hot humid climates

Areas up to latitudes 10-15° north and south of the equator where high temperatures persist all the year round (27°C on average) and with a small daily temperature range and maximum temperatures higher than 30°C and minimums between 20 - 24 °C are included in this climate. High humidity values and low wind speeds. Rainfall varies considerably from place to place, but no dry season exists. In some areas at latitudes higher than 15° in the eastern parts of the continents (SE United States, SE China and south Japan, E Australia, etc.), very hot and humid summers cause strong heat stress on human beings, mostly during the night. In these areas the main strategies to minimize heat stress are:

- To provide or maximize ventilation in and around buildings, urban canyons should be aligned with the dominant sea breeze direction.

- To reduce solar radiation, shading of urban spaces is indispensable, either by purpose-built shade structures, appropriate combinations of height and building orientation, or strategically positioned and selected vegetation. "To promote maximum protection during the most oppressive months when the sun is high in the sky, sun shading is more easily achieved when the longest dimension of the buildings runs E-W.

- Promote evaporative cooling that may improve physiologic comfort, but only in spaces that are reliably well ventilated during the critical late morning and afternoon hours.

Figure 17 Khartoum city streets planning [9]
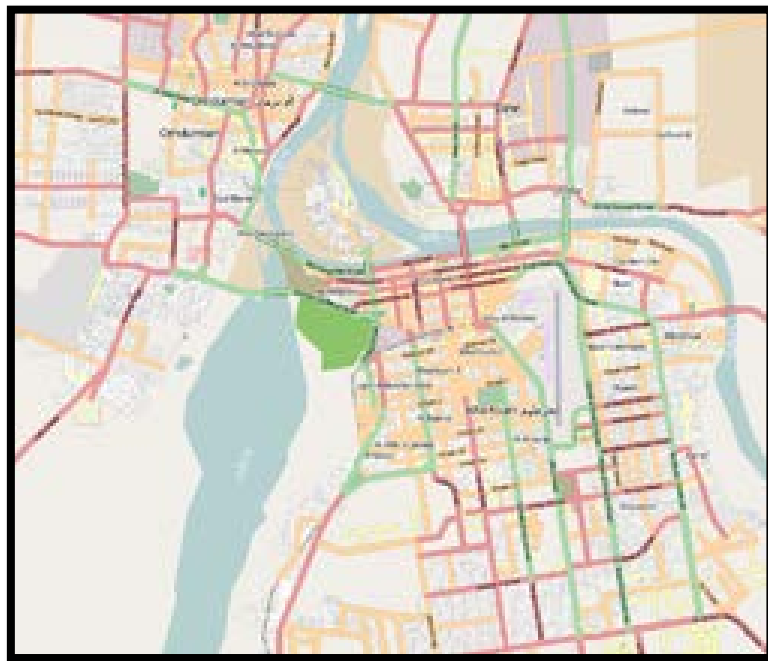
Hot arid climates

Hot and dry regions are located not only in subtropical latitudes but also in continental locations at higher latitudes. Very high daily air temperature ranges are one of their main climatic features, as are very low air humidity values. Air temperature can swing from 50ºC during the day to 15ºC or lower overnight. At higher latitudes, stronger seasonal

temperature variations occur, and in winter temperature goes down to negative values. The main measures to minimize climatic stress are the following:

- Reduce solar gain. In order to avoid air conditioning, strategies to minimize heat stress must be pursued. For example, trees, arcades and narrow streets, can be used to reduce radiation and thus reduce heat loads.

- Maximize solar gain in winter (and during cool nights). Heading for creating more pleasant thermal conditions in continuously hot climates, but they are not directed towards winter low temperatures in high latitude deserts.

- Increase the extent of evaporation. In order to balance net radiation at the ground surface by latent heat loss, the extent of evaporation must be increased. This can be achieved by reducing non-permeable surfaces and designing irrigated greenbelts within the communities. In different neighborhoods of hot/dry County, the importance of irrigation was well established when comparing surface temperature of native grass with heavily watered residential or park lawns.

- Minimize wind exposure by building within the smallest possible building envelope. The importance of compact geometry and short walking distances to avoid extreme conditions.

Figure 18 Buenos Aires city streets planning [(23)]

Planning strategies for a better 'Climate Quality' in cities

Cities give rise to UHI (Urban Heat Island), which, according to regional climate, may be highly negative. Urban areas increase surface roughness, decrease wind speeds (which also enhances UHI and decreases air quality) and emit different sorts of pollutants. Some of these consequences may be mitigated by natural means, examples of which in reference to thermal, ventilation and air quality aspects have been considered the most important for planning purposes and are presented in this section.

Mitigating UHI (Urban Heat Island)

   a) Building density

Reducing building density and focusing on the climatic effects of different elements of city design such as the layout and width of streets, their orientation in relation to the prevailing winds, and patterns of subdivision lots and building heights, shapes and relative locations.

   b) Green areas

Solid evidence indicates that planting trees and increasing green areas will contribute to decreases in the near surface air temperature present mixture of the effects of green areas:

- Vegetation has a lower heat capacity and thermal conductivity as well as higher evapotranspiration than building materials;

- Plants can also filter dust out of the air and reduce wind speed near the ground, which is positive in hot dry climate but negative in hot humid climates).

As a consequence, microclimates of nearby areas are (positively) modified. To improve human comfort, shading along streets and parking lots is advised, as is the assurance of short distances for walking. Disadvantageous bioclimatic conditions can be improved, even in case of old 'inherited city structures', by planting trees. Furthermore, urban growth has proceeded at a higher speed than greening.

c) Water areas

Integrating artificial water bodies in arid areas, as studies indicate that even small water bodies lower the heat stress index.

3.7.2 Spatial distribution of facilities (services) and availability

Spatial justice and geographical justice as fair distribution of services and amenities in order to achieve a harmonious, so city is one of the social justices approach. The improper distribution of services, leads to elimination of the justice and will increase dissatisfaction of citizens from their location. Considering the structure of coherent and systematic of city, attention to the spatial justice of distribution service in neighborhoods and distribution of these services according to the population, has made it necessary. There are three kinds of spatial distribution for services; uniform (even), random and clustered; this depends on the type of pattern also. Services have a values and it can be evaluated in three types: existing values, accessible values, and perceived values, in which existing values are examined by the scale of service

facilities; accessible values are affected by travel costs, and perceived values are affected by people's preferences to each service.

All neighborhoods are not designed equally and there's no such thing as the perfect neighborhood; people has different needs and desires. However, there are common components to all good designed neighborhoods. As you evaluate the best aspects of a prospective neighborhood, people will want to match them to their daily needs:

1. Lifestyle match, renters and homebuyers tend to settle at areas with similar demographics. Just as a fantastic suburban neighborhood in a gated community may not be right for a young single professional, a small family might not find a small house in downtown neighborhood to be the best fit for their lifestyle.

2. Low crime rate, Low crime rates give a neighborhood a sense of ease and calm. Crime rates are a quick way to tell if a neighborhood is improving or not, since everyone is concerned with safety and security, and spotting a transitional and improving neighborhood by the improvement in its crime rates.

3. Great schools, for residence with children, great schools top the list of what makes a great neighborhood. Not only are great schools important for families with children, but they also make the surrounding neighborhoods more valuable and more required after, keeping property values strong.

4. Outdoor activities, being close to the outdoor adventures you love can improve the demand of the neighborhood. Being closes (or within a reasonable drive) to places to jog, sail, or pedal can make the neighborhood perfect.

5. Historical value, There's something about an area with history that makes it very desirable, these neighborhoods are usually very stable,

with longtime residents and community support, which also helps encourage safety and low crime rates.

6. Access to medical care, being close enough to get to a hospital or doctor's office quickly is a key for many people, especially for seniors, retirees, and families with young children.

7. Family-friendly, neighborhoods where plenty of families live are attraction for buyers with children. There are more opportunities for children to play, socialize, and make lifelong friends. Carpooling groups and other children's programs are much more accessible when the neighborhood is overflowing with kids.

8. Close to public transportation, Easy access to public transportation is a fantastic plus for a neighborhood and an amenity for almost any lifestyle. Retiree who wishes to keep the car at home, public transit is a solid upgrade to any neighborhood.

9. Nearby shopping and restaurants, having great restaurants, shopping, and markets close is a must!

10. Nightlife and entertainment, a nearby town center or downtown with movies, theaters, could be the one thing that makes the neighborhood come alive. This is a priority for anyone who is young and single, but everyone appreciates a neighborhood where the hot spots are within walking distance or a short cab ride away.

11. Walkability, Being able to leave the car at home and use the pavement to walk to markets, shopping, restaurants, parks, and all the other amenities the neighborhood has to offer can ease the road rage, and make you fall even more deeply in love with your neighborhood.

3.7.3 Radius of catchment

Connectivity (or permeability) refers to the directness of links and the density of connections in a transport network. A highly permeable

network has many short links, numerous intersections, and minimal dead ends. As connectivity increases, travel distances decrease and route options increase, allowing more direct travel between destinations, creating a more accessible and resilient transportation system. Connectivity affects the degree to which transportation networks such as streets, walking and cycling paths, connect people to their destinations (including intermediate destinations such as public transport services). Good connectivity provides easy access to key destinations for pedestrians. Excellent connectivity actively seeks to discourage car use by making local trips easier and more pleasant by foot than by car.

Transportation activity (walking or cycling) is positively associated with number of destinations and public transport and perceived access to bike lanes near home. In addition, the presence of well-maintained footpaths is associated with walking for recreation and for transport. The type and density of intersections in the network (not just those for cars) has a significant impact on how people move around, whether by foot, bike, public transport or car. A less permeable network has few intersections making it difficult to reach a destination in a reasonably direct route, and using a number of different routes from point A to point B. Destinations in areas with a well-connected path network are easier to reach, than those in areas with a less connected path network. The diagram below shows a ten minute (800 meter) pedestrian catchment in an area with a connected street network (left), compared with an area with a less connected street network (right). The diagram indicates the dramatic difference in catchment area between the two neighborhood types.

800m radius walks in a compact Neighborhood

800m radius walk in a sprawling suburb

Figure 19 ten minute (800 meter) pedestrian catchment [27]

When combined with mixed use planning a permeable path network significantly increases the opportunities for residents to walk to undertake daily tasks, rather than drive. Studies have proven a link between network connectivity and use of active transport or car dependence.

(Increased connectivity (combined with increased density, mixed use planning and good urban design) = increased walkability = better health) According to neighborhood unit theory by Clarence Perry, the radius of catchment is only one-quarter of a mile and no more than one-half mile without a crossing a major arterial street. Defines reasonable walking distance by general understanding of willingness to walk 5-15 minutes to get to or from a transit stop, corresponding to ¼ to ½ mile, but varies based on topography, sense of safety and security, presence of interesting activity.

Most people are willing to walk 500m to shopping or transit, and suggest that short walkable blocks increase the attractiveness of pedestrian transit. Recommended spacing for bus stops is calculated based on a catchment area of 500m from each side of the road traveled, defined as from which most residents can easily walk to access transit service. Residents within

this distance are considered to be "adequately served", closer spacing is recommended for higher density areas. People can be expected to walk no more than 350m to a bus stop or a park and open space.

Many people refer to 400 meters being a "reasonable" distance for people to walk. This stems from United States research in the 1960s. The purpose was to consider walking distances to public transport facilities. A "reasonable" walking distance is likely to be affected by location, topography, weather, pedestrian facilities, trip purpose and cultural factors. While a five minute walk (the time taken for the average person to walk 400 meters) may seem like a reasonable benchmark, it will not provide for a person's daily exercise needs alone. More recent studies have shown that people are willing to walk much greater distances if the walking environment is favorable (an average of 1.2 kilometers in good conditions).

Figure 20 Street networks can make pedestrian movement easier than car movement [27]

A number of reviews have examined the relationship between neighborhood walkability (including urban sprawl) and various measures of weight status (such as the Body Mass Index,).

To achieve good connectivity the following points will help:-

- Provide a grid path network - Spacing of pathways should optimize pedestrian movement and discourage car movement such as the use of cul-de-sac roads with pathways to enable pedestrian only access to the next street.

- Plan new subdivisions based on pedestrian and cyclist movement in the first instance before then "fitting" the road network into the plan.

- Modify existing subdivisions by closing road space (particularly one leg of cross intersections) while retaining cyclist/pedestrian paths (this makes pedestrian movement safer and more attractive while also improving vehicle safety at these intersections).

- Provide footpaths on both sides of all streets except where the road surface is so narrow that cars are expected to share the space with pedestrians.

- Provide local employment, recreation and retail facilities, to decrease the work journey.

- Ensure pathway networks connect with arterial networks to travel longer distances (particularly relevant for cycle use).

On average people are willing to walk one kilometer to reach a functional destination. This is dependent on many factors including topography, weather and the walking environment including directness of the route. By providing path connections around every 100 meters a suburb will be highly permeable and more likely to encourage pedestrian trips. Where major barriers (such as creeks and railway lines) make connections

expensive to provide, the network should confluence around fewer crossing points spaced around 500 meters apart.

The neighborhood planning should encourage:-

- Highly interconnected path network providing choice of walking and cycling routes that lead to local and regional destinations
- Limited road space to encourage slower traffic speeds and higher pedestrian amenity;
- Limited road connectivity to encourage cars to use arterial roads rather than local streets and promote walking as the local trip mode;
- Closure of existing roads while maintaining pedestrian access to increase pedestrian and vehicular safety by removing unsafe intersections;
- Parking on street (rather than indented bays) to slow vehicle speeds;
- Improved pedestrian and cyclist safety through the provision of safe street crossings (See Safety and Surveillance and Active Transport Design Principles for further information).
- Require raised pavement crossings on all side streets in retail environments and any other location where pedestrian safety is an issue (such as left turn slip lanes);
- Install way-finding signage that utilizes heads-up displays;
- Narrow road widths to increase pedestrian crossing opportunities and reduce vehicle speeds; and
- Construction of complete arterial and collector road networks early in the subdivision process to enable bus routes to commence in their optimal (long term) form.

The neighborhood planning should avoid:-

- "Gated" communities as they restrict walking and cycling access and reduce the connectivity and connectivity within and outside the local street network
- Land uses, subdivision and design features that act as physical barriers and impede access to key destinations
- Cul-de-sacs except where pedestrian access is provided to link with other streets
- Delaying construction of walking and cycling paths in new subdivisions, as transport habits are difficult to change once established.
- Use of roundabouts (prohibit them in retail and high pedestrian volume environments).

3.8 Al-Taif neighborhood (block 24)

Taking Al-Taif (block 24) as one of the Khartoum neighborhoods to study the services in this area and compare it with Khartoum State original plans.

Map 17 Al-Taif neighborhood (block 24) [23]
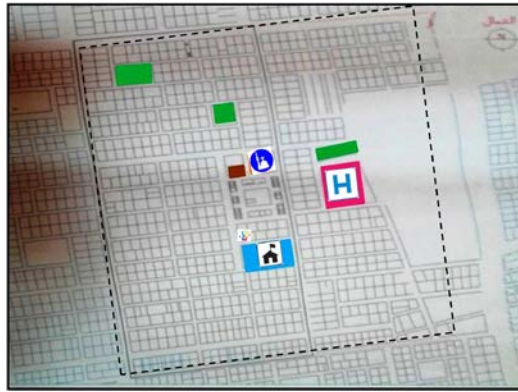
Figure 21 Al-Taif neighborhood (block 24) (original plan) [24]

Legend

 Kindergarten

 municipality

 Primary school

 open spaces

 Hospital

 Masjid

Map 18 Al-Taif neighborhood (block 24) (existing situation) [23]

Legend

	Kindergarten		commercial area & workshops
	Primary school	⬛	municipality
	Hospital	⬛	electric supply office
	Masjid	🟩	open spaces

- **Planning typology:** Al-Taif neighborhood plan pattern typology is a grid pattern - as most of Khartoum neighborhoods – with an arterial street along the neighborhood which divided the neighborhood into two (but accentually it's one neighborhood) that causes a through-traffic; and the design of the internal streets there is no hierarchy to distinguish local streets from Arterial streets, and the streets are straight instead of the curvilinear for both safety and aesthetic purposes. Streets, by design, would discourage unwanted through traffic and enhance the safety of pedestrians specially the children and the elderly.

- **Spatial distribution of facilities (services) and availability:** Services must be available according to the number of residents in the neighborhood (density); the residence in Al-Taif is about 5000 person (5 persons per family), so there must be 4 kindergartens for about 200 child from 1-5 years (4% of the residents – the age pyramid), 2 primary schools one for boys and one for girls for about 500 child both boys and girls from 6-16 years (10% of the residents – the age pyramid), 1 health center, 1 masjid, and 1 super market. But the existing situation is not following this standard, the kindergarten is one in the neighborhood and the school is one also. A comparison between the original planning and the existing situation in the scope of the spatial distribution has been made; they are similar with an addition of some services in the existing situation (electric supply office, commercial shops & workshops). All the services are pretty much at the center of the neighborhood (no proper distribution of services) that lead to spatial and geographic injustice, and decrease the satisfaction of the residence from their location.

The areas of the services are not up to Khartoum state standards (Khartoum state follows the British standards), some are bigger than

the standard (Primary school) and other are smaller (Open space and parking. The shopping area are far from the neighborhood entrance that is not helping in the excluding the nonlocal traffic destined for these commercial uses, that might intrude on the neighborhood.

The kindergarten is located near the arterial street which is dangerous for the children to cross or to be near to it, same as the primary school. Although there are three open spaces in this neighborhood yet it's not covering the entire neighborhood, because of the injustice of the distribution, all the open spaces are in the north of the neighborhood.

Next table shows the comparison of the services availability and services areas, between the Standard areas according to Khartoum state Standards (Khartoum state follows the British standards), and the existing areas in Al-Taif neighborhood.

Table 5 - Al-Taif services availability and areas [10] [11]

Services	Standard Area m^2 (according to Khartoum state)	Availability and Area m^2 (Al-Taif)
Kindergarten	600	300
Primary school	5000	6667
Health center	2000	1188
Club	600	Not Available
Open space	6000	3960
Masjid	1000-600-500	3300
Super market	4500	700
Craftsmen	25-50	50

- **Radius of catchment**: Radius of catchment is also not up to Khartoum state standers (Khartoum state follows the British

standards), because all the services are pretty much at the center of the neighborhood which make the walking distance the school in the neighborhood is more than 500m, and the child's walk to school should only about one-quarter of a mile and no more than one half mile and could be achieved without crossing a major arterial street. The following figures show the radius of catchment for all services and the area that the services cover and the area out of coverage.

Figure 22 Radius of catchment (Kindergarten) [23]

The Kindergarten radius of catchment is 200m, it serves almost (12%) of the neighborhood; the hatched area is out of the kindergarten coverage radius (88%) of the neighborhood, so the residence might use car to get their children to the kindergarten because the children cannot walk more than 200m.
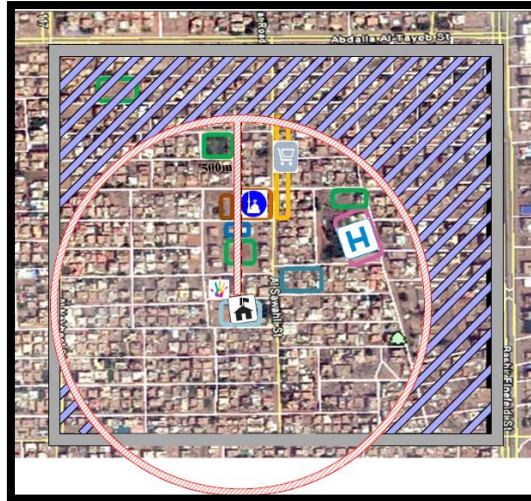
Figure 23 Radius of catchment (Primary school) [23]

The Primary school radius of catchment is 500m, it serves almost (70%) of the neighborhood; the area is out of the Primary school coverage radius (30%) of the neighborhood, some of residence might use car to get their children to the Primary school because the children cannot walk more than 500m.
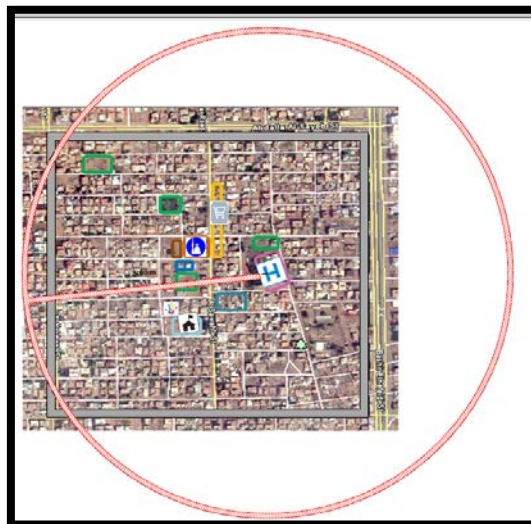
Figure 24 Radius of catchment (Health center) [23]

The Health center Radius of catchment is 800m, it serves (100%) of the neighborhood - and serves part of other neighborhood- all the residence can reach it.
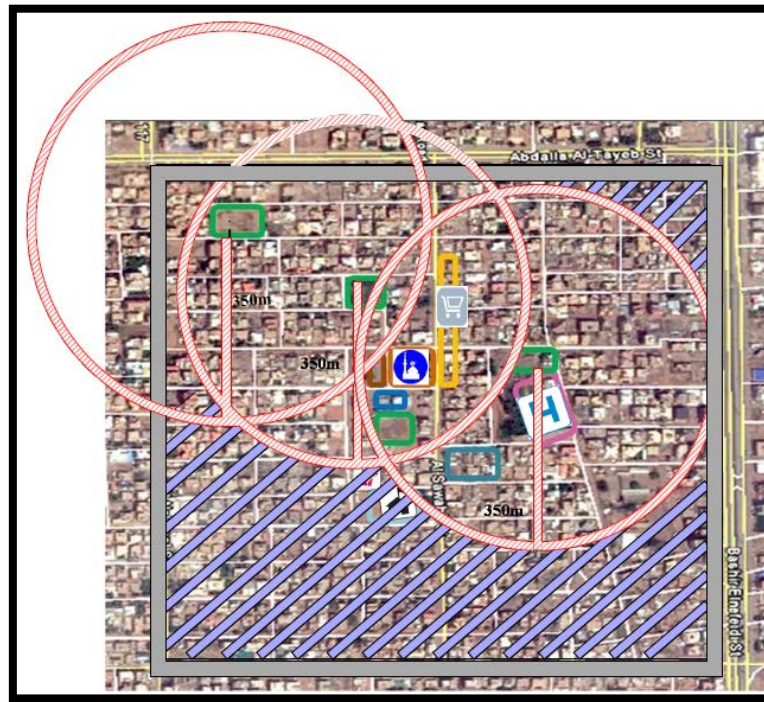
Figure 25 Radius of catchment (Open space) [23]

The open space Radius of catchment is 350m, all the three open spaces serves almost (60%) of the neighborhood; the hatched area is out of the open spaces coverage radius (40%) of the neighborhood, Although there are three open spaces in this neighborhood yet it's not covering the entire neighborhood due to the injustice of the distributing.

Figure 26 Radius of catchment (Masjid) [23]

The Masjid Radius of catchment is 500m, it serves almost (85%) of the neighborhood; the hatched area is out of the Masjid coverage radius (15%) of the neighborhood, pretty much accessible to most residence of the neighborhood.
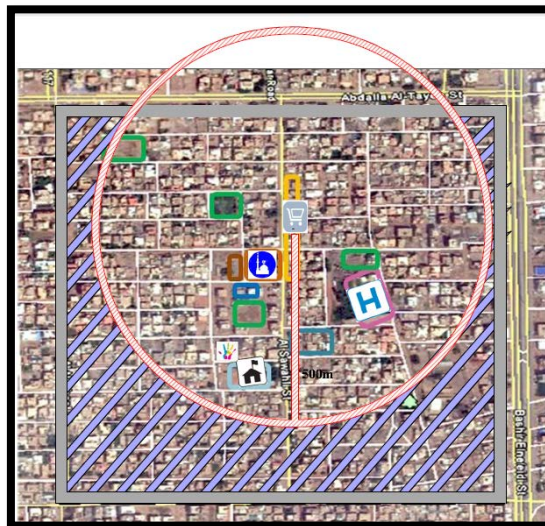
Figure 27 Radius of catchment (Super market) [23]

The Super market Radius of catchment is 500m, it serves almost (65%) of the neighborhood; the hatched area is out of the Super market coverage radius (35%) of the neighborhood, it's difficult for the residence in the

uncovered area to walk more than 500m to reach the super market, but they can use the small shops for daily needs.

Next table shows the comparison of Radius of catchment between the Standard areas according to Khartoum state Standards (Khartoum state follows the British standards), and the actual situation in Al-Taif neighborhood.

Table 6 - Services in Al-Taif (Radius of catchment) [10] [11]

Services	Radius of catchment m (according to Khartoum state)	Services coverage percentage (%)	Area out of services coverage percentage (%)
Kindergarten	200	12	88
Primary school	500	70	30
Health center	800	100	0
Club	900	-	-
Open space	350	60	40
Masjid	500	85	15
Super market	500	65	35
Craftsmen	-	-	-
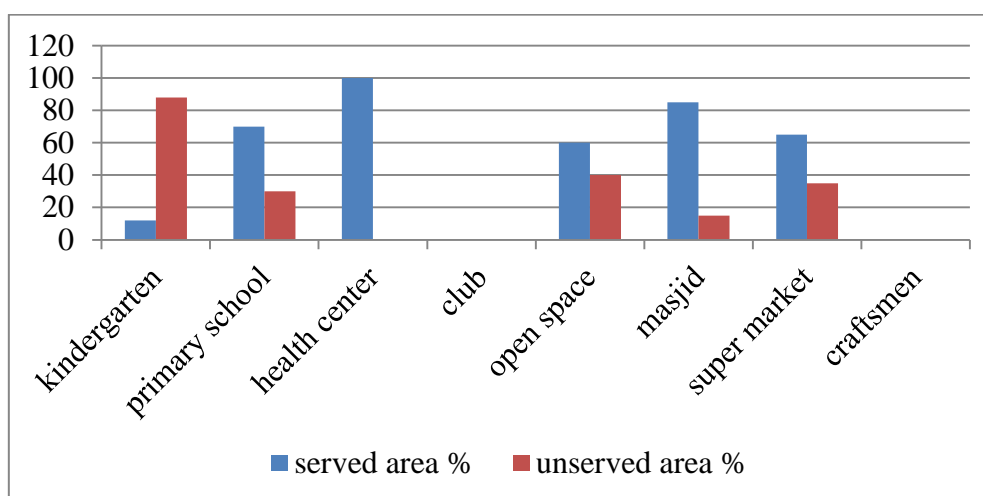
Figure 28 Services coverage percentage in Al-Taif neighborhood [11]

3.9 Al A'marat neighborhood.

Another example of neighborhood, Al-A'marat neighborhood.

Map 19 Al-A'marat neighborhood [23]

Figure 29 Figure 48 Al-A'marat neighborhood (original plan) [24]

Legend

 Kindergarten   commercial

 Embassy   Masjid

 Open spaces   Clubs

 Bank

Map 20 Al-A'marat neighborhood (existing situation) [23]

Legend

🟥	market area	🟩	Embassy
🟩	Restaurant	🟪	Clubs
🟧	Masjid	🟩	Open spaces

- **Planning typology:** Al-A'marat neighborhood plan pattern typology is also a grid pattern - as most of Khartoum neighborhoods – and the design of the internal streets there is no hierarchy to distinguish local streets from Arterial Street, the streets crossing the neighborhood; that reduce the privacy of the residence. The streets are straight instead of the curvilinear street for both safety and aesthetic purposes. Streets, by design, would discourage unwanted through traffic and enhance the safety of pedestrians specially the children and the elderly.

- **Spatial distribution of facilities (services) and availability:** Services must be available according to the number of residents in the

neighborhood (density); the residence in Al-A'marat is about 3000 person (5 persons per family), so there must be 2 kindergartens for about 120 child from 1-5 years (4% of the residents – the age pyramid), 2 primary schools one for boys and one for girls for about 300 child both boys and girls from 6-16 years (10% of the residents – the age pyramid), 1 health center, 1 masjid, and 1 super market. But the existing situation is not following this standard, the kindergarten is one in the neighborhood and there is no school. A comparison between the original planning and the existing situation in the scope of the spatial distribution has been made; the services are almost the same distribution as in the original plan from the ministry of planning. This neighborhood has a lack of many of the essential services such as primary school, health center…etc. and the existing services are not up to Khartoum state standards (Khartoum state follows the British standards). The distribution of the existing services is injustice within the neighborhood, the kindergarten is pretty much in the center of the neighborhood and very close to the arterial street, its location is not safe for the children, the super market is at the boundaries of the neighborhood and it's difficult for all the residence to reach it, there are also two masjids in this neighborhood; one is locate at the far Northeast of the neighborhood, and the other one is at the west, there is no need for those two masjids in one neighborhood and the distribution doesn't represent the equity and the radius of catchment.

Next table shows the comparison of the services availability and services areas, between the Standard areas according to Khartoum state Standards (Khartoum state follows the British standards), and the existing areas in Al-A'marat neighborhood.

Table 7 - Al-A'marat services availability and areas [10] [11]

Services	Standard Area m^2 (according to Khartoum state)	Availability and area m^2 (A'marat)
Kindergarten	600	300
Primary school	3000	Not Available
Health center	2000	Not Available
Club	600	4800
Open space	6000	2400
Masjid	1000-600-500	1200
Super market	9000	504
Craftsmen	25-50	Not Available

- **Radius of catchment:** Radius of catchment is also not up to Khartoum state standers (Khartoum state follows the British standards), because the services are scattered all over the neighborhood; some at boundaries of the neighborhood, other are in the center etc…, but most of them are accessible to the residence because of the radius of catchment is less than the standards .For the rest of services the residence have to get them outside their neighborhood, either by walking or by cars, both provides uncomfortable life style and may affect the economic situation of the residence (transport).

   The following figures show the radius of catchment for all services and the area that the services cover and the area out of coverage.

Figure 30 Radius of catchment (Kindergarten) [23]

The Kindergarten Radius of catchment is 200m, it serves almost (25%) of the neighborhood; the hatched area is out of the kindergarten coverage radius (75%) of the neighborhood, so the residence might use car to get their children to the kindergarten because the children cannot walk more than 200m.
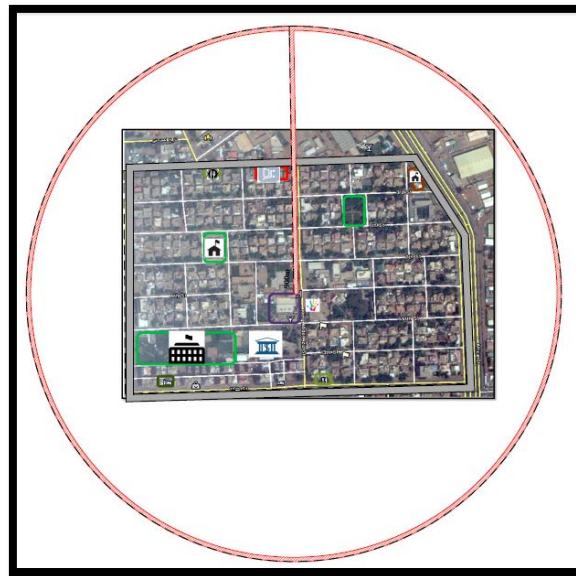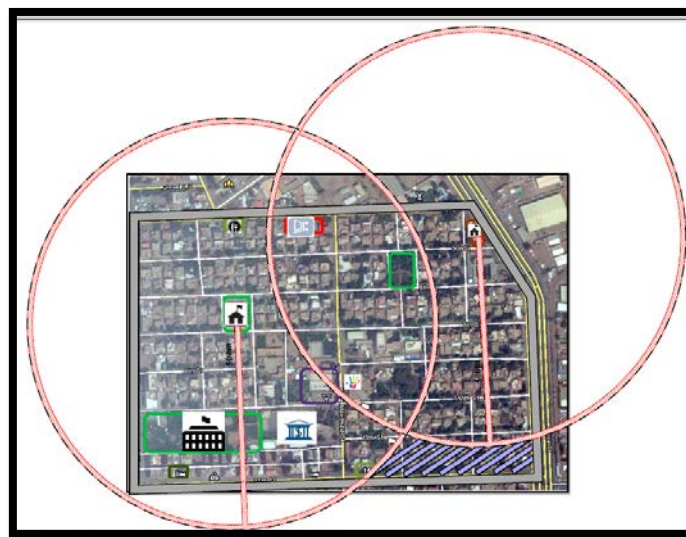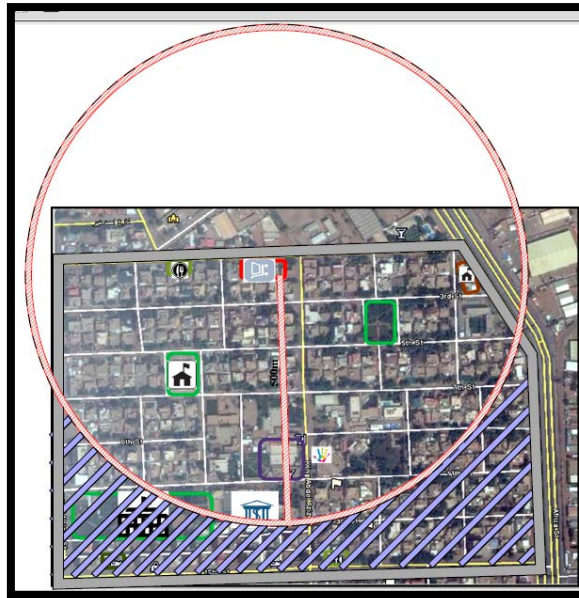

Figure 31 Radius of catchment (Club) [23]

The Club Radius of catchment is 600m, it serves (100%) of the neighborhood - and serves part of other neighborhood- all the residence can reach it.
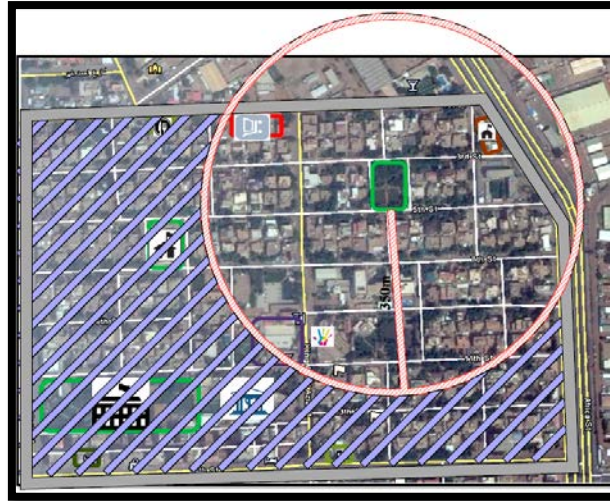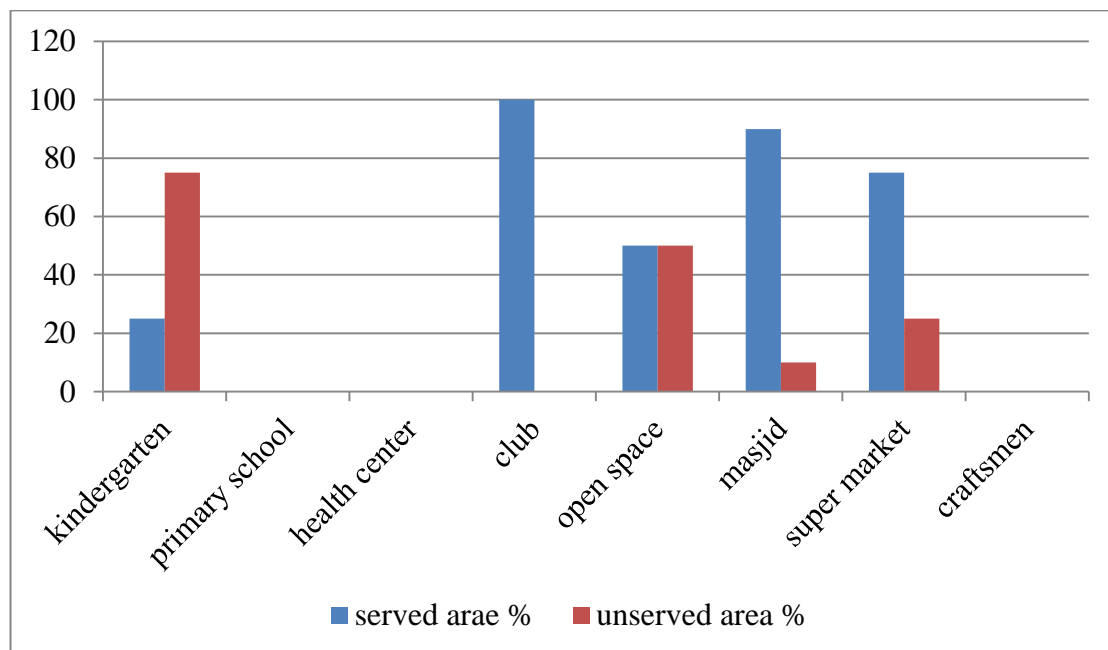
Figure 32 Radius of catchment (Open space) **(23)**

The open space Radius of catchment is 350m, it serves almost (50%) of the neighborhood; the hatched area is out of the open spaces coverage radius (50%) of the neighborhood.

Figure 33 Radius of catchment (Masjid) **(23)**

The Masjid Radius of catchment is 500m, the two masjids serves almost (90%) of the neighborhood; the hatched area is out of the open spaces coverage radius (10%) of the neighborhood, Although there are two Masjids in this neighborhood yet it's not covering the entire neighborhood due to the injustice of the distributing.

Figure 34 Radius of catchment (Super market) [23]

The Super market Radius of catchment is 500m, it serves almost (75%) of the neighborhood; the hatched area is out of the Super market coverage radius (25%) of the neighborhood, it's difficult for the residence in the uncovered area to walk more than 500m to reach the super market, but they can use the small shops for daily needs.

Next table shows the comparison of Radius of catchment between the Standard areas according to Khartoum state Standards (Khartoum state follows the British standards), and the actual situation in Al-A'marat neighborhood.

Table 8 - services in Al-A'marat (Radius of catchment) [10] [11]

Services	Radius of catchment m (according to Khartoum state)	Services coverage percentage (%)	Area out of services coverage percentage (%)
Kindergarten	200	25	75
Primary school	500	-	-
Health center	800	-	-
Club	900	100	-
Open space	350	50	50
Masjid	500	90	10
Super market	500	75	25
Craftsmen	-	-	-

Services coverage percentage in Al-A'marat neighborhood [11]35 Figure

3.10 Proposals for neighborhood

- Next figure shows the new neighborhoods layout according to the ministry of planning strategic plan. It shows the land use mainly, services are in the center and the industrial area is on the edges of the neighborhood, and blocks and streets are in grid pattern.
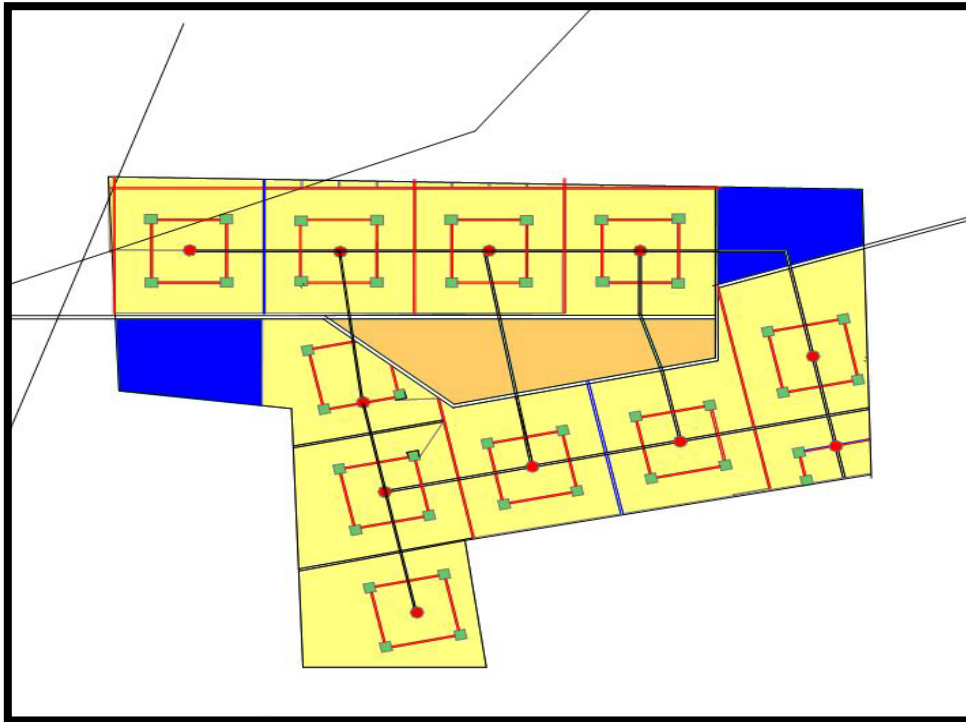
Figure 36 New neighborhood in Khartoum [9]

Legend

- Residential zone
- City center
- Community center
- Industrial part
- Main city axis

- Next figure shows all the services are available inside the neighborhood at the center in a liner form; it's accessible for all the residences with open space between clusters of houses and a large one

in the middle of the neighborhood. Blocks and streets are in grid pattern.

Figure 37 linear services [9]

- Adapted from habitat group (ETH Zurich), project amal ‖.

   - On assignment by the ministry of planning and public utilities.

Legend

Residential units
(low & middle
cost houses)

Open spaces

Services (mosque
, workshops , daily
needs shops ,
bank ,.......)

- Next figure shows example of services distribution within the neighborhood; it's crossed liner services at the main street, the radius of catchment is 5 minutes. Each cluster has a green area and cul-de-

sac road to keep the privacy of the clusters, and blocks and streets are in cobblestone pattern.
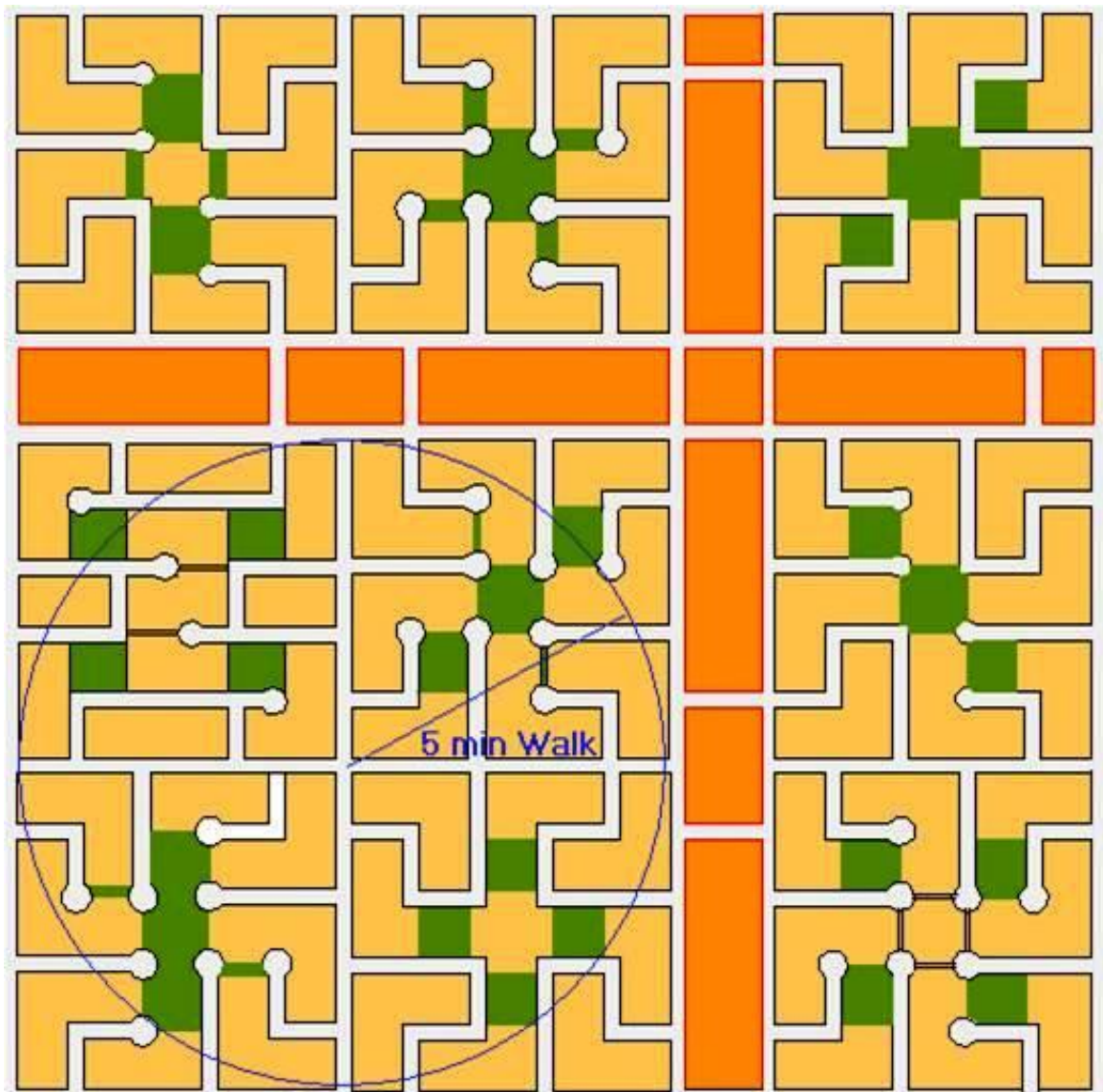
Map 21 crossed liner services [(26)]

Flexible, mixed-use zones | Parks
Building blocks (housing) | Roads

- Next figure shows example of services within the neighborhood in; the services distribution is mainly at the center and some of it at the end of the neighborhood, blocks and streets are in a grid pattern.

Map 22 T shape services

Legend

1. Avenue
2. Combined Community Facility
3. District Park
4. Small Villa Plots
5. Townhouses
6. Retail
7. Office
8. Clinic
9. Women's Center
10. Mosque
11. Desert Thread

3.11 Conclusion

All the previous figures, tables and analysis of Khartoum's neighborhoods show that the Al-Taif and Al-Amaraat neighborhoods already follow the example of the mixed use neighborhoods; but some of these neighborhoods lack some of the basic services within them, in the existing situation and in the original plans prepared by ministry of planning of Khartoum. Residence forced out of the neighborhood to get some of their needs that doesn't available in their own neighborhood and that's lead to a poor life style.

After a comparison between the original planning and the existing situation for two neighborhoods in Khartoum (Al-Taif and Al-A'marat) The areas of the services are not up to Khartoum state standers (Khartoum state follows the British standards), some are bigger than the standard and other are smaller. The spatial distribution and radius of catchment also not up to the standers because all the services either at the center of the neighborhood or at the boundaries of the neighborhood. The lack of the essential services and the injustice in the spatial distribution for the existing services within the neighborhood force the residence of the neighborhood to get them outside their neighborhood this provides uncomfortable life style and may affect the residence economic sense (transport).

These problems came as a result of two reasons; the first and the very important one is the original planning from the ministry of planning, it doesn't follow the same standers in all neighborhoods planning, sometimes the plan has more blocks than services areas, according to the population increasing. And other times the original plan has all the services on it, but when it comes to the execution they replace the

services blocks with residence blocks for the same reason (population increasing) or they turn it to an investment projects to the benefit of certain people not for the neighborhood residence benefit.

The second reason is that the residence themselves use the blocks that fixed for the services in other purposes.

Chapter Four – Results and Discussion

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The researcher has questioned a 100 person about the services in their neighborhoods, and the results came as following:
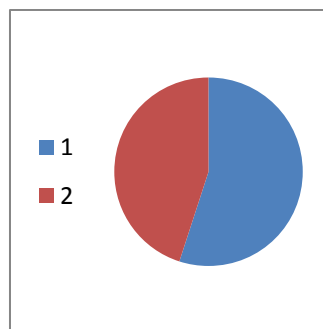
1) About Type

Figure 38 Gender [11]

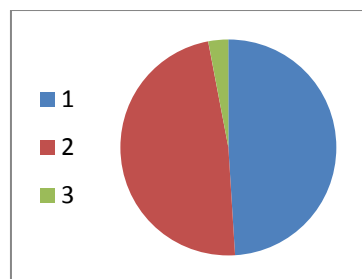People who took the questionnaire were: 55 females, 45 males

2) About Age

Figure 39 Age [11]

People who took the questionnaire were: 49 were 18-25, 48 were 25- 40, 3 were 40-55
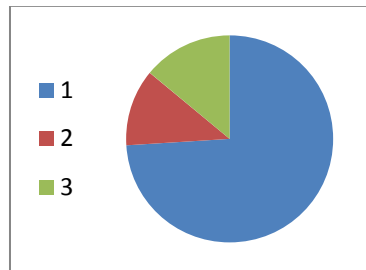
3) About Marital Status

Figure 40 Marital Status [11]

People who took the questionnaire were: 74 are single, 12 are married, and 14 are with kids
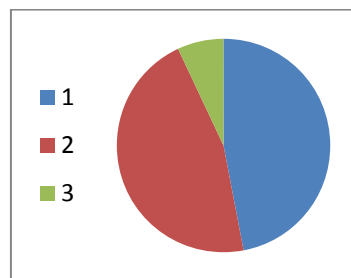
4) About job

Figure 41 Job (11)

People who took the questionnaire were: 47 are students, 46 are employee, and 7 are freelancer
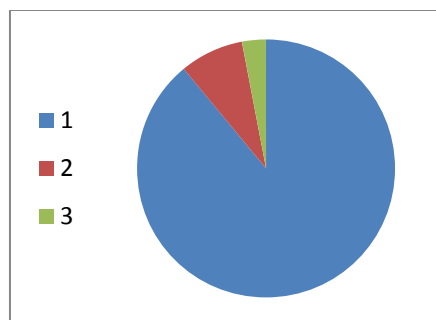
5) About the workplace

Figure 42 Workplace [11]

People who took the questionnaire were: 89 are working in Khartoum, 8 are working in Omdurman, and 3 are working in Bahri

6) **About income level**
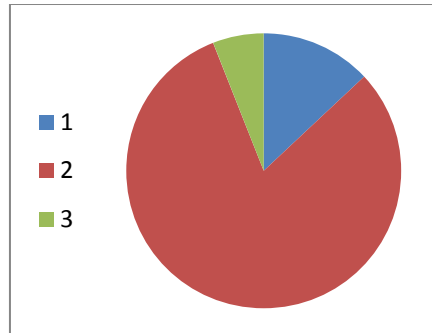
Figure 43 Income levels [11]

People who took the questionnaire were: 13 have high income, 81 have medium income, and 6 have low income

7) **About the name and the degree of neighborhood they live in**

Figure 44 degree of neighborhood [11]

People who took the questionnaire were: 30 are living in first class neighborhood, 52 are living in second class neighborhood, and 18 are living in third class neighborhood

8) **About services in their neighborhood**

Figure 45 Services in the neighborhood [11]

- 5 people said that they have all the eight services in their neighborhood

- 19 people said that they have seven services out of the eight services in their neighborhood

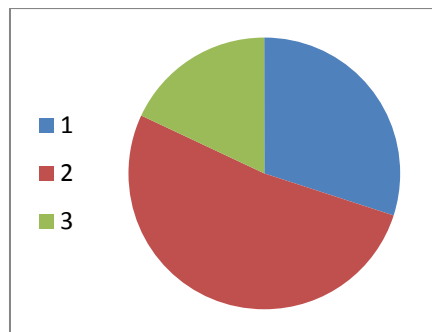- 11 people said that they have six services out of the eight services in their neighborhood

- 8 people said that they have Five services out of the eight services in their neighborhood

- 4 people said that they have four services out of the eight services in their neighborhood

- 4 people said that they have three services out of the eight services in their neighborhood

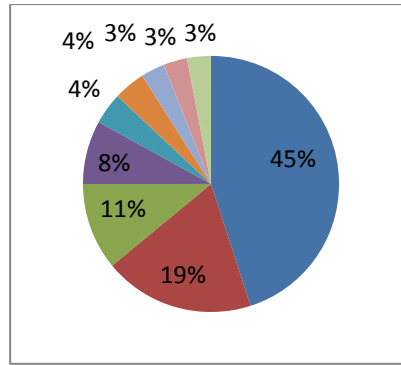- 3 people said that they have two services out of the eight services in their neighborhood

- 3 people said that they have one service out of the eight services in their neighborhood

- 3 people said that they have zero services out of the eight services in their neighborhood

9) About accessibility to the services within their neighborhood
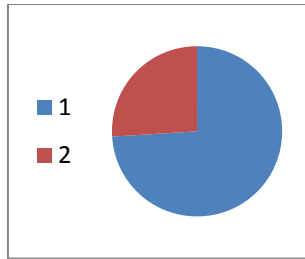
Figure 46 Accessibility to the services within the neighborhood [11]

People who took the questionnaire were: 74 reached the services by walking, 26 reached the services by car

10)　**About the question Dose the existences of services outside the neighborhood affect the economic sense?**
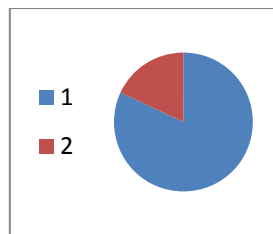
Figure 47 Dose the existences of services outside the neighborhood affect the economic sense [11]

82 said that the existences of services outside the neighborhood dose affect the economic sense, 18 said that the existences of services outside the neighborhood does not affect the economic sense

11)　**About the question what do they think is the reason or (reasons) for the lack of basic services within their neighborhood?**

Figure 48 The reason or (reasons) for the lack of basic services within the neighborhood [11]

- 16 said the reason for the lack of basic services within the neighborhood is the large number of pieces of residential plots
- 47 said the reason for the lack of basic services within the neighborhood is the neighborhood planning
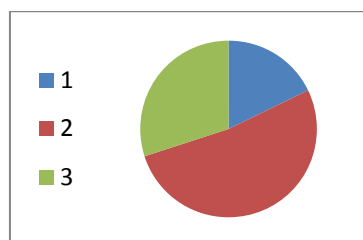- 27 said the reason for the lack of basic services within the neighborhood is the degree of neighborhood (first degree, second degree, third degree)

12)   About the question which do they prefer a large home space and some of the services in the neighborhood or a small space with the provision of all services within the neighborhood?
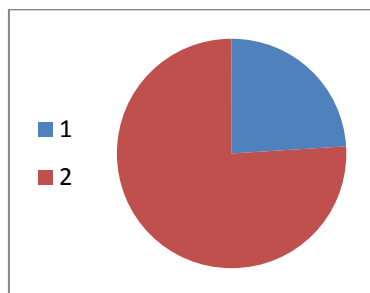
Figure 49 prefer a large home space and some f the services in the neighborhood over a small space with the provision of all services within the neighborhood [11]

- 24 said that they prefer a large home space over the services within their neighborhood
- 76 said that they prefer the existence of all the services within their neighborhood over the home area

13)   About the question what are the solutions that they think it's appropriate to provide all the basic services within the same neighborhood?

People have different opinion about this question:

- Activation of the neighborhood committees to seek to demand the provision of basic services to the neighborhood

- Cooperation of the people of the neighborhood to provide the services as far as possible (self-help)
- Not to exploit the spaces allocated for services for other purposes, and stick to the original plan for the neighborhood
- vertical Expansion rather than horizontal expansion to provide a larger space for services
- Give residential blocks less area and provide services
- modify neighborhood conditions to facilitate the availability of a full-service within the neighborhood

Chapter Five – Conclusions and Recommendations

5.1 Conclusions

5.1.1 The comparison between the original plans by the ministry of planning and the existing situation for the two neighborhoods in Khartoum (Al-Taif and Al-A'marat) revealed that the areas of the services are not up to Khartoum state standards (Khartoum state follows the British standers), some are bigger than the standard and other are smaller.

5.1.2 The spatial distribution and radius of catchment are also not up to the standards because all the services either at the center of the neighborhood or at the boundaries of the neighborhood. The lack of the essential services and the injustice in the spatial distribution for the existing services within the neighborhood force the residence of the neighborhood to seek them outside their neighborhood, this provides uncomfortable lifestyle and may affect the economic situation of the residents (transport).

5.1.3 The original plans from the ministry of planning, it doesn't follow the same standards in all neighborhoods planning, and sometimes the plan has more blocks than services areas, according to the population increase.

5.1.4 the original plans has all the services on it, but when they come to the execution they replace the services blocks with residential blocks for the same reason (population increase) or they turn it to an investment projects to the benefit of certain people not for the neighborhood residence benefit. Or

the residence themselves, use the blocks that fixed for the services in other purposes.

5.1.5 Twenty four of the questioned people have opinion that they prefer a large home space over the services within their neighborhood, but the majority of them seventy six said that they prefer the existence of all the services within their neighborhood over the home area. That shows that the existence of the services within the neighborhood is mostly preferred to maintain a good and easy life style, and from an economic perspective too (transport – expenses of moving the good to the house, saving time…etc.).

5.2   Recommendations

5.2.1 The ministry of planning should apply the same standards for all the neighborhoods.

5.2.2 Should stick to the original plan of the neighborhood, and not make use of the spaces allocated for services for other purposes.

5.2.3 Vertical expansion rather than horizontal expansion should be preferred to provide a larger space for service.

5.2.4 Minimize the residential blocks to provide more services.

5.2.5 Activate the neighborhood committees to demand and seek the provision of basic services within the neighborhood.

5.2.6 Cooperation of the residents of the neighborhood, to provide the services as far as possible (public participation / self-help).

5.2.7 Encouraging the residence to use a part of their houses for providing service (the services could be at the ground floor

and the domicile on the upper floors) that create jobs as well as providing services.

5.2.8 Promoting the handicrafts and small businesses; to generate income to the family, so the services will be available and the family income increases.

5.2.9 Modify neighborhood conditions to facilitate the availability of a full-service within the neighborhood.

5.2.10 Adding extra services to the neighborhood such as (police station, community center, and library) helps to upgrade the neighborhood and the quality of life, to maintain a perfect daily life.

5.2.11 Further researches effort is recommend proceeding in the future in field of mixed use neighborhood land use development.

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Appendix

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Questionnaire for the master thesis about mixed use neighborhoods development

1) **Type**

    Female   Male

2) **Age**

    18-25   25-40   40-55   55-70

3) **Marital Status**

    Single   Married   have children

4) **job**

    Student   employee   Freelancer   Unemployed

5) **the workplace**

    Khartoum   Omdurman   Bahri

6) **income level**

    Low   Medium   High

7) **the name and the class of neighborhood you live in**

    ....

    First class   second class   third class

8) **services in your neighborhood**

Kindergarten   elementary school   health center

Club   supermarket   masjid   open space

Craftsmen (carpenter – Smith– plumber - electrician)

9) accessibility to these services

On foot   by car

10)   Dose the existence of services outside the neighborhood affect the economic factor?

Yes   No

11)   What do you think is the reason or (reasons) for the lack of basic services within your neighborhood?

o The large number of pieces of residential plots

o Neighborhood planning

o The degree of neighborhood (first degree, second degree, third degree)

12)   Which do you prefer?

o A large home space and services less in the neighborhood

or

o Small space and provide all services within the neighborhood

13)   What are the solutions that you think it's appropriate to provide all the basic services within the same neighborhood?

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إستبيان لرسالة الماجستير حول تطوير الأحياء متعددة الاستخدامات

1) النوع

انثي   ذكر

2) العمر

70-55   55-40   40-25   25-18

3) الحالة الاجتماعية

لديك اطفال   متزوج   عازب

4) الوظيفة

لا تعمل   اعمال حره   موظف   طالب

5) مكان العمل

بحري   امدرمان   الخرطوم

6) مستوي الدخل

عالي   متوسط   ضعيف

7) اسم ودرجة الحي الذي تسكن به

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درجة ثالثة   درجة ثانية   درجة اولي

8) الخدمات الموجودة بالحي الذي تسكن به

نادي   مركز صحي   مدرسة ابتدائية   روضة

مسجد   سوبر ماركت   فسحة

حرفيين (نجار – حداد – سباك -كهربائي)

9) **الموصولية الي هذه الخدمات**

مشيا علي الاقدام   بالسيارة

10) **هل وجود الخدمات خارج الحي يؤثر علي الناحية الاقتصادية؟**

نعم   لا

11) **فى رأيك ماهو السبب او (الاسباب) عدم توفر الخدمات الاساسية داخل الحي الواحد؟**

كثرة القطع السكنية بالحي   تخطيط الحي

درجة الحي السكنية (درجة اولي , درجة ثانية , درجة ثالثة)

12) **ايهما تفضل؟**

مساحة منزل كبيرة وخدمات اقل   ام

مساحة منزل صغيرة وتوفر كل الخدمات داخل الحي

13) **ماهي الحلول التي تراها مناسبة لتوفير كل الخدمات الاساسية داخل الحي الواحد؟**

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