ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL OF SCIENCE ENGINEERING AND TECHNOLOGY

DEVELOPING A PARAMETRIC DESIGN TOOL AS A DECISION SUPPORT SYSTEM FOR DESIGNING POCKET PARKS

M.Sc. THESIS

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Department of Landscape Architecture

Landscape Architecture Master Program

JULY 2020

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ISTANBUL TEKNİK ÜNİVERSİTESİ ★ FEN BİLİMLERİ ENSTİTÜSÜ

CEP PARKLARININ TASARIMI İÇİN KARAR DESTEK SİSTEMİ OLARAK PARAMETRİK TASARIM ARACI GELİŞTİRİLMESİ

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Temmuz 2020

Aseel Hammad, a M.Sc. student of İTU Graduate School of Science Engineering and Technology 502171601, successfully defended the thesis/dissertation entitled "DEVELOPING A PARAMETRIC DESIGN TOOL AS A DECISION SUPPORT SYSTEM FOR DESIGNING POCKET PARKS", which she prepared after fulfilling the requirements specified in the associated legislations, before the jury whose signatures are below.

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Date of Submission : 15 June 2020
Date of Defense : 08 July 2020

To my parents,

FOREWORD

I would like to express my appreciation and thanks to my advisor, Assist. Prof. Dr. Muhammed Ali Örnek. For his patience, support, and encouragement during the entire master study. Without his guidance and constant help, this thesis would not have been possible.

I wish to express my deepest gratitude to my family, especially my parents Mahmoud Hammad and Narmin Majdalawi for their love, praying, and warm support throughout my life. You were and still being there for me and standing behind any of my success in this life. Anything would be written it will be never enough.

Finally, I would like to state warm thanks to my friends: Hilal, Rukiye, and Seda for their untiring support along the journey of my master's study.

July 2020

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(Architect)

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ABBREVIATIONS

CAD : Computer-Aided Design

BIM : Building Information Modeling

LIM : Landscape Information Modeling

GIS : Geographic Information system

SQM : Square meters

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DEVELOPING A PARAMETRIC DESIGN TOOL AS A DECISION SUPPORT SYSTEM FOR DESIGNING POCKET PARKS

SUMMARY

During history, especially after the industrial revolution, urban populations had raised dramatically. As a result, the cities became in dramatic and unplanned situations. Consequently, the pressure of creating or developing urban open spaces had been increased. There are not many doubts about the importance or benefits of urban open spaces such as parks but the problem starts when cities try to build and develop parks. Cities usually have not had enough money to accomplish all that they hope especially within the current economic crisis where establishing new parks or develop the old ones is not in the top priorities anymore. Pocket parks can begin in tackling these issues, due to their small sizes and simple requirements comparing with other types of parks. The pocket park is a small urban open space and considers as the smallest type of park. It provides a space for gathering and socializing in the dense cities and can be woven within the urban fabric in the most developed cities. Moreover, it contributes to enhancing the ecological and social life of the city as much research mentioned. on the other hand, it can be noticed that some of the design decisions can’t fulfill the community's desires or ecological and social life needs. So, if the computational methods were incorporated in the designing process this can provide different options and possibilities for the designers and planners.

As mentioned above, this research proposes a decision support guide system that aims to assist decision-makers in establishing pocket parks in antiquated areas or developing the existing ones. Based on updated guidelines and standards at a global level, the database has been established to provide a unique study that collected and classified pocket park standards and create a set of design rules.

The thesis is consisting of five chapters: In the first chapter, a brief history explained the beginning of the urban parks in the United States and Europe, then in a separated

section, an overview of the pocket park's emerging circumstances, definitions, and other related details was summarized.

In the second chapter, to create a framework of the designing tool, the chapter shed the light on pocket park design guidelines and standards according to the main design parameters, then local and global case studies with applications have been gathered to broaden and support the database. After that, the primary analysis of design guidelines and standards were addressed and categorized in tables.

The third chapter focuses on the literature of computer-aided design approaches and related fields such as BIM, LIM, and GIS. It also explained the genetic algorithms and parametric design concepts with applications and examples.

The fourth chapter contains the research approach and methodology. This chapter presents the process of developing the decision support guide which started with re-categorizing design guidelines and design standards from a programming perspective to evolve, identify, and exclude some -if needed-.

The last chapter includes the conclusion and the results that the research reached which includes a set of design rules which can assist landscape architects, urban planners, and researchers to design pocket park

CEP PARKLARININ TASARIMI İÇİN KARAR DESTEK SİSTEMİ OLARAK PARAMETRİK TASARIM ARACI GELİŞTİRİLMESİ

ÖZET

Tarih boyunca özellikle endüstriyel devrimden sonra kent nüfusu önemli ölçüde artış göstermiştir. Bu artış, şehirlerin plansız gelişimine sebep olmuştur. Kentlerin nüfusundaki artış, kentsel açık alanları yaratma ya da geliştirme baskısını artmıştır. Parklar gibi kentsel açık alanların önemi ve faydaları konusunda şüphe yoktur ama parkların inşası ve süreç içerisindeki gelişimi ele alınması gereken bir probleme dönüşmektedir. Yerel yönetimlerin ekonomileri planladıkları herşeyi tamamlamak için yeterli olmayabilir. Cep parkları, küçük boyutları ve basit gereksinimleri nedeniyle diğer parklara kıyasla kent içerisindeki yeşil alan ihtiyacını karşılamada önemli rol oynayabilirler. Cep parkı küçük bir kentsel açık alan ve en küçük park tipi olarak tanımlanabilir. Kalabalık şehirlerde toplanma ve sosyalleşme için gerekli alanı sağlar. Ayrıca yapılan araştırmalarda şehrin ekolojik ve sosyal hayatına katkı sağladıkları da görülmektedir. Öte yandan, bazı tasarım kararlarının toplumun arzularını veya ekolojik ve sosyal yaşam ihtiyaçlarını karşılayamadığı görülebilir.

Bu tez çalışması kapsamında, yerel yönetimler, planlamacılar, tasarımcılar gibi karar mekanizmalarının atıl alanlarda cep parkı kurma veya mevcut cep parklarının iyileştirilmesini desteklemek amacıyla bir karar destek aracı sunmaktadır. Küresel ölçekte varolan tasarım rehberleri ve standartları derlenmiş, mevcut cep parkları üzerinden sistematik bir sınıflandırma yapılmış ve elde edilen bulgular neticesinde cep parklarının tasarımlarına ilişkin parametlerin sunulduğu bir tasarım altlığı sunulmuştur.

Bu tez dört bölümden oluşur;

Birinci bölümde, Amerika Birleşik Devletleri ve Avrupa'daki kentsel parkların tarihi kronolojik gelişimini, ardından cep parklarının ortaya çıkış koşullarına genel bir bakış, tanımları ve detayları sunulmuştur.

İkinci bölümde, tasarım aracının çerçevesini oluşturmak amacıyla, ana tasarım parametrelerine göre cep parkı tasarım kılavuzlarına ve standartları ortaya konulmuş ve yerel ve küresel kapsamdaki uygulamalar sunulmuştur. Ardından, cep parklarına ilişkin tasarım kılavuzlarının ve standartlarının birincil analizi ele alınmış olup tablolarda kategorize edilmiştir.

Üçüncü bölümde, bilgisayar destekli tasarım yaklaşımlarına üzerine odaklanılmıştır. Bina Bilgi Modelleme, Coğrafi Bilgi Sistemleri ve Peyzaj Bilgi Modelleme teknoloji ve araçları hakkında güncel envanter ortaya koyulmuştur. Ayrıca genetik algoritmalar ve parametrik tasarım kavramları uygulamalar ve örneklerle açıklanmıştır.

Dördüncü bölümde, tez kapsamında yürütülen araştırmanın yaklaşımı, kapsamı, yöntemi ve süreci sunulmuştur. Bu bölüm temel olarak, tasarım yönergelerini ve standartlarını bir programlama perspektifinden yeniden kategorize etmekle başlayan ve gerektiğinde bazılarını geliştirmek, tanımlamak ve hariç tutmak için kullanılan araç programlama sürecini içermektedir.

Son bölümde ise, bu tez araştırması kapsamında elde edilen bulgular sunularak; peyzaj mimarlarına, şehir plancılarına ve araştırmacılara cep parkları tasarlamalarına yardımcı olabilecek bir dizi tasarım kuralı ortaya koyulmuştur.

1. INTRODUCTION

Urban sprawl and the rapid increase in population have converted cities to be dense and crowded. Thus, the need for urban open spaces has been increased. The urban open space concept has developed since 1965, synchronized with the urban renaissance that was evidence of the appreciation of city vitality. Urban green spaces contain public parks and gardens, playgrounds, natural green spaces, and green corridors. Urban parks located nearby to the city center were the only one of several potential places such as shopping centers where people used to spend their recreation time (Marcus,1997). Pocket park considered the smallest type of urban park which has no difference from other parks in providing an opportunity for residents to escape some of the challenges of urban life. The unique benefit of pocket parks is that they can be located within the urban fabric in different places where a more traditional, larger parks would never be possible (Harnik, 2008).

Due to pocket parks small size, it is important to be cared for and designed well. The success of the park doesn't determine by the size, the park's quality is a more important determinant of success than its size (Seymour, 1969). Various design parameters take a role in the success of a pocket park. According to National Recreation and Park Association, the successful pocket park has four key qualities: it is accessible, people are involved in parks activities, it is a comfortable place and has a good image, and it is a sociable place and interaction point where people meet each other and take people to when they come to visit. thus, the pocket park design should design carefully and follow guidelines and set of rules.

In addition to what mentioned, landscape design relays on various parameters and numerous relations that increase the complexity of the designing process, even greater in urban areas. In this manner, combined computer-aided design in the designing process offers a wide range of options and alternatives in short times and increases the environmental performance of the design solution.

The effect of green space units such as large parks, small parks as pocket parks, boulevards, green corridors, and private garden need to be understood more, especially for pocket parks, there is a research gap. If pocket parks designed well, they could be attractive in a city planning context and they can easily integrate into the dense city structure than large green spaces. Moreover, they may increase the quality of the urban green infrastructure by prefacing for other types of urban green spaces (Peschardt, 2014). From this perspective, the need for defining a set of rules and design guidelines for pocket park need to be studied with the aim of help designers and stakeholders improving the outdoor spaces in dense cities.

1.1 Aim of The Thesis

As mentioned before, there is a research gap in pocket park studies. And the need for defining design parameters for pocket parks would be a keystone for researchers in developing the urban green infrastructure in cities. The main purpose of the research is to address the basic design guidelines for the pocket parks which categorized under design parameters to set design rules for developing a decision support guide system that would lead designers, planners, and stakeholders in creating pocket parks, altering unoccupied lots, rooftops and other disregarded spaces into appealing, vital and enjoyable places. To achieve the research aim, the research went through three stages: starting from assembling a unique collection of guidelines and standards from different resources in addition to built pocket parks analysis. Then, throughout many categorizing phases, the main design parameters and guidelines stated in groups to create parameters combined for the support guide system.

1.2 Content of The Thesis

The changes experienced in modern cities are reflected in the urban spaces which lead to the shrinking of public spaces in the urban structure. Thus, open urban spaces need to be considered with a comprehensive approach in the scope of urban planning. Pocket parks can serve the urban open space structure needs within the municipality's ability. The pocket park importance comes from its simple requirements comparing with other types of parks, its accessibility where the scattered pocket parks are more accessible than a large center park. Moreover, it has an important role in making the

nature close to residents and providing near open space for workers, people to relax, and meeting as well as with the ability to developing at a small cost.

the research focuses on collecting pocket parks design guidelines and standards from various resources to provide an inclusive guidelines database that represents a design parametrical guide that could be used in computer-aided design applications. Furthermore, the research recategorized all the founded guidelines under new design parameter terms from a computer-aided design perspective within a process of producing a decision support guide system that would assist decision-makers, planners, and landscape architects in improving the existing pocket park design as well as create ones that designed according to studied standards.

1.3 Method of The Thesis

With the object of achieving the thesis aims, the research framework goes into five chapters. Divided into a literature review, model development, and propose the decision support guide as shown in (Figure 1.1).

The literature review includes a brief history of urban parks' emergence and development process through history which led to pocket park appearance in the United States and Europe. Moreover, it tackles the pocket park definitions and emergence circumstances.

The model development represents the beginning of establishing the design guidelines database, which includes identifying general design parameters then expand the scope of design criteria based on Abd Al Aziz, research (2017) which leads to the final step in this stage; creating a primary classification for the design guidelines and built pocket park's elements as well.

With the aim of proposing the decision support guide, the research addresses setting up design rules starting from building an information database about computer-aided design, then optimizing all the collected guidelines data by recategorizing them for the design guide under developed terms. Consequently, the research produces a design algorithm for pocket parks in the end.

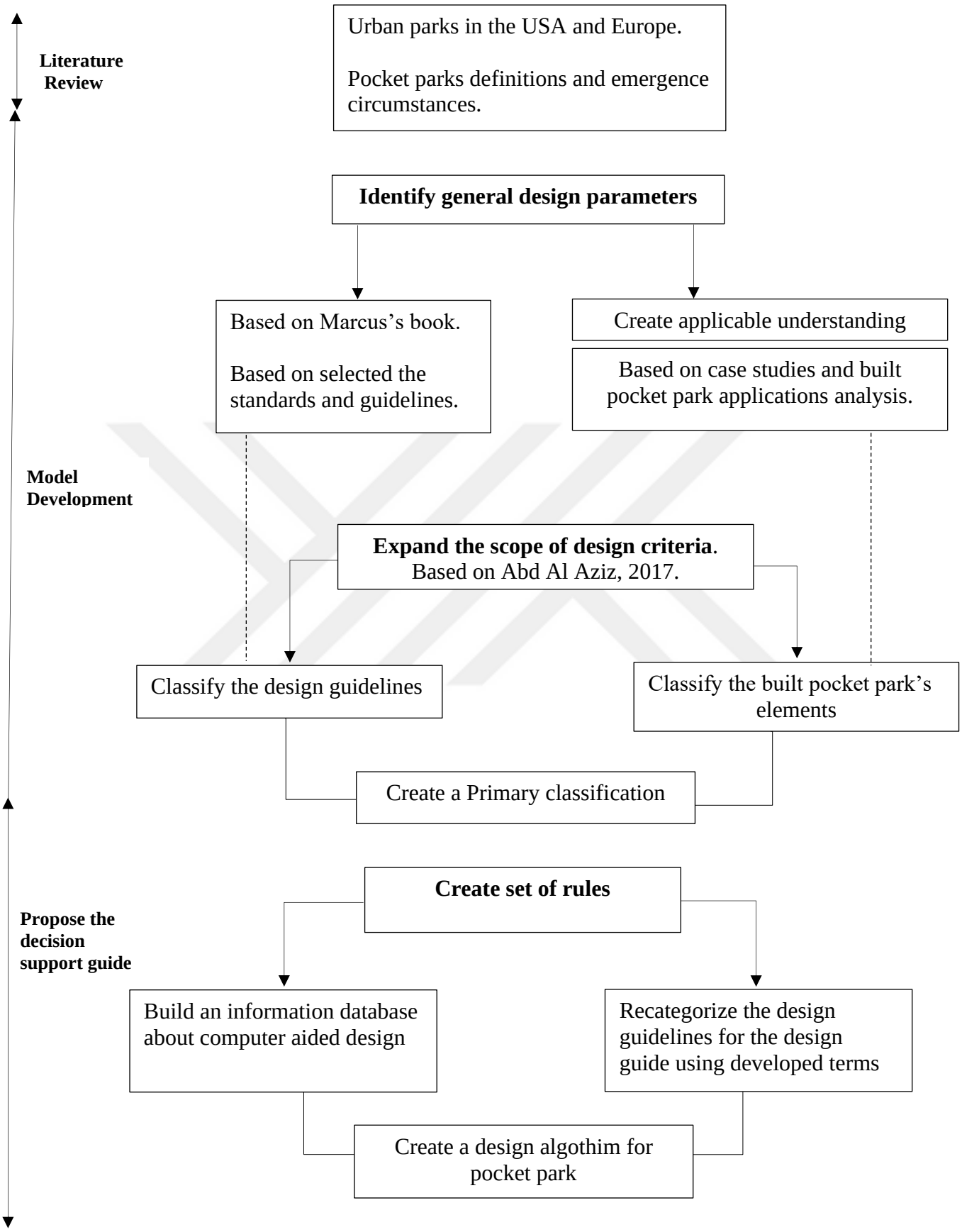

Figure 1.1: Research method flow chart.

1.4 Literature Review

After the industrial revolution (1760-1840) urban areas have been expanded as a result of secluded people from nature areas located far from centers and needed time to travel. This made workers class demanded parks that contain different recreational features, such as sports, playgrounds for kids, and provide social life near their homes (Chadwick, 1966). Gradually, the countryside moved to the city after opening parks and gardens for the public for recreation and entertainment (Jones and Wills, 2005). For instance, Central Park in New York has been built for the public to mentioned purposes and the first pocket park, Bowling Green in 1733 was built for public and working-class to interact with nature nearly from them (Dempsey, 2012; Seymour, 1969).

In the mid of 1960s and later years the parks and gardens were fenced and had restrictive activities and programs, which led to reduce users for these parks thus these urban spaces became unsafe. For the sake of attracting people again, many programs and different activities have been added, such as motocross, skateboarding, and a variety of physical fitness programs. Moreover, development in children's playground facilities. In this period, the term “open space” became common and used repeatedly. In other words, recreational space doesn’t bound in parks and gardens, it includes variety in open public spaces open for all (Flagler, 1985).

The idea of the pocket park was born in Europe after world war 2 because of the need of rebuilt the damaged areas after the war and to provide recreational public spaces at an affordable cost and available land. This meant, in other words, a minimum of expense, but with a big chance for creativity “great deal of imagination”. As a result, the designed pocket park achieved success more than had been anticipated, which led to developing the concept in the later years in a border scale and developed ideas (American Society of Planning Officials, 1967). After that, the idea has been transferred to the United States in the early 1950s. The pocket park idea was promoted by landscape architect Professor Linn (1968), with his idea “neighborhood commons”. The project launched in the middle of the 20th century to build a network of pocket parks in different cities in the United States: New York, Baltimore, Philadelphia, and Washington.

In the mid of 1960s and following years the prices of lands raised synchronize with competition on them, with the pressure of creating green urban areas as a response to the changes in urban policies and the increasing in the development of different types of parks and open spaces. Consequently, this gave a chance to rethink of unplanned and irregular shaped small areas, which considered unusable. "Vest-pocket parks" which appeared earlier in the 17th and 18th as an enclosed urban garden (American Society of Planning Officials, 1967).

Much of the utility of park facilities can be determined in its accessibility to the surroundings, thus, scattered pocket parks are more accessible than a large scale park. They are preferable more than large parks because they are nearer to the public; from houses and workplaces as well (Gold,1977; Grahn and Stigsdotter, 2003; Neuvonen et al., 2007; Peschardt and Stigsdotter, 2013). From a different point of view, the nearest places contribute to raising the sense of identity and attachment to the people who live surrounding them, especially to children. Pocket parks playing a role in giving an identity to the neighborhoods. In this context, pocket parks have an important role in making the nature close to residents and providing near open space for workers, people to relax and meeting, with the ability in developing at a small cost; estimated to be approximately $3.50 per square foot including land (American Society of Planning Officials, 1967; Forsyth et al., 2005; Mumford, 1969).

1.4.1 Urban green spaces

Landscape and urban designers give urban green areas a big concern due to their impact on the quality of life in cities. From different perspectives, nature plays a significant role in the daily life of people. Natural environments captivate human beings and considered a valuable part of their life (Kaplan, 1983; Kaplan and Talbot, 1983). “Access to natural open spaces is a central value in modern society”. Furthermore, urban green areas play an important role in enhancing the social life of the residence. They allow a social interaction by providing context; remind people about their childhood and memories of community life, and serve as “gateways” or chances for people to escape from the stress and noise of urban life (Burgess et al., 1988).

Nature has been interlaced with the life of city residents throughout history (McKibben, 1989; Madanipour, 1996). From old Persian gardens to today’s pocket

parks, nature has been an essential design element in cities (Migge,2013). Due to the industrial revolution (1760-1840) the division between nature and habitation became larger and farther (Williams, 2005)

Due to the industrial revolution (1760-1840), the number of natural areas has been decreased. The need for bringing green spaces to the cities again has begun to be supported, and the concept of "urban green area" has appeared as an important element of the cities (Özgüner, 2003).

The first definition of urban green areas was written by American landscape architect Frederick Law Olmsted who was affected by the public-open space movement in England by the Boston Park System that was formed in the 19th century.

The concept of “park” or garden has a root in old civilizations such as the hanging gardens of Babylon (604 BC), the Persian paradise (539 BC), and Nineveh (705 BC) they are early examples of improved and adjusted landscapes. The Greeks understood green spaces in the city as a sacred place and a place for civic life. The Romans considered the open spaces important for the health and happiness of Roman residents. Roman parks used for recreation and entertainment. For example, in Rome Porticus Pompeiana (55 BC) the design consists of large open green areas, some sheltered areas, and water elements. The design reflects aesthetics and function at the same time (Ghavampour et al., 2019; Jones and Wills, 2005)

Later, in European countries, the first parks were designed for rich people, rulers, and high classes. Furthermore, it was common in England "to set aside a portion of land in the towns for the common use of the people" (Frye, 1980, p.22). These shared areas were used for pasture sheep and cattle in the first place. after that, the towns built by colonists from England had a common characteristic feature of the New England communities. To adapt the growing population of New England a lot of town common lands were ultimately sold or reduced in size. On the other hand, one of the few that survived was the Boston Common which established in 1634. The reason was the new functions that applied to these common lands. It captivated rope makers from the docks, orators and evangelists, and was also used as a place for an evening walk (Brodeur, 1971, p.293). So, Boston commonly considered as an early municipal park in the United States, even if it didn’t have recreational facilities until many years later in 1728 when officially organized as a park (Van Doren and Hodges, 1975, p. 14).

1.4.2 A brief history of urban parks in the United States and Europe

To understand the formation and changing process in designing parks, it is important to study the development of parks and the changes that went through in terms of purpose and form and how the form affected by the purpose. The following sections show the changes in the design of urban parks and how it's reflected the time.

1.4.2.1 Urban parks in the United States

Throughout the history of the urban park and recreation movement in the United States, different types of urban parks have developed. Cranz (1982), divided the united states urban parks into four typological eras, in which he explained how the events and purpose of each period affected the form of the parks and recreation area. The four eras are:

- The Pleasure Ground Era 1850-1900
- The Reform Era 1900-1930
- The Recreation Era 1930-1965
- The Open Space Era 1965 and After.

The pleasure ground era 1850-1900

In the 1800s the population of the United States has been increased rapidly and the number of people who move from rural areas to urban ones was increased too. This increased the demands on the need for appropriate places to engage in leisure and recreation activities for residents. While the urban areas were growing up the towns and rural areas were shrinking and the desire for the development of passive park and garden has been raised. New York City was one of the cities that went through these changes. The need for recreational area forced the city of New York in 1857 to announce a competition to overall planning and design for the central park.

Landscape architect Frederick Law Olmsted and architect Calvert Vaux won the first prize for their plan, of which the main concept was "to develop a pleasure ground that would provide a healthful atmosphere and a rural retreat as a positive contrast to city conditions" (Frye, 1980, p.25). The concept of the park was influenced by the naturalistic parks in England. The design was mainly consisting of a pastoral landscape, informal trees, grass bounded meadow and ponds and lakes with walking pedestrian paths separated from vehicles. Central Park was a place to accommodate

passive activities such as picnicking, horseback riding, walking, boating, and ice skating. Olmsted believes that the true park design allows urban residents to enjoy and recreate to the fullest extent with an idealized rural landscape atmosphere giving contrast to their confusion city (Butler, 1958-59, p.10).

Central Park became famous with the first large planned public park and with his designers Olmsted and Vaux who became famous for setting "a standard for park work that has not been materially improved or altered in subsequent years" (Newton, 1971, p.289). which led to the design and build new municipal parks not just in New York City but in other cities such as Brooklyn, Buffalo, Boston, Detroit, Philadelphia, Chicago, and San Francisco.

Consequently, the first parks in the United States have an anti-urban or rural form. The main features were pleasure grounds with vast landscapes of meadows, massive trees, lakes with meandering waterways, and pedestrians' pathways. Buildings were rarely to contrast with the buildings' confusion of the city. These municipal parks were located at the edge of a city (Cranz, 1978, p.9).

In the last half of the 19th century, the cities became larger and the number of populations who came from rural areas to urban suburbs has increased, this synchronized with the awareness of needing recreation spaces and public parks in different types such as playgrounds, beaches, and reservations.

In response to the growing municipal park movement, Olmsted came with the concept of a system of parks within a city, rather than individual parks. He aimed to design large green spaces to become "the lungs of the city". The idea was mainly containing a series of parks which linked into a working complex by way of parkways or pleasure driveways (Rutledge, 1971, p.4; Francis et al., 1984). It was not just to provide different types of open spaces but to connect these open spaces to form a unified whole (Frye,1980, p.29). The first Metropolitan Park Commission was opened in Boston in 1892 (Doell and Twardzik, 1979, pp.48).

In the 1880s and 70s, the demand for active recreational facilities increased, especially for children. The crowded unsafe cities weren't included suitable spaces to play which led people to ask for a suitable playing area for their kids

The first land purchased for playing areas was in Massachusetts in 1871 but it took several years before the lands were developed as a children park. After that, in Boston

in 1885 a land located near to the Children's Mission yard contains playing facilities and set aside as a children's playground.it was known as the Boston Sand Garden. within another two years, Boston had ten more playgrounds underway and the playground movement was spreading to many cities such as New York and Chicago.

The reform era 1900-1930

The term "playgrounds" of the late 19th and early 20th century was including not only space for children but also for teenagers and young, older adults (Cranz,1982). The two terms that appeared in this era and it needs to clarify them are “playground” and “reform park”; The first term refers to small spaces which designed exclusively for children and "reform park" refer to the area which includes other recreational facilities as including small children's playground areas too. However, the recreation facilities in this era were focusing on the young more than adults.

The need for the separated playground and accessible parks for working-class people along with the city not just on the edge of it led to small neighborhood parks appearance. According to Frye (1980), theses small parks were as "play park", providing a setting for the public playground or reform park. On the other hand, the large city park was a "breathing place". The area and location of small parks were different from other parks plus small parks included play equipment within the character of a park.

Many parks have been developed in different cities in the United State under the concept of providing a park and playground in the same place which is achieved both green attractiveness and functional area (LaGasse and Cook, 1965).

In Chicago, the need for opening small parks increased due to lack of urban open spaces except for the three city’s parks which were far to reach plus they were unadaptable to playground equipment. The Special Park Commission equipped and maintained many small parks particularly on the south side of the city with one to five acres (4047 – 20234) square meters. The plan included not only areas for children but it became a social center for all ages and within the time the parks were crowded and heavily used. J. Frank Foster, an engineer and general supervisor of the South Park District, mentioned about the small park movement "taking the park to the people" (Frye, 1980, p.32.). In inner cities, neighborhood parks became essential for children to play and gather instead of the streets. Furthermore, the space around building especially public schools have been developed to add playground activities. In 1890

New York City required that all schools constructed after that date should include open-air playgrounds. The school-park concept spread throughout the United States, and in 1911 the National Education Association formally approved the use of school grounds for recreation (Van Doren and Hodges, 1975).

In 1922 the model of reform park size changed by ten to forty acres (40469- 161874) square meters formal design. Pathways kept to the minimum to provide space for landscape and nature. The lighting elements spread along with the parks for night use. Moreover, the parks planned for indoor and outdoor usage. Indoor activities included a gym, basketball courts, and dance hall. However, outdoor facilities included a running track, an open game field, a children's playground, and gymnastic equipment. Activities in the reform park were separated by age and sex and programmed by social workers (Cranz, 1982).

During the reform era lawmakers also recognized the importance of recreation and in 1911 New Jersey passed the first State Recreation Enabling Legislation that authorized local governments to provide recreation programs. In 1924 President Coolidge invited to a National Conference on Outdoor Recreation to develop a national recreation strategy. This conference allowed park planners to meet with recreation leaders and supervisors which concluded to a request for an inventory of outdoor recreational resources. L. A. Weir was assigned a director of the study and in 1928 his book entitled Parks: A Manual of Municipal and County Parks was published. The book was a manual that covered the maintenance, development, design, and financing of parks and playgrounds for municipal and district parks system then the book became important reading for the park and recreational professionals for many years (Van Doren and Hodges, 1975).

The recreation era 1930-1965

In this era, the concern was given to the recreational facilities (Cranz, 1997). Moreover, the term "facility" appeared and used to develop and transform older parks by adding facilities such as swimming pools, bleachers, and stadiums.

During this period, people realized that recreation and open space can be found in any place throughout the city, it doesn’t have to be in one type of space. Consequently, that led to the creation of Open Space Systems which characterized as a sustainability movement (Cranz, 1989; Cranz, 1997). People started to see the parks not only a space for spending time but also as a learning tool for children about food production for

example. Furthermore, parks were considered as a resource that people use to live more sustainably (Cranz, 1997). In the 1930's leisure time increased due to a shorter workweek, improved automobiles, and road systems, and earlier retirement ages. As a response the federal government developed many projects for recreation and maintained many urban parks "…. positions for 26,500 recreation leaders were made available through federal funds" (LaGasse and Cook, 1965).

From the 1930s until the 50s one of the important parks and recreation leaders was Robert Moses. He started to rebuild and added to the park system of the city with the help of a professional planning team who were working through the federal government's relief programs in New York. Many projects undertaken varied from small neighborhood playgrounds to major parkways (Chadwick, 1966). His plan started with rehabilitating the central parks, Landscaping was renewed and many other smaller, run-down older parks were redesigned and reconstructed. As mentioned in the 1940 report of the New York City Park Department: many of new parks and playgrounds were constructed ranged in size from small neighborhood areas to large developments which had variety in recreation facilities such as running tracks, football and baseball fields, stadiums and indoor activities inside buildings (Newton, 1971, p.634).

World War II affected the redevelopment movement and slowed down park fixing until the 1950s when new construction and repairing started again. The war influenced park development in different aspects; the economizing restraints of the war decreased the park budgets also a large percentage of the young male went to war declined the recreation contribution by this group in the cities they left. in addition to gas and tire shortages during the war led to limit the trips to recreation areas located outside the city, as a result, people preferred to go to parks and recreation facilities closer to home (LaGasse and Cook, 1965). During the depression of the war, parks helped to sustain the morals of people by keeping them busy. Park management arranged different events such as music concerts and art exhibitions.

Other features of this era were the multiple-use function. This influenced the design of the park itself; the paved areas with asphalt and surrounded by a wire fence to cover multiple functions, with little attention to the landscape. Also, the design of new parks was repeating the elements of the old ones regardless of site circumstances or residence

needs. Whether people who live in suburbs or city dwellers, the same design was received by both groups (Cranz, 1982, pp.122-123).

A new development the playgrounds went through within the 60s and 70s it contained free-form play sculptures of bright colors made of fiberglass or prefabricated concrete. The main idea was to provide dramatic and creative play devices for children (Cranz, 1982). To attract more people to municipal central parks, the park's management added more attractions elements such as children's zoos and children's rides.

In 1965 National Recreation and Park Association was formed as a result of the merging of five major national organizations to form a single unity nevertheless park departments and recreation departments were still separated agencies in some municipalities (Frye, 1980, p.42). The five merging organizations were all involved in the support of park and recreation services and included the National Recreation Association, American Institute of Park Executives, American Recreation Society, National Conference on State Parks, and the American Association of Zoological Parks and Aquariums. NRPA's aims to improve parks, support recreation, and environmental conservation efforts that promote the quality of life for all people (Flagler, 1985; National Recreation, 2012).

The open space era 1965 and after

In the mid of 1960s, inner-city parks were disordered, fenced, and had limited programs which led to some of them being unused thus, unsafe. For the sake of attracting people again, parks administrators adjusted many events and activities such as motocross, skateboarding, and a variety of physical fitness programs. Also, they allowed some popular activities that were prohibited before such as rock music and drinking beer (Cranz, 1982, p.141).

In this period, the term “open space” became common and used repeatedly. which meant that recreational space doesn’t bound in parks and recreation spaces, it included that many different types of outdoor spaces were designed for public use (Flagler, 1985).

Within this period land became expensive and the competition of it has been increased which caused the development of existing parks and open spaces particularly the Small parks and plazas. "Vest-pocket parks" were small and usually founded among buildings in the center of a city or residential neighborhoods. Their form usually has

the same theme, playground for children, and sitting areas for adults in some cases they include teenage social and athletic areas. The small parks or “mini-parks” founded to improve the downtown area of the city by adding attractive places which could use as "pleasant rest spots for [people] shopping downtown and for clerks and business people on lunch breaks" (Cranz, 1978, p.17). the small parks varied in levels and sizes. They included water features to attract people and to block the noise from the streets. Moreover, vertical trees used to provide shade in addition to, vegetation used to cover the ground. This type of park began to spread in the '60s and 70s and became popular in many metropolitan areas throughout the country.

Other types appeared strongly were urban open spaces around museums, hospitals, industrial and office parks. Besides, in some cities “urban cultural parks” appeared which aimed to preserve important historic areas for educational and recreational purposes. Streets, sidewalks, waterfronts, bikeways, and pedestrian spaces in shopping malls all considered as urban open spaces. The new urban open spaces were characterized to be an essential part of the city and its culture (Cranz, 1982).

In the late of the 19-century communities developed and managed open spaces in different fields. Families cultivated lands for vegetable gardens (Bassett, 1981). This idea was existing during world war I and II as a means of growing food. However, this period witnessed an expanded interest in open spaces with various kinds of projects in America and abroad. The inhabitants developed different community open spaces which were successful to be an alternative to the city park system. These projects differed from the city’s ones, they were fenced and locked, used recycled materials, and maintained by residents. The main aim was to provide a place for education, recreation, and social activities (Francis et al., 1984).

1.4.2.2 Urban parks in Europe

To understand the factors that led to the appearance of the public park movement in Europe, a thesis study made of landscape and open spaces circumstances in the early 19th century in the Western World particularly in England, Paris, and Continental countries.

Starting from Roman times and middle ages garden design considered as an art that appeared clearly in Louis XIV’s Versailles and England’s Kew Gardens. In France, the school of garden design was affected by the Renaissance in which man dominance

over nature, it was reflected in their geometric and grid system garden design. However, in England, the design was nearer to rural countryside and natural forms. During the 18th Century England, the rich and the nobility supported the "English Landscape Movement" (Hinds,1979).

In the 18th Century," park" meant a private land close to a gentleman's residence which was supported and planned by the English landscape school. The idea of an area designed to gather and enjoyed outside "public park" in a city was essentially a Victorian idea. Early parks have been created under unpleasant circumstances because of population growth and the industrial revolution in Britain's effect. However, the Victorian had the precedence of starting the landscaping and gardening which led to building the first public park in Britain. During the 18th century, the idea of entering green spaces houses had spread to transfer homes to more comfortable places, this movement "connection dwellings with nature" was influenced by Jacques Rousseau's writing of " natural man" (Giedion,1967).

At the end of the 18th century, the nobilities were interested in designing their estates or lands which designed as a "natural landscape". These estates were outside the city in the country and rural areas. Their importance came from that they represented a design concept in itself. The private estate played a significant role in park development; while these lands were used as hunting parks and wooded retreats by rich people, these areas became public parks in the 19th century. The Royal Parks of London is an example which gives the west of London its characteristic. some of the wealthy people were hiring a landscape designer to design their estates. One of the famous designers was Lancelot Brown who worked in a natural style. He was one of those who changed the classical garden forms in England to the natural landscape style. His works based on softened land formations. The landscape park he designed which called "Picturesque", the style of landscape gardening became accepted and popular in England. The design included: a belt of the trees that surrounded the park, wide grass meadows, and a lake. He usually created a continuous view of the grounds. Which showed a smoothness of natural forms and a gradual variation between lawn, shrubs, and trees (Hinds,1979).

During the 18th century, many great industrial cities came into existence like Britain by the expansion of industry and growth in population. The rapid increase of people and the change in lifestyle due to new industrial techniques and new ways of

organizing the work created a lot of pressure on people to deal with changing in new cities. The promoting and building public parks were in part, a reaction to the conditions and social concern in these cities and during the mid of 18th century, the British government began to consider public parks as an important tool to help in dealing with hard conditions. Moreover, bad health and sanitation standards became big problems that protest used to push on the government. By the 1830s many organizations created to deal with sanitary conditions, like the Health of Towns Association. Concurrently with the arguments which early supporters of public parks used that public parks and walks would enhance the general health of the city's dwellers (Briggs,1963).

The first involvement from the government was in 1833 when Parliament assigned a select Committee to study the conditions and availability of public open space in England and make a record of them. The appointment was very important to reorganize the increase in the population plus to deal with workers who were working in manufacturing and saw. Which pointed the need for the public parks and open spaces to the middle and lower classes. The Committee stated that these recreation spaces would increase productivity by enhancing the health of the workers (Olmsted,1973).

One of the first designers of public parks was Joseph Paxton. He worked in the north and midlands of England. He was not just a designer of parks and gardens but he contributed to the movement of designing gardens for the general public. Besides, He wrote two articles in 1831 about supporting public parks (Chadwick,1966).

The first park that Paxton designed was Prince's Park in Liver-pool. The Park area was a 900-acre landscape of which 50 acres form as central park, and the remaining area was a series of villas. The villas were separated and detached from their trees and plants. This kind of development was popular in Britain for public and private parks due to the high cost of building parks thus covered by the value of the revived housing sites within the area. Many parks built in this period with the same concept as Regent park and Birkenhead. The Birkenhead public park (1847) gained its importance from its utility by adding active and "recreation "facilities within the park-like games. In 1850, Frederick Law Olmsted, the "Father of landscape architecture in North America" visited Birkenhead Park. He was very impressed by the design of the park and he worked and redeveloped some ideas which used on a large scale, in the creation of Central Park in New York (Olmsted,1852).

The parks of Paris

The industrial revolution occurred a half-century later than it started in England. Paris was still in the late Baroque city while England was affected by the new industrial cities. After a while, Paris became a much more modern city compared with England. The parks built in Paris considered as a part of a city environment not for recreation to unpleasant circumstances or a place to escape. To re-plan and organize Paris, Napoleon III hired George Haussmann in 1853 to transform Paris into an efficient city with a green environment. In a short time, Paris became a “City of Lights” where people where spreading in sidewalks, cafes, and public parks. In 1851 Paris had only 47 acres of public parks within 19 years the areas had expanded to 4500 acres. Haussmann created new parks and redesigned the old ones. Moreover, he connected the parks and the open spaces by great planted Boulevards (French, 1973).

The French landscape garden followed the development of the English garden in the first half of the 19th century like the influencing of Picturesque garden style. However, the French design of parks was partly different comparing with England’s parks. The French put more paved areas in their designs which minimized the lawn areas due to climate conditions. Furthermore, the French's conception of rest was significant thus, developing a system of walks and rides was necessary. In England, formal public walks were giving an impression to more games and less formal places which were the opposite in France.

One of the public park traditions the North Americans influenced by French parks was the use of complex flower designs to write or display messages and this tradition still used in many parks until now. Haussmann achieved three essential accomplishments in the organizations of Paris: the communication system; a park system; and a managerial organization that allowed the changes to be carried out in Paris within 15 years. The park system was the first system in the Western World which was unique with its accessibility to most social sectors (French, 1973). The French parks weren’t a place to escape instead they were a continuation of the city. In France, people didn’t suffer from suburbanization and decentralization that the British and North Americans had. Which allowed them to evolve a new and unique type of park system, which was in harmony with the urban fabric in Paris.

In the Continental countries, the opening of royal parks and public gardens were in the late 1700s and early 1800s. but the forms and designs were old until well after the British and French experience (Chadwick,1966).

The first changes that led to the pocket park appearance occurred in the early nineties when the urban planner architect Jean Pierre Charbonneau was mandated by the city of Lyon as an adviser for the design program called Grand Lyon. Charbonneau came up with an inventory of open space after an accurate analysis of Lyon city. The open spaces included streets, squares, plazas, etc. That considered important functions, But at the same time, other areas were part of another classification, as less important with small size. They were defined as "dormant spaces", which was similar to the pocket park concept. The plan included 25 pocket parks located through a program that produced a different way of getting around the city. People enjoyed using pocket parks as they can stop and take a break during the day and taking a breathe before continue their path. Pocket parks are small open spaces, their main function is to share intimacy with the social, where the social aspect is the essential point of the project as described as "living-room" in the open air (Armato, 2017).

1.4.3 Pocket parks

1.4.3.1 Pocket park definition

Pockets are something small we use to keep our hands warm and safe. Hajime (1988) defines pocket parks as a ‘hand-made warm space’ where people can relieve far from homes and work like an oasis in the middle of a city. There are many definitions founded for the pocket park also known as mini-parks or vest-pocket parks (Peschardt, 2014). According to National Recreation and Park Association (2012), A pocket park or vest pocket park as called firstly in the 1960s is a small urban space, usually, no more than a quarter of an acre (1011.7 sqm), surrounded by houses or buildings. It is usually located in commercial or residential areas. It provides many functions for the surrounded community; a small urban space for entertaining, gathering and socializing, an event area, and peaceful space for the surrounded society residents.

Another definition of Pocket park may find; it’s an urban space usually located between buildings in the city center or residential neighborhoods. They have different designed types and activities, such as the playground area, simple sports equipment, and sitting areas (Flagler, 1985). Earlier, particularly in the 60s and 70s, they considered as a "pleasant rest spots for [people] shopping downtown and for clerks and business people on lunch breaks" (Cranz, 1978, p.17). A pocket park is a term that can definite as “parks in densely built locations occupying interstitial space between buildings and bounded by sidewalks and walls of existing buildings" (Goldsteen, 1994, p. 12).

1.4.3.2 Pocket parks emergence

There are many theories tackled the appearance of pocket parks. In this section, the emerging of the pocket park will be explained to understand the circumstances that accompanied the appearance of the pocket parks.

Marcus mentioned in his book design guidelines for urban open space (1997), that small neighborhood parks started in America particularly in Philadelphia in the early 1960s where a group of students from the University of Pennsylvania carried out the responsibility of inventorying the trash-ridden which founded in vacant gardens and backyards. From this starting the program called Neighborhood Commons began to

give hand for low-income citizens to restore their gardens, sitting, and play areas where the land that would be owned used and monitored by the locals (Linn, 1968). The efforts done by Neighborhood Commons were growing up after the first step in demolishing the site near the school. The municipal agencies in Philadelphia started to build vest-pocket or mini-parks and other cities followed that too.

The early miniparks were limited across the country and without serious evaluation (Clay and Nanine 1971, 1972). Although the most approved on the size of the miniparks -somewhere among one and four house lots- there was some confusion about the aim of them; Are they small size from of neighborhood parks? Are they seating plaza for the elderly, playground, green area in dense districts, or little something from each? A little clarifying information appeared about their design in the professional literature. A significant conference held in 1969 about Urban open Space sponsored by the American Society of Landscape architects Foundations. From this workshop, the first booklet and several articles published directed to the users, city department personal, and the funders about how complicated the work was and to explain the idea (ASLA, 1969). As mentioned in the Architectural Forum article (1972): many playgrounds and mini-parks have been built due to the existence of vacant areas. “Demolished buildings, riots, fires even private owners who don't want to cut their weeds, have caused in some cities a building boom in mini-parks more to tidy up the neighborhood than fit a daily need of either children or adults”. Building the small parks was evidence for “city hall” to prove they are doing something to the community while the delay in other difficult issues such as housing (Clay and Nanine,1972, p.36).

In the big cities such as New York and Philadelphia a mini-park relative to small space with twenty feet (approximately 6 meters) in width. However, in Texas, one small park comes out to be 3 acres (12141 square meters). In general, the size of the pocket parks is one to three lots. The popular Paley park in New York cost millions of dollars due to private funds on high-rent commercial land. On the contrary, it would cost a few hundred dollars if built with volunteer effort and used materials on rented land. Generally, pocket parks varied in size in midwestern and western U.S cities compared with the East Coast due to large lots in less dense cities also due to undeveloped existed land (Marcus et al., 1997).

The design of small parks usually included all or sometimes parts of the following elements:

- Vegetation area and trees,
- Sitting area for adults,
- Playground for children,
- Identifying logo for the park, like name, wall painting or color scheme, etc.
- Basketball nets.
- In some cases, the area is large to accommodate playing group games. Some vest-park faced a problem to survive in the cities due to the great value of land for other uses. in that time the neighborhood organizations aimed to build small parks in rented land in low-income neighborhoods. As Lisa Cashadan observed in 1982 that New York City has about 3000 acres of vacant land. So, according to her rather than using these lands in selling property that has low economic value as open space. It is better to rent or sell some of these vacant areas as open spaces to the community groups (Cashadan et al., 1983).

According to the American Society of Planning, Officials report “No.299” (1967), the emerging of pocket parks occurred in these circumstances.

The idea of the pocket park started originally in Europe after the Second World War, then it was transferred to the United States in the 1950s. After the war, Europe suffered from labor, capital, and materials to rebuild the cities and the need for shortcuts was essential to return the cities to normal peace-time life. some of the outdoor small areas which destroyed due to early bombing could be converted to small parks with a minimum of expense but with a lot of creativity. These small parks achieved a great success than had been anticipated, and the idea was developed and applied on a larger scale in later years.

In the United States, Professor Linn (1968) was responsible to adapt the mini-park idea that originated from the European experience to North American cities. He tried to convince city authorities in Baltimore, Washington, and Philadelphia to create "neighborhood commons" for recreational purposes in tax-delinquent land. This idea was accepted because of the need for creating recreation areas like public parks in

crowded populated areas but at the same time, the cost to build parks encounter the traditional standards were hard to cover from the resources allocated for recreation.

The vest-pocket park can be developed in a small amount of cost estimated to be around $3.50 per square foot (0.10 square meters) including land. Also, if the land was to the city, the cost would be less. The cost was not only the concern to create the small parks, but the belief that parks must be large was a problem too. In urban city settings, the success of the parks doesn't limit only in their facilities but the success measured in terms of accessibility. The spread of small parks among a neighborhood is more accessible than a large park even with facilities. Even if large parks have more facilities and services, they are separated from users due to the distance and the need for transportation. Furthermore, neighborhood dwellers especially children, build a sense of identity and attachment to the near area. Besides, from the residents' perspective, the surroundings are familiar, and the social network is strong. which made the smaller parks is better to achieve the resident's needs (Faraci, 1967).

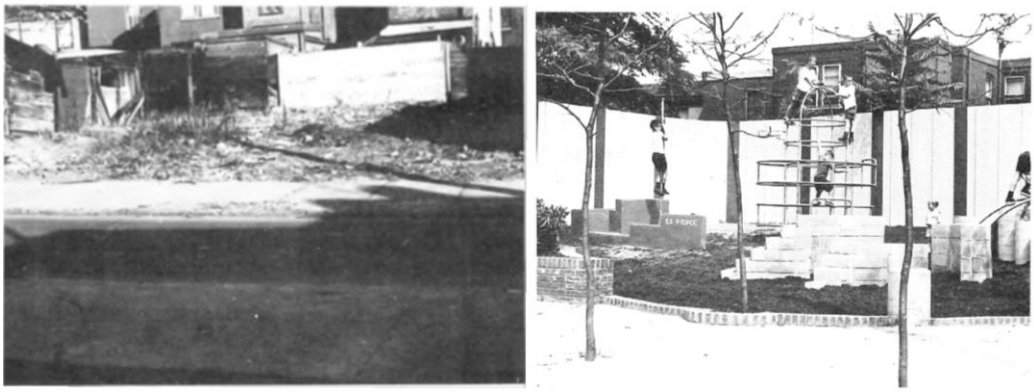

Figure 1.2: A vacant lot in Philadelphia had been converted to an attractive small play area for children (Faraci, 1967).

2. POCKET PARKS GUIDELINES AND STANDARDS

The first phase determining the design parameters and general standards of the pocket park. For that purpose, Marcus's book design guidelines for urban open space has been used as a general guide of design parameters, standards, and design guidelines of the pocket park to draw the general framework. Then, the updated standards and design guidelines were collected in global scope; Hongkong, U.S.A. (various states), England, Australia, and Canada.

In this chapter, each design parameter of the pocket park was mentioned including the previous standards statements. After that, local and global built pocket parks have been analyzed to build a set of data of guidelines that will be used in the study in the next phases.

The global selected guidelines are:

The design guideline for Public Open Spaces in Private Development (POSPD) issued by the Development Bureau, 2014.

> POSPD are privately owned and managed open spaces that are open to the public. The principles of the guidelines are the same as the government planers followed when designing public urban parks in Hong Kong. Consequently, all small public urban open spaces (SPUOS) in Hong Kong are designed according to this guideline (Lau, 2014).

Parks and Open Space Plan May Draft, Seattle Park, and Recreation (2017).

> It is a six-year plan that describes Seattle park and recreation's (SPR) facilities and parks. The plan based on the demographics changing and considering the future. The Parks and Open Space Plan is required by the Washington State Recreation and Conservation Office to preserve the state grants and funding programs in the City of Seattle that will help in developing outdoor recreation and creating new open space projects. Also, the plan has importance in

addressing the future needs of the community and achieve the state mission. For the purpose of developing the plan based on previous plans, the 2017 Parks and Open Space Plan works together with and is informed by other planning documents, including Seattle 2035 – the City of Seattle's Comprehensive Plan, 2014 Parks Legacy Plan, the 2016 Seattle Recreation Demand Study, the 2015 Community Center Strategic Plan and other city plans.

The Essex Design Guide, Design Details Landscape and Greenspaces V.1, England, 2018.

This study aims to clarify the importance of landscape and its role in our life plus it shows how to achieve the benefits of the landscape through good design. Green spaces improve quality of life, provide recreational benefits, and help to achieve social cohesion. The main key requirements in designing open spaces are; the design should encourage different activities for all genders, ages, cultures, and people who have physical and mental abilities. Furthermore, the open space should be connected in a coherent network. Plus, the design should be flexible to allow changes in their use over time and to support the needs of residents.

The Montgomery County Department of Parks, the Maryland-National Capital Park and Planning Commission: Designing Public Spaces Energized Public Spaces Design Guidelines, 2018.

The guidelines are based on current conditions analysis, stakeholder input, and best existing practices in public space design inside and outside the state. It helps the designers to link between plan recommendations and zoning code requirements, and the overall context for the various types of spaces within an integrated system of public spaces. Design guidelines have taken the approval from the Montgomery County Planning Board for use by public associations and developers in creating design proposals, and planners and the Board in reviewing them.

Local Parks Program Guidelines, Victoria government (Metropolitan Melbourne, Australia), 2019.

The program aims to create new parks and reactivate the existing local ones to provide more green spaces and green suburbs in built-up urban areas of

Metropolitan Melbourne. The program with a $35 million budget aims to design 25 new pocket parks across Metropolitan Melbourne. This investment is part of the Victorian Government's commitment to building a new parkland in growing suburbs and is supervised by the new Metropolitan Open Space Strategy principles under Plan Melbourne, the Victorian Government's long-term vision for the city in 2050. The mentioned guidelines have been used in planning for the new pocket parks, Richmond Terrace pocket park in Yarra city is an example.

Parks, Recreation and recreation facilities element, City of Thornton, 2017.

The guidelines examine existing and future needs for parks, and recreation facilities, and also recommendations design standards. The design standards should be used when parkland is acquired to decide is it suitable or not based on terrain, natural features, and location, also the standards should be used when designing for new parks and in the redevelopment and enhancement to existing parks.

Standards help establish coherence in the design and designing facilities, and ensuring accessible, barrier-free play and recreation opportunities, which as a result contribute to achieving a positive community image. Additional design standards are provided within the city of Thornton's "Standards and Specifications for the Design and Construction of Public Improvements."

Edmonton's Urban Parks Management Plan, Canada, 2006-2016.

The City of Edmonton's Urban Parks Management Plan: 2006-2016 provides strategic direction for the acquisition, design, building, maintenance, preservation, and use of parks. The plan lasts for ten years and directs the community, City, and land planners, which will guide park decision-making in the future. The main goal of this plan is to enhance park management commands like guidelines, standards, etc. which support the vision and achieve coherence in the implementation phase.

Abd El Aziz's article, 2017.

The article aims to provide a successful pocket park design that meets the users' vision and needs. thus, many aspects are involved, such as the location of the park, the relation between the park and other recreational facilities the

accessibility and flexibility of the design. To achieve this goal, a common design criteria has been collected based on researches, case studies, and several lecturer reviews that concerned in pocket park design. The mentioned references that the article based on are:

- Copenhagen - Pocket Parks, A Drop of Urban Green (Danish Architecture Centre, 2015).
- Pocket Park Research: Small Public Urban Green Spaces, In Copenhagen (Triman, 2012).
- Increasing Urban Open Space Through Pocket Parks (Leflore, 2012).
- The Possibility of Converting Available Spaces into Pocket Parks in Urban Settlements in Indonesia (Shirley, 2013).
- Corporate Report. Surrey City, Canada (Lamontagne and Cavan, 2008).
- National Recreation and Park Association, 2012.
- Recreating a Successful Neighborhood Pocket Park -A Proposal for Mandeville Court Park (Smith, 2005).
- Parameters Contributing to The Design of a Successful Urban Pocket Park (Sinou and Kenton, 2013).

2.1 Pocket Parks Design Parameters

In 1914 a landscape architect for the New York State Department of Parks, Charles Dowing Lay, suggested a system of parks for a city with 100,000 people. The system included a series of parks that differ in size and function. After years, many standards about pocket parks have been developed and became generally accepted. This was among the efforts of many organizations such as the National Recreation Association. The standards were related to the size, location about the area served, activities appropriate for each park, suited equipment and facilities required, and other design parameters (Illinois,1965).

In this section, the main design parameters that have found on Marcus's book design guidelines would be mentioned, and in front of each parameter, the related standards if exist- from the guidelines would be mentioned.

The size

The basic characteristic of vest-pocket parks that they are small in size, smaller than the one-to three-acre minimum (1214.06 square meters). Which is pointed as the smallest unit in the park system. The actual size of the mini-park is determined by land availability in the area. The average size of a vest pocket park is around the equivalent of three lots. The maximum size proposed is no more than four vacant lots. This size limitation is considered desirable since larger parks are more difficult to maintain (Faraci, 1967).

According to Marcus's book design guidelines for urban open space (1997).

The name mini-park is relative: in the big cities like New York and Philadelphia, a mini-park maybe only 20 feet wide (6 meters). In Texas, one mini-park would be three acres (12141 sqm). But usually, they are one to three lots in size.

According to the Development Bureau standards (2014).

There is no mention of the maximum area of the pocket park; "The size is 100 sqm in the minimum".

According to Seattle Parks and Recreation standards (2017).

The maximum area is 1012 sqm; "The size is generally under 0.25 acre".

According to The Essex Design Guide standards (2018).

There is no specific size or area mentioned; "It can be very small spaces knitted into the built fabric of a town".

According to the Maryland-National Capital Park and Planning Commission standards (2018).

The size of a pocket park is about 405 – 1012 sqm; "1/10 - 1/4-acre average size"**.**

According to Local Parks Program Guidelines, Victoria government standards (2019).

"up to 0.2 hectares or 2000 square meters in size". The maximum area is 2000 sqm.

According to Parks, Recreation and recreation facilities element, City of Thornton standards (2017).

The size of a pocket park is ranging from 1012 to 20234 sqm; “Acreage from ¼ to 5 acres”.

According to Edmonton’s Urban Parks Management Plan standards (2016).

The area is 5000 sqm; “Pocket Parks are small, 0.5 hectares”.

According to Abd El Aziz article (2017).

The size of the pocket park should not exceed 5000 sqm; “Must not exceed 5000 m2”

<u>The site selection and placement</u>

According to Marcus’s book design guidelines for urban open space (1997).

A minipark should be located so that users from a four-block radius can reach it by walking and without crossing a major street. The location of minipark is important because it determined the type of users and the time of use and activities (Figure 2.1). For example, if a park sited near a post office it would be a meeting place for neighbors, and if near firms or factories it may become a lunch break place.

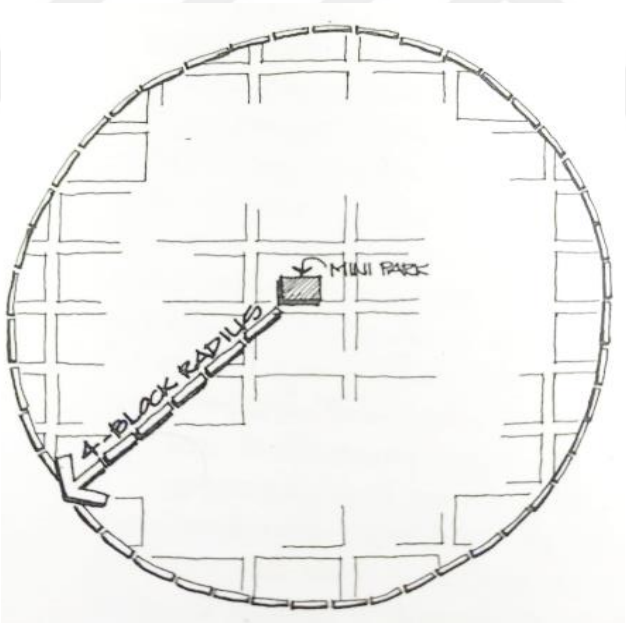

Figure 2.1: Most of the users will come from a 1-2 block radius, few will walk more than 4 blocks (Marcus,1997).

“sites not within walking distance of potential users may be suitable for specialized use”; a park with special facilities not found nearby attracts users from larger areas as neighborhoods too. such as tennis court or rented garden areas. For example, in San Francisco the Seward Street minipark, there is a double, very long concrete slide which

very steep lot. They are attracting children and their families from a far distance in the city as well as from surroundings (Figure 2.2).

Figure 2.2: The double slides in Seward Street minipark (Url-1).

The site topography playing a role in determining the activities that may the park include. A site with mature trees and varied topography seems larger and can include walking, sunning, and picnicking activities. A hilly site has potentials for amphitheater or earth slide. A flat empty site is suitable for paved walking which suits elderly, disabled people, children with bikes, and parents pushing a baby stroller. If a site couldn't be designed to suit their neighborhood, it wouldn't be minipark at all.

The designer of mini-parks should consider the weather conditions in his designs. A park that provides sheltered areas to protect from the sun is attracting more users than open ones. Parents prefer to sit in convenient areas in summer and winter and watch their children playing.

According to the Development Bureau standards (2014).

- The radius of attraction "it attracts passers-by or users of the immediate neighborhood."
- For the topography: "it preferably to be on flat land."
- About the site location: "There should be more than one street frontage of the open spaces and they are expected to have a similar wide of the open space."

According to Seattle Parks and Recreation standards (2017).

“Pocket parks can be in all zones and surrounded by residences, small commercial, non-arterial streets, or on unused land between roads.”

The radius of attraction for mini-parks should cover a maximum of 402 meters; “The Geographic range of users is the immediate neighborhood – less than ¼ mile in distance.”

According to The Essex Design Guide standards (2018).

The site should be “accessible and worth visiting for all members of the community.”

According to the Maryland-National Capital Park and Planning Commission standards (2018).

- The site placement should consider the following: “maximize sun exposure in locations in between tall buildings and “provide connectivity to other public spaces and transit.”
- Also, it serves the residents and workers from adjacent areas; “serves neighborhood/district and connected to public spaces network and to be a local destination.”
- “This park type will serve residents, workers, and visitors from the nearby blocks.”

According to Local Parks Program Guidelines, Victoria government standards (2019).

The site placement should be in a built-up area underused open space, or in a site where it is appropriate for allocating. Moreover, it would be in the sites which need such parks plus in previously planned sites;

- “underutilized open space, or suitable for repurposing”
- “ideally already identified in an approved open space, precinct structure or recreation plan that has undergone community engagement, and demonstrates a need (i.e. lack of open space in the area). “

According to Parks, Recreation and recreation facilities element, City of Thornton standards (2017).

The service area should be a 402-meter radius to serve 2023 sqm per 1,000 population. Also, it has to have access to neighborhoods;

- “Service Area: ¼ mile radius, Level of Service 0.5 acres per 1,000 population”
- Pocket parks should be located in each new subdivision if not covered by the 402-805 meter service radius from an existing or planned neighborhood park, or when a main arterial or other barriers that prevent users to reach the park;
- “shall be constructed in each new subdivision unless covered by the ¼ to ½ mile service radius from an existing or proposed neighborhood park, or when a major arterial or some other barrier compromises access to a neighborhood park”

According to Edmonton’s Urban Parks Management Plan standards (2016).

The service area of pocket parks as mentioned in the standards is: “parks that are intended to ensure residents have a park opportunity within 0.5 kilometers or a 10-minute walk from their home.”

The population that cover: “A single Pocket Park serves 2,250 people”

The location of the pocket park should consider the following points:

- “Pocket Parks are typically located on local roads or are stopovers along a greenway or trail.”
- “They are intended for short-term, unstructured recreation and may be utilized at any time by nearby residents or by cyclists, rollerblades, walkers or joggers passing through the neighborhood.”
- “Pocket Parks are located on a local or collector roadway.”
- “A Pocket Park’s perimeter must have roadway frontage on a minimum of one side so that safety issues related to configuration of park sites can be addressed.”

According to Abd El Aziz article (2017).

Many considerations should be taken in in the location of the pocket parks;

- “Parks should serve a resident population of approximately 500-1000 persons.”
- “Pocket park is 5 to 10 minutes’ walk from target users.”
- “Place the park in front of active rooms in adjacent buildings.”

- “Use vacant land, on small, irregular pieces of land, forgotten and unused spaces.”
- “Use non-traditional locations: rooftops, building facades, or foyers.”

Location Types

According to Marcus’s book design guidelines for urban open space (1997).

There are three basic locations for urban mini-parks: corner lots, mid-block lots, or through -the-block lots (Figure 2.3). The site design in corner lots should benefit from its exposure to passes by on two of its four sides. This can be achieved by:

- Several access points and especially a pathway that makes the park used as a shortcut across the corner.
- A fence or boundaries design with a sitting area like benches that allows passerby pedestrians to sit and take a rest facing the street.
- Add plants and trees to give a green experience for vehicle drivers.

A mid-block lot has many advantages and disadvantages. The disadvantages are: the location of the entrance onto the street that is only one house lot wide can be easily passed by without noticing the existence of a park. In some cases, in a mid-block location, there is only one entrance. Besides, a site that is about 2.5 to 4 times as long as it wide gives a comfortable feel, while one that is about 5 or 6 times as long as it is wide can feel very uncomfortable (Marcus, 1975).

On the other hand, the advantages of this location are: The calm place can be designed for elderly people and more protected from traffic and cars if it designed for children. Moreover, the park can be protected from the wind**.**

The through-the-block lot location has many advantages, it connects two streets and two neighborhood and allows children and adults to walk directly among home and school, or shops. The disadvantages are that it may become a throughway for speeding bikes**.**

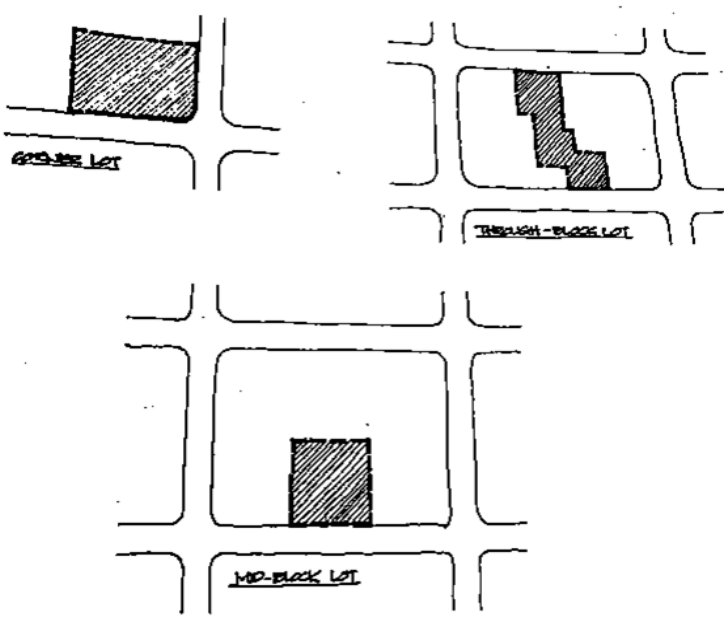

Figure 2.3: Three typical minipark locations (Marcus, 1997).

<u>Design Program</u>

According to Marcus's book design guidelines for urban open space (1997).

To determine the program of a mini-park it is important to analyze the area within a four-block radius around the site. Studies have found that almost the users of mini-parks come by walking (Bangs and Mahler 1971; Gold 1972; Mason, Forrester, and Hermann 1975).

Specified the users of the surrounding area is essential because of the design based on the type of the residents; children, teenagers, adults, or elderly. After the group of users stated, the designers should point priorities of use to reduce possible collisions among the users. For example, if the area is very small and close to residence the design might eliminate noisy activities such as basketball. If the teenagers are known to be groups in the area, it might be more suitable to provide their activities in a neighborhood park instead of a mini-park due to their fast movement comparing with children and the elderly. But if a mini-park located in a corner near traffic noise and/or non-residential surroundings it might be specified for teenage activities like football or basketball.

The older people feel comfortable near preschool children and their parents. If a sitting area for the elderly needed, a good choice of the seating area is to be near the entrance with a view to or out of the park. And to be far from active areas as possible.

According to Seattle Parks and Recreation standards (2017).

There is no desired program but "The optional program includes small community gatherings."

According to The Essex Design Guide standards (2018).

The main program is sitting and socializing; "Park should include sitting and socializing area, they can be particularly important for the aging population and those with dementia."

For the optional program:

- "The park may include public art installations, smart infrastructure, and digital technology"
- "Such small-scale spaces often offer the greatest opportunity to integrate smart infrastructure and digital technology …. Examples for this, recycling or waste management points, open-access wi-fi networks."

According to the Maryland-National Capital Park and Planning Commission standards (2018).

The program includes: "contemplative areas supported by social gatherings and active recreation in smaller scale flexible program". Moreover," a place for quiet contemplation, unstructured recreation, contact with nature."

According to Local Parks Program Guidelines, Victoria government standards (2019).

The program is mainly about: "provide recreation and socializing opportunities in a green space"

According to Parks, Recreation and recreation facilities element, City of Thornton standards (2017).

Pocket parks provide playgrounds and gathering areas for the surrounding neighborhood especially when there is no near neighborhood park;

"Pocket parks can serve the needs of surrounding neighborhood residents for playgrounds and informal gathering spaces when a neighborhood park is not available."

According to Edmonton's Urban Parks Management Plan standards (2016).

The main program includes unstructured passive and active recreation spaces, social gathering spaces and community garden;

- "A small park to accommodate passive recreation activities (e.g., reading, birdwatching, talking, etc.) and unstructured active recreation activities (e.g., frisbee, catch, etc.). "
- "Social gathering spaces"
- "Community garden"

And there is some prohibited development:

"sports fields and sports fixtures, community halls, recreation facilities of any kind, parking, permanent washrooms, outdoor ice hockey rinks, or basketball /tennis courts.

According to Abd El Aziz article (2017).

The design program for the pocket park is about designing a space which provides the following:

- "Welcoming and appealing design to a diversity of users/ offers variety and choice"
- "Adaptable / comfortable spaces."
- "Provide space for mental improvement, and relaxing."
- "Add activities that will activate the park at all times."
- "Defined identity and represent local communities."
- "Spaces should provide sufficient sunlight and ventilation."
- "Ensure clear sightlines across the entire site."

<u>Boundaries</u>

According to Marcus's book design guidelines for urban open space (1997).

Because of the unavoidable closeness of the public to the private territory, the boundaries of a mini-park should be clearly defined. The neighborhood park usually designs to be two or more of its boundaries are clearly defined by adjacent streets.

However, mini-parks are very small in size so two, and often three sides are usually bounded by adjacent residential buildings.

“Because an inherent characteristic of a mini-park is its very small size, every square foot should be used to advantage “. In some case plants or “keep-off” ground cover could be used to separate spaces or for the places where people should not go. For example, there might be a border of shrubs between active areas of the parks and adjacent residential lots.

The vertical planes of adjacent buildings should be creatively covered as possible. A mini-park at 24th Bryant in San Francisco has nice wall painting on three sides of its mid-block lot, it adds colors to space instead of white concrete (Figure 2.4).

Figure 2.4: A colored side in a mini-park at 24th Bryant (Url-2).

Park’s street boundary is also a significant issue to think about. A low, attractive fence and may add a gate along the street side to direct the pedestrian movement along pathways and to keep children inside the park.

According to Parks, Recreation and recreation facilities element, City of Thornton standards (2017).

Mini-park boundaries requirement is: “3-rail fence when adjacent to residential lots”.

According to Abd El Aziz article (2017).

The mentioned requirements about boundaries and edges are:

- “Defined edges and a focal point.”

- “Easy and equitable access with multiple points of entry /No barriers between the street and the park.”

Play Areas

Pocket parks are best designed for use by the least-mobile users. This includes pre-school children who, for the reason of safety, should not be desired to travel long distances to reach play areas and for the elderly residents.

Play equipment, thus, is selected to meet the needs of these two groups and for older children who need larger areas and activities than can be provided in these small parks.

Generally, small parks seem to function best with as little equipment as possible. Play structures need a large space which can be hard to provide it in vest-pocket parks. It has been found, that children often create games that do not certainly follow the restrictions imposed by the facilities provided.

The concept of the "adventure playground" has been suggested as an alternative approach, which meets children's needs reasonably. The idea emerged in Europe during the German occupation of Denmark by Professor T. Sorenson, architect and designer of many large parks in Denmark. He noticed while observing children play that they preferred rubble-filled lots and construction sites to the developed parks although if they were available and easily accessible.

He interpreted that to the opportunity to experiment with different materials, the children were feeling free to build and destroy in a permissive atmosphere which going more with their energies and their imagination than the limited environment of elaborate parks (Allen,1964)

After years, the idea transferred and applied in many countries like Switzerland, Sweden, and England. In the United States "The Yard" in Minneapolis is holding the same concept. Many cities applied the idea with varying degrees of success.

The significant point of the "adventure playground” is the safety; The equipment for these playgrounds is easily available and cheap since it consists mostly of discarded materials, but it is not necessarily safe. therefore, children need to be supervised by qualified adults while they playing. However, the equipment can be designed to be suitable for children. it can be made from secure materials such as wood and rubber.

If there is a need for watching in the vest pocket parks. The main aim of these parks minimum spending and maximum involvement of residents, volunteers can be used for this purpose. Parents, youth, or elderly citizens ready to donate their time can be organized to achieve the supervision required (Faraci, 1967).

Figure 2.5: The adventure playground in Canada (left) and in Central Park in New York (Right) 1974 (Url-3; Url-4).

According to Marcus's book design guidelines for urban open space (1997).

Because most users for a mini-park is from children and teenagers, the location and the design of play areas must be considered well. For large mini-park (Four to six house lots in size) play areas for preschool and older children are usually separated. But for a small mini-park, the best option is to have one divide combined play area with equipment. Therefore, the areas could be separated vertically for older and younger children.

If the park design can have just one play area it's better to locate it toward the back of the park. That will achieve safety from traffic for young children, privacy for older children, and privacy for old people who use the entrance area to sit. but it's important to take into consideration when the park is too deep or in L shape this area may be used for illegal activities.

A play area designed for mixed-use ages should have the following conditions:

- Scaled-down play equipment like slides, swings, or climbing blocks, it's important for 3 years and above.
- Sand under and around the play equipment to provide a safety step and a play material for young children. A water fountain may be added to let children make clay. Also, the sand area should be in the sun to dry quickly after rain.

- Benches around the play area in different locations to be used from adults to supervise.
- Grass for rolling on should be planted on a little slope.

After many observations applied to different mini-parks, there has been found that there is a relationship between the diversity of play equipment and the park's use. For example, in San Francisco in one mini-park it just has a square sandbox and nothing else for children, the park used rarely.

According to Seattle Parks and Recreation standards (2017).

It just mentioned that the play area is an optional program for the mini-park.

"Assets (optional): play area."

According to The Essex Design Guide standards (2018).

The only thing that the standard mentions about play area that the mini-parks are too small for ball games; These kind of parks "are usually too small for ball games".

According to the Maryland-National Capital Park and Planning Commission standards (2018).

There are no details about play area in the pocket park; "small play areas or game area".

According to Parks, Recreation and recreation facilities element, City of Thornton standards (2017).

The play area details as mentioned in the standards:

- "The ages 5 to 12 with accommodations for 2 to 5 years with multiple elevated and ground level, upper body, spinners"
- "Swings (4 minimum)."
- "Slides (2 minimum - 1 slide must be 8' in height) ", 8' equals 2.4 meter
- "Climbing play components with overall shade."

According to the site conditions, the playfield could be (77.7x 91.4) meters and sport court is preferred but with no softball/baseball fields;

- "Open Play Area: Preferred. 225' x 300' playfield, site-specific."

- “Softball/Baseball Fields: No.

According to Edmonton’s Urban Parks Management Plan standards (2016).

The only type of playing area that mentioned is a tot-lot playground;

- “Tot-lot playground (requires Maintenance Agreement)”
- On the other hand, the outdoor ice hockey rinks, basketball courts, or multiple tennis courts are prohibited in small parks; “mentioned previously”.

According to Abd El Aziz article (2017).

The types of play areas that mentioned are courts, small playground, and in some cases provide a space for learning through playing;

- “Provide spaces for physical fitness as basketball courts/tot-lots / climbing structures.”
- “Add educational spaces as children can gain a better understanding of and appreciation for nature.”

<u>Site Furniture</u>

According to Marcus’s book design guidelines for urban open space (1997).

Site furniture should be designed or brought according to users of the park. For example, a seating area suitable for adults doesn’t mean it’s suitable for children. An example from mini-park (Anza and 7th) a low wooden panels footrest in front of the benches can be used also as kids' seats.

- A drinking fountain may be added to the design by taking into consideration the young children; a step for them or another lower fountain (Figure 2.6). Also, it is preferable to be next to the sand area with a spigot.

Figure 2.6: Drinking fountains positions (Marcus,1997).

- Lighting element could be a good addition to the pocket park, it would be useful in the followings:
  - The park would be used for a longer time especially in summer.
  - It would become a safe place to walk and hang out in the evenings and at night.

However, in the limited budget cases; play equipment, benches, and a water fountain have the priority -unless in high crime areas- then lighting elements come.

- Litter cans are important especially in front of the activity area and the entrance of the park.
- Provide mixed-use tables and benches. There are two cases in which picnic tables are highly utilized: in an average density residential neighborhood where some families don't have a personal open space. The other case when the park near to high school where students can go to the park at lunchtime, they will use it for playing games, eating and hanging out.
- If possible, toilets should be provided in a pocket park, especially for children's use. But due to heavily constructed toilets, they are almost eliminated from the program.

According to the Development Bureau standards (2014).

The amenities that the pocket park should have are seating area elements, weatherproof covers, and lighting elements;

- "weather protections and places for casual gatherings. Therefore, canopies and seating are two major facilities".
- "Different types of seats such as chairs, benches, wall seats, and planter ledges will be installed based on the overall design".
- "Appropriate lighting should also be provided if possible".

According to Seattle Parks and Recreation standards (2017).

The desired and optional site furniture as mentioned in the standards;

- "Assets (desired – size dependent): Benches".
- "Assets (optional): Lighting for safety (rare), Picnic table".

According to The Essex Design Guide standards (2018).

The desired site furniture that the park should include is sitting area elements;

- "provide places for sitting and socializing".
- For the optional ones, the park may include public art installations and smart infrastructure; "mentioned previously ".

According to the Maryland-National Capital Park and Planning Commission standards (2018).

The main site furniture is the seating areas and weather protection;

- "Sunlit small gathering areas with a mix of shade and sunny seating".
- "They can provide areas to eat".

According to Local Parks Program Guidelines, Victoria government standards (2019).

The amenities in the pocket park are seating elements, lighting, and water features;

"already supported by or in proximity to services/amenities e.g. seating, lighting, toilets, access to water and shading."

According to Parks, Recreation and recreation facilities element, City of Thornton standards (2017).

The site furniture includes as mentioned in the standard;

- "picnic tables (2 minimum), benches (2 minimum), trash receptacles (4 minimum for parks greater than 2 acres" equals 8094 sqm
- ".... dogs waste stations, bike racks and LED lighting with steel poles at playgrounds and along trails".
- There is no need for water features; "Water Features: No"

According to Edmonton's Urban Parks Management Plan standards (2016).

The desired site furniture according to the standards is: "Social gathering spaces (e.g., plazas, picnic tables, etc.), bicycle parking/racks, sliding hill, Gazebo or shade structures, lighting, and social skating/snowbank rink."

According to Abd El Aziz article (2017).

The desired site furniture as mentioned in the standards:

- "Add water features, gazebos, individual seating, benches, drinking fountains, bicycle racks, trash receptacles, heat lamps, etc."
- "Use previous surfaces, bio-filter landscaping beds, high-efficiency lighting (LED), and solar-powered amenities."
- "Provide weather protection."
- "Provide opportunities for public art. "

Functional Areas

According to Marcus's book design guidelines for urban open space (1997).

- "User spaces should take priority over visual spaces ". Because a mini-park is small so, every square meter should be designed carefully. The areas that have an aesthetic impact should always have a dual purpose. For example, trees that provide shaded area, grass area that also can be used for sunbathing. Park designs should be varied and detailed plus users should be able to see all the activities and facilities that the park has from the entrance.
- Children prefer a varied and interesting environment. They prefer to move from activity to another and variety in choices as they scarcely, involved in the same activity for a long time. Besides, they like to discover nature around them like rocks, trees, water, and insects. This can be achieved by providing a possible diversity in spaces, surfaces, levels, and plant kinds (Marcus et al.,1986).
- Providing some passive "secret "places away from the street. For the reason of giving some privacy and kind of isolation for users. Children of all ages, for example, need to explore and hide sometimes also teenagers need a place to talk in privacy. but the place shouldn't be isolated as unsafe.
- The site design should consider people with disabilities. All the facilities and spaces in the mini-park should be designed to suit people with disabilities. For example, if there were levels in the park a parallel ramp should be added too plus all the pathways should be wide enough to assist people using wheelchairs or walkers.

- Bicycles should be considered in the early design process whether it will be in the park or not. If the design would include them, it is important to design wide and smooth paths with gradual corners. If they are to be eliminated, a way should find to prevent people with bikes -in the entrance- to use them in the park by using signs and providing special places to stop them. in both cases, racks should be provided in all parks' entrances.

According to the Development Bureau standards (2014).

The place should include these function areas:

"Use: Brief stop, resting, sitting, casual gatherings waiting, and weather protection."

According to Seattle Parks and Recreation standards (2017).

The desired functional areas are improved paths, plaza, or grassy areas for informal activity. The optional areas could be: designed landscape, play area, public art, and viewpoint. no parking area;

- "The built environment percent developed should be 70-100%."
- "Assets (desired – size dependent): improved paths, plaza, or grassy area for informal activity (no sports field)."
- "Assets (optional): designed landscape, play area, public art, and viewpoint. no parking area."

According to the Maryland-National Capital Park and Planning Commission standards (2018).

The feature of the functional areas should be sunlit small gathering areas with a mix of shaded and sunny seating small scale green areas. Plus, a small play area; "mentioned previously"

According to Local Parks Program Guidelines, Victoria government standards (2019).

The main functions include a seating area, toilets, access to water, and shading; "mentioned previously".

According to Parks, Recreation and recreation facilities element, City of Thornton standards (2017).

The functional areas mainly about gathering, seating, and play area for the surroundings "mentioned previously". Moreover, it should include multi-use areas, shelters, and pavilion in some cases;

- "Pocket parks should include multi-use lawn areas for picnics and open play area, shelters, and playgrounds."
- "Pavilion: Preferred, required for parks greater than 2 acres" which equals 8094 sqm.

According to Edmonton's Urban Parks Management Plan standards (2016).

The main functional areas include unstructured passive and active recreation spaces, social gathering spaces like a plaza, community garden, Public art and statuary, walkways/trails, bicycle parking/rack, and a small playground; "mentioned previously" plus, small water designed area; "Small spray deck".

According to Abd El Aziz article (2017).

The function areas are mainly about providing spaces for sitting with nature, playgrounds, event spaces for different activities, and in some cases an edible garden;

- "Recreate through playgrounds, opportunities for sitting, and open grassy areas."
- "Add small event spaces, spaces for meeting friends, taking lunch breaks, and social interaction."
- "Possibility to include edible gardens."
- "Provide…. rain garden, and swales."

<u>Plant Materials and Green Areas</u>

According to Marcus's book design guidelines for urban open space (1997).

It is impossible to generate all suitable plant materials and suggestions that apply to different countries, cities, or neighborhoods. So, the main criteria for choosing trees and plants and the design suggestions will be mentioned. Besides, Designers should always think about alternatives. For example, in New York City and cities with the same conditions, it may be impossible to plant anything in the shadow of tall buildings. So, in this case, a mini-park could be treated as a Mediterranean plaza with a sitting area and gazebos.

The criteria for choosing trees on the site should consider the followings:

- The trees should be climbable. In the case of an arid site, with a need to plant small trees, they should be well staked. Also, it might be good to provide a large dead tree to be used for climbing until the young trees grow are be strong enough for such use.
- Deciduous trees are preferable for these reasons: They provide full shaded areas in the summer and allow sunlight exposure to warm the areas during the winter. Additionally, using fruit trees as they produce color in spring months and fruit for climbers' lovers later in the year.
- Trees must be placed to give some shaded sitting areas on both benches and lawn areas. In urban areas, it is important to provide shady spots to sit and rest due to the glare from surrounding sidewalks, roadways, and buildings. In one of San Francisco mini-parks, a park has just three spindly trees (one had died), users almost gathered in and around the other two trees on hot weather, without using 95 percent of the park. if it considered desirable, trees could be planted in the park borders, can provide a beautiful frame and screen, especially for adjacent buildings.
- Children usually need shaded areas to play especially in hot days at the same time adults enjoy their time in lawns on sunny days. For the reason of using mini-parks usually in the afternoon more than in the morning time, the tree should be sited for shade at afternoon times particularly in summer (Figure 2.7).
- "Vegetation is much appreciated by city-dwellers even if they do not use the park". Kevin Lynch mentioned that people have a passionate attachment to small green spots in the city. Commuters prefer to choose a longer road to their work to pass through a park or garden (Lynch,1960). Drivers or people using vehicles are not counted as park users, but they value the green spaces through their travel. Therefore, lawns and trees should be placed near the street frontage of the park.
- Ground covers used usually to keep users off should not be planted in mini-park unless there is a reason to keep them off a particular part in the site.

Ground covers which used for a purpose just to be seen have no place in a mini-park, except if the park designed passively just for sitting and looking.

- All plant species must be "tough, impervious to trampling, fast-growing and not poisonous". Children like to use plants in their play so they have to be safe and suitable to be used plus the plants should be potential resources for children.
- Planted areas should have raised borders from the hard surface that adjacent to. Thus, these borders will prevent children from using the bikes to ride into planted beds or over lawns. On the other hand, the height should be suitable so it couldn't prevent children to walk from pathways to lawns.

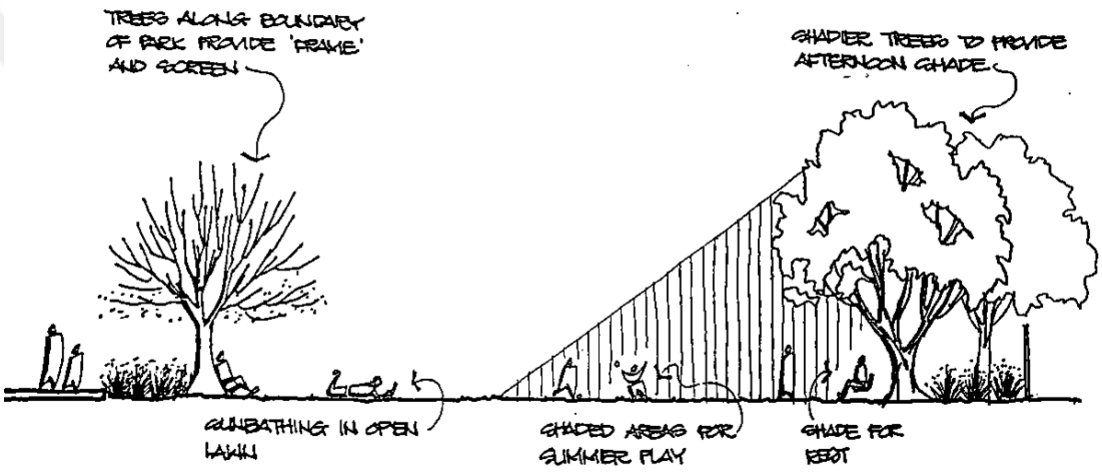

Figure 2.7: Trees' locations in a mini-park (Marcus, 1997).

According to the Development Bureau standards (2014).

- Green coverage should be 30% minimum of the mini-parks area.
- "At least 30% of the area of small open spaces should be placed with vegetation such as trees and shrubs. Existing natural habitat or trees should be the highest priority to be preserved."

According to Seattle Parks and Recreation standards (2017).

The natural area is not essential but if existed native plants should be used.

According to The Essex Design Guide standards (2018).

The native planting should be used and small areas of grass should be avoided; "Small areas of grass can be difficult to maintain and should be avoided but, where

appropriate, carefully chosen native planting can be used instead…. while planting should seek to stimulate a range of senses."

According to the Maryland-National Capital Park and Planning Commission, standards (2018).

There is no mention of green criteria just the mini-park may include sunny seating small scale green areas; "contact with nature… small scale green areas."

According to Local Parks Program Guidelines, Victoria government standards (2019).

The natural environment should not impact wildlife or existing vegetation. And not to be contaminated;

"Not going to significantly impact wildlife or existing vegetation of developed…not contaminated"

According to Parks, Recreation and recreation facilities element, City of Thornton standards (2017).

- "Pocket parks should include multi-use lawn areas for picnics and open play area"
- The natural area is optional; "Natural Area: Optional "

According to Edmonton's Urban Parks Management Plan standards (2016).

The green spaces desired development is:

- "Naturalized landscape development (e.g., butterfly gardens, sensory gardens, community berry patches, etc.). These may require Partners in the Parks agreement."
- About the planting area: "Tree planting should be "70 trees per hectare" which equals 70 trees/10000 sqm.
- Also, "Unique cultural landscapes" can be added and it requires maintenance agreement.

According to Abd El Aziz article (2017).

The standards that related to green areas design and requirements are:

- "Maximize the amount of natural shade."

- “Provide ceiling with a tree canopy.”
- “Space walls can become vertical lawns.”
- “Recreate through …….and open grassy areas.”

Surfaces

According to Marcus’s book design guidelines for urban open space (1997).

“Different surface materials should be used for different purposes”. Hard surfaces like asphalt are preferable to be used from children to ride tricycles, pull wagons, or play with wheel toys. Older children use hard surfaces for ball games, running games, jump rope or roller skating, and so on. thus hard-surface area should be part of the park’s circulation may be as expanded portion of the pathway or separated section next to the play equipment area. Adults also use the hard-surface areas to wheel baby carriages and people with disabilities can use it to move around the mini-park easily. Bricks and concrete could be also used.

A soft surface such as sand should be used under play equipment to be safe for children during the playing. Grass consider as soft surface too, it often used for rolling down on slight slopes.

According to The Essex Design Guide standards (2018).

For paving: predominantly hard-paved should be suitable for use by all ages and levels of physical and mental ability;

- “They may be predominantly hard-paved”.
- “The materials used should be suitable for use by all ages and levels of physical and mental ability”.

According to Abd El Aziz article (2017).

The only thing that mentioned related to surfaces is to add an attractive hardscape design to the park;

“Provide opportunities for….and attractive hardscape.”

2.2 Case Studies and Applications.

To abroad the study, in this section many built pocket park cases have been gathered; some from books, guidelines, and others from articles and websites, at local and global levels. The cases have been analyzed mainly according to their site placements, functions, and key features; some details have been added according to the reference.

According to Marcus's book design guidelines for urban open space (1997), the mentioned pocket park is:

2.2.1 Charlie Dorr Mini-park, Berkeley, California, USA

It located in a low-moderate income residential neighborhood West Berkeley. It was created in 1973 after a protest about the lack of open spaces made by neighborhood residents.it ended when the city of Berkeley obtained one house lot on Acton Street and built the pocket park, which named for residents, Charlie Dorr (Figure 2.8).

The area of the mini-park is 0.22 acres (890 square meters) .it forms a small open space between two houses. The park is virtually invisible due to narrow entrance, the adjacent house, and lush street trees. The play area consisting of a wooden play structure with swings and a slide which characterize the front of the park, also, an asphalt path leads to the large play area with a climbing structure set in sand shaping the back (L) of the park.

There is a tree with a seating area and two picnic tables that separate the front and back play areas. The park has a drinking fountain visible from the street. Shrubs and ground planting cover 5% of the park, the grass 5 % too, hard surfaces cover 12%. The remaining percentage is for sand and redwood chip-surfaced play areas.

Figure 2.8: Charlie Dorr Mini-park, Berkeley (Url-5).

Major Uses and Users

Users come to the park by walking or using the bike from a three- to a four-block radius. The majority of users are children between six and twelve years old. The trees area is used by teenagers and young men to hang out. According to the 1975 survey, this park founded to have the minimum use among Berkeley mini-parks observed.

Site Placement

- It located in a residential neighborhood.
- The site positioned in a calm, narrow, and tree-lined street of single-family houses.
- The park located between buildings with two openings (Through location type).

Function / Services Area

- Play area for kids.
- A place for socializing and rest.

Key Features

- Water features (A drinking fountain).
- Diversity in surfaces, materials used, textures, and levels.
- Vine-covered chain fence providing efficacious boundaries.

The unsuccessful features in the pocket park are (Marcus,1997):

- Park is not visible due to narrow entrance.
- The play area is very near to surrounding houses.
- Most of the seating areas are not visible from outside thus, it doesn't motivate people to use the park.

According to Energized public spaces Design Guidelines, The Maryland, standards (2018), the mentioned pocket park is:

2.2.2 John F. Collins Park, Philadelphia, USA

This privately-owned public space is a through-block pocket park in the heart of Center City in Philadelphia inspired by the design of Paley Park in New York City. The area

of the mini-park is 0.09 acres (364 square meters) (Figure 2.9). The cascade fountain is the focal point of this linear park framed by vine-covered walls with mature, native shade trees scattered in the whole area (Figure 2.10). The enclosed nature of the space provides a chance for private events like weddings. The park is a popular lunch and meeting point. In the winter, the colorful movable chairs and tables make the space more welcoming and attractive. This park is sited near bus and transit stops.

Figure 2.9: John F. Collins Park, Philadelphia, PA (Url-6).

Figure 2.10: The cascade fountain in the park (Url-6).

Site Placement

- Maximize sun exposure in locations in-between tall buildings (through-blocks location type).
- Facilitate connectivity to other public spaces and transit.

Function / Services Area

- Local destination.
- Serves neighborhood/district.
- Connected to a public spaces network.
- A place for pause and rest.
- Small play areas.

Key Features

- Water features (A cascade fountain).
- Small scale green areas.
- Sunlight small gathering areas with a mix of shaded and sunny seating areas.

Main Program

- Meditative areas supported by gathering area and active recreation on a smaller scale.
- Flexible program Places for rest and quiet meditation.
- Unstructured recreation.
- Contact with nature.

2.2.3 Paley Park, New York, USA

Paley Park was named by former Chairman of CBS, William Paley, who funded the project to be a prototype for a new type of privately-owned public space (POPS). It designed by landscape architects Zion and Breen Associates, who tried to design it wisely due to limited area; 390 sqm (Figure 2.11). The park officially opened in 1967. It is located at 3 East 53rd St. in Midtown Manhattan's cultural district, surrounded by dense urban high-rise buildings. Some theories considered the park as the archetype pocket park which inspired many pocket park designers (Supinsky et al., 2015; Url-7).

Figure 2.11: Paley Park, New York, USA (Url-8).

Site Placement

- The park is surrounded on three of four sides, with one side open (mid location type) with an effective overflowing onto the public sidewalk.
- Paley considered an open urban space at a very small scale, serving immediately the local population (approximately a 4-block radius).
- It is directly visible from the street in a district of high pedestrian traffic and gives natural light to the street level.

Function / Services Area

- Small café.
- Serves neighborhood/district.
- Connected to a public spaces network.
- A place for pause and rest.

Key Features

- Sunlight small gathering areas with a mix of shaded and sunny seating areas with movable wire-mesh chairs and tables which can be arranged to suit the user's desires (Figure 2.12).
- The side walls are covered in ivy as a vertical green space creates like an oasis amid a crowded city.

- A 6-meter high waterfall on one of the park's walls. The purpose of the waterfall is to create a white noise, which masks the surrounding noise and creates a comfortable sitting area for users.

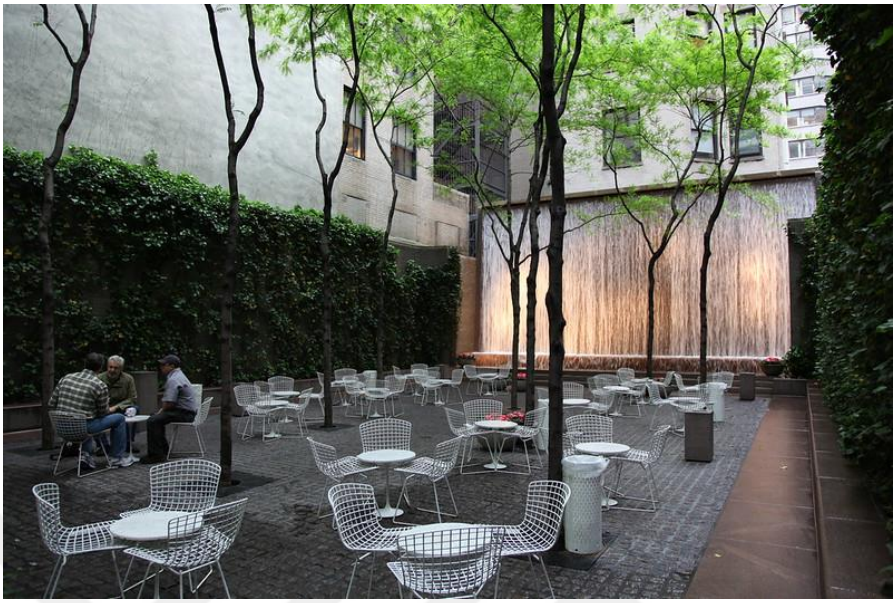

Figure 2.12: Movable wire-mesh chairs and tables (Url-8).

Not like other parks, Paley Park has not been designed to be a multi-functional park; its success lies in its simplicity. The main program and functions are simply for sitting, resting, and a place to contact with peers. (Supinsky et al., 2015; Url-7).

2.2.4 Sun Hop Vancouver, Canada

Based on community response, a hybrid concept was created, taking into consideration gathering, connections, and site history as its main principles plus developing sustainable principles of tree protection and stormwater management. The park was designed by HAPA Collaborative and Vancouver Park Board consulted with Mount Pleasant residents. Hapa created a park's layout which fits smoothly among a six-story commercial and residential building and busy Main Street. (figure 2.13).

The main feature in the park is the "bendy-straw" trellis as a symbol referring to the Palm Dairy and Milk Bar that occupied the site from 1952 to 1989 (figure 2.14). As a result of the collaborative process between client and consultant, Mid Main Park became an important gathering spot in a neighborhood and a significant link between the site and Main street. Moreover, it has a local-city wide important status (Url-9; Url-10).

Figure 2.13: Sun Hop Vancouver pocket park (Url-10).

Figure 2.14: The “bendy-straw” trellis (Url-10).

Site Placement

- The park located adjacent to the street from two sides (corner location type).
- The park located in a commercial and residential neighborhood connected with busy Main Street.
- It is directly visible from the street due to the colorful trellis.

Function / Services Area

- Serves neighborhood.
- A place for pause and rest.
- A social hotspot on the Main Street promenade.

Key Features

- The park has various types of fixed and movable seating areas such as winding, underlit benches, and a small mounded lawn.
- It has pervious paving that collects water into an underground infiltration area.
- The colorful trellis which used as a play structure and seating area for children. (Url-9; Url-10).

2.2.5 Richmond Terrace pocket park, Yarra, Australia

The park has been created as a part of an innovative strategy by the City of Yarra to build more 'open space' in Melbourne's inner city. Due to limited circumstances to open new green public spaces, the strategy aimed to re-develop the traditional use of streets and convert them from places for cars to places for people to produce green livable spaces to residents (Figure 2.15).

The design reflected the adjacent historical church design in the park through materials and elements, for example, the lighting elements mesh and retaining walls that reference the stained-glass windows of the church (Figure 2.16).

The pocket park was a finalist in the 2015 Think Brick Awards and was also awarded a 2015 AILA Design Award (Ur1-11).

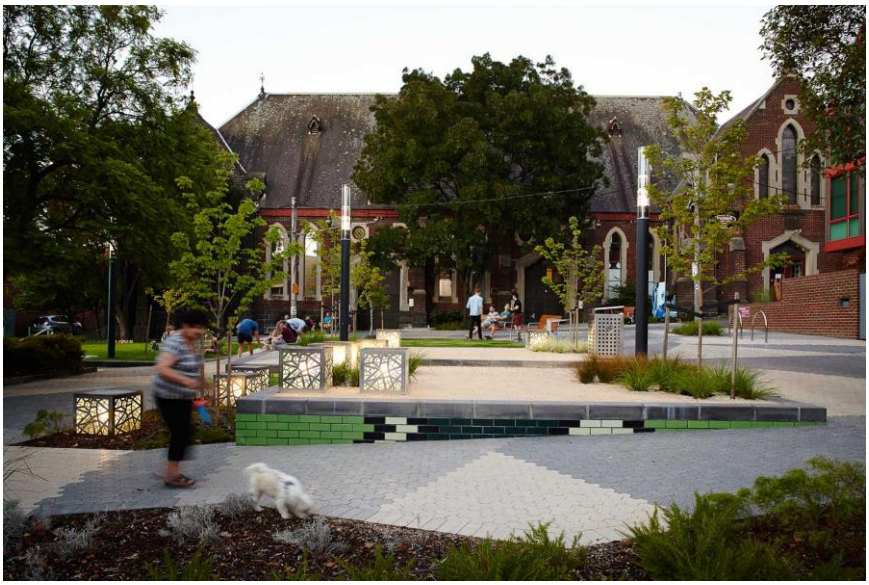

Figure 2.15: Richmond Terrace pocket park (Ur1-11).

Figure 2.16: The retaining wall and lighting elements (Ur1-11).

Site Placement

- The site has direct views of the city skyline and was used by the residents to gather and make events.
- The park located adjacent to the street from two sides (corner location type).
- The park located in a historical and residential neighborhood.

Function / Services Area

- Serves neighborhood.
- A place for pause and rest.

Key Features

- A series of terraces for community gathering, with seating areas.
- A drinking fountain.
- Planting beds.
- Unique feature lights and a noticeable custom-designed paving pattern. (Url-11).

2.2.6 Pallis pop up pocket park, Stockholm, Sweden

Pallis is a pocket park that pioneered a change in how inhabitants can adjust their built environment. The community took the responsibility of designing and programming their pocket park. Furthermore, a group tutorial has been existed to teach residents how to design and make horticultural and ecosystem services that develop the park. (Figure 2.17)

The main idea was to combine ecological elements to create a microclimate where plants, animals, and humans can live in equal measures. The design concentrated on creating a sustainable living ecosystem that pocket parks can use to decrease the negative effects of the urban environment (Url-12).

Figure 2.17: Pallis pop up the pocket park (Url-12).

Site Placement

- The park located adjacent to the street from two sides (corner location type).
- The park located in a crowded populated urban environment.

Function / Services Area

- The pocket park host community events.
- Serves neighborhood.
- A place for socializing and rest.

Key Features

- Green walls that filter the polluted air become a habitat for small creatures.

- Water ponds which purify rainwater.
- Nesting boxes located in the lighting features which attract birds.
- Beehives home bees that inoculate plants and produce honey.
- Sand play area for children including spaces for adults to rest and observe the kids. (Url-12).

2.2.7 Merchant Square Floating Pocket Park, London, Britain

Merchant Square is a mixed-use complex in London's West End, it consists of residential and commercial buildings with approximately 10000 workers and residents. The idea of creating a floating public pocket park has been started from the studies published as a 2016 report in Health & Place Journal, that living near water Improves mental, physical health and reducing stress. Taking that in consideration, Garden Club London designers, aimed to combine between water and green spaces to maximize the potential of the site and they considered this is not only a challenge of designing a unique urban blue space project in Central London but also the result would increase social, environmental and economic benefits to the city (Figure 2.18).

The floating pocket park provides further convenience for people who already live or work there and for the public too. Moreover, it contributes to increasing biodiversity and aesthetic interest. The design has taken into consideration the existing elements, features, colors, and architectural style in the surrounding area so the floating pocket park would coherent with the surrounded environment (Url-13).

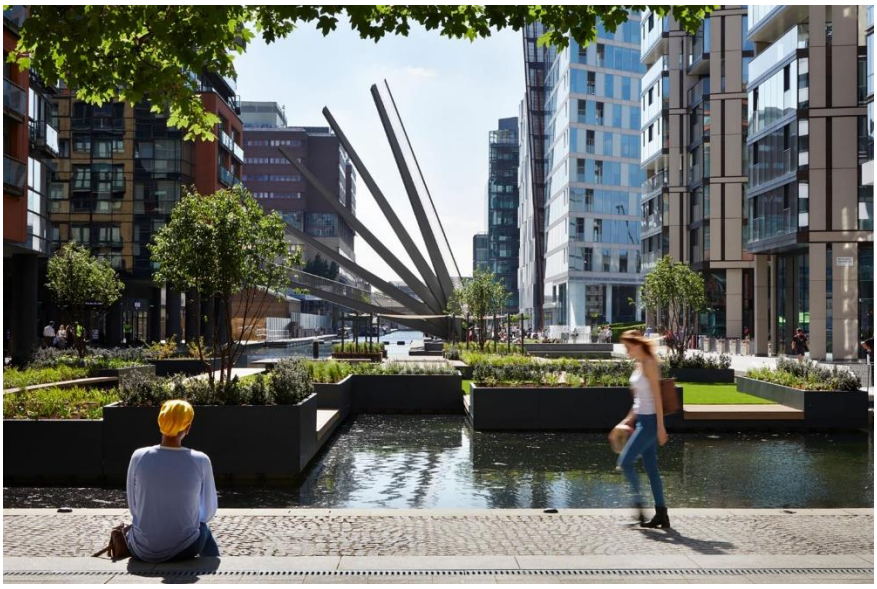

Figure 2.18: Merchant Square Floating Pocket Park (Url-13).

Site Placement

- The park located between buildings with two openings (Through location type).

The park located in a commercial and residential neighborhood and surrounded by luxury apartments and offices, hospitality places, and near the Hilton London Metropole.

Function / Services Area

- Serves workers, residents, visitors, and wildlife too.
- A place for meeting, relaxation, water interaction, and events.

General pedestrian activities in a previously unused area.

Key Features

- Water features with green space.
- Different types of seating areas and benches near the water.
- A grass lawn area.
- Pergolas and shelters (Figure 2.19). (Url-13).

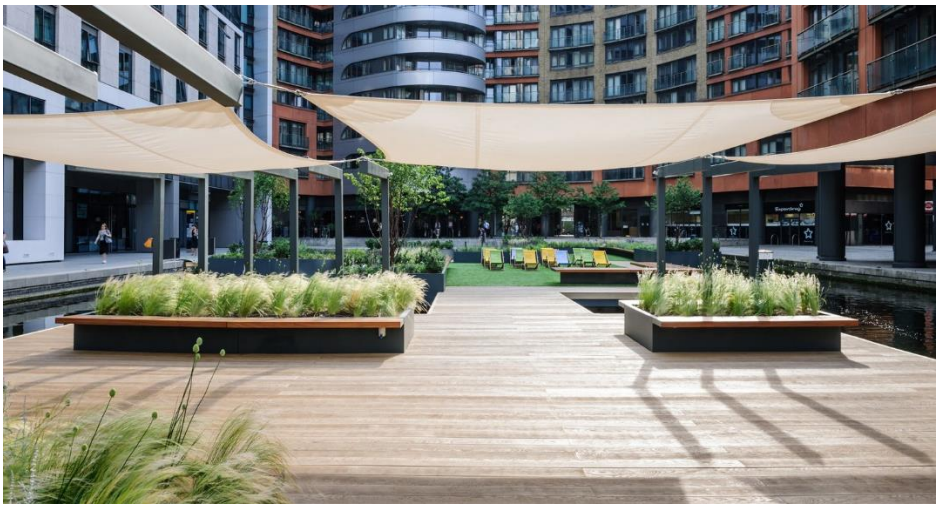

Figure 2.19: Some of the key features in Floating Pocket Park (Url-13).

2.2.8 Omoken Park, Kumamoto, Japan

A project aimed to regenerate the ruins of the building after the 2016 Kumamoto earthquake. Public space of private space was planned to let people interact with each other while shopping or walking around. The design has a pocket park and a rooftop plaza which is not found usually in the arcades on the street. it connects the lively street on the front and the calm area on the back (Figure 2.20).

The service area structure has been built with a low construction cost program and with less impact on the environment. It consists of a simple steel frame and a mixed structure of CLT (Cross Laminated Timber) and a pile foundation. Moreover, it has daylight during daylight which reduced power consumption and brings the air open by trees, lights, and people's activities to the arcade (Url-14).

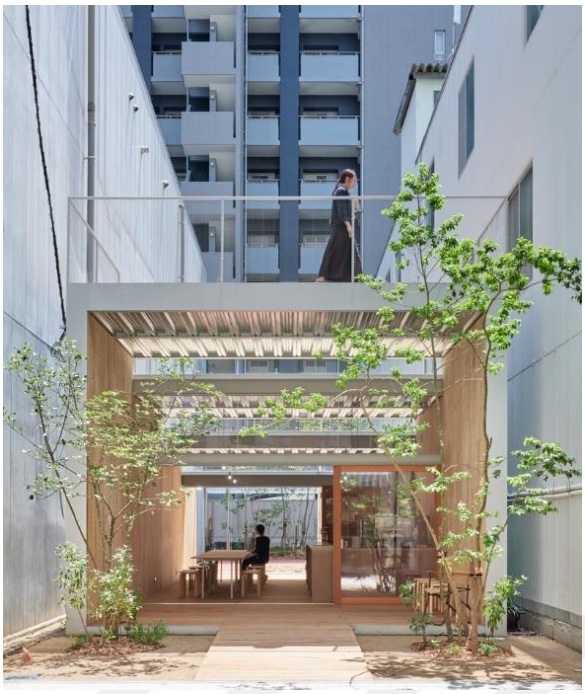

Figure 2.20: Omoken Park. (Url-14).

Site Placement

- The park located between buildings with two openings (through location type).
- The park located in a commercial and residential neighborhood near the shopping area from one side and quiet area on the other side.

Function / Services Area

- Small café.
- A place for local events, administrative use, and cultural exchange.
- A place for pause and rest.

Key Features

- A Rooftop seating area.
- A Light timber and steel structure. (Url-14).

2.2.9 Aydin Demir Park, Istanbul, Turkey

The park is located in Üsküdar in a residential and commercial neighborhood. According to Türkmen -the head of Üsküdar Council- each citizen in Üsküdar district has 9 sqm green space which was previously 4.2 sqm and the aim is to increase the area to be 10 sqm green space for each citizen in 2019.

The Council reopened Altunizade Aydın Demir Park, which was built in the name of the son of the former Üsküdar Council Member, Hasan Demir, who had been lost in a traffic accident in 2003. The park has 25 new trees planted and its area is reaching 2500 square meters. It has a basketball court, sports equipment, wooden children's playgrounds, and a walking track (Figure 2.21). (Url-15).

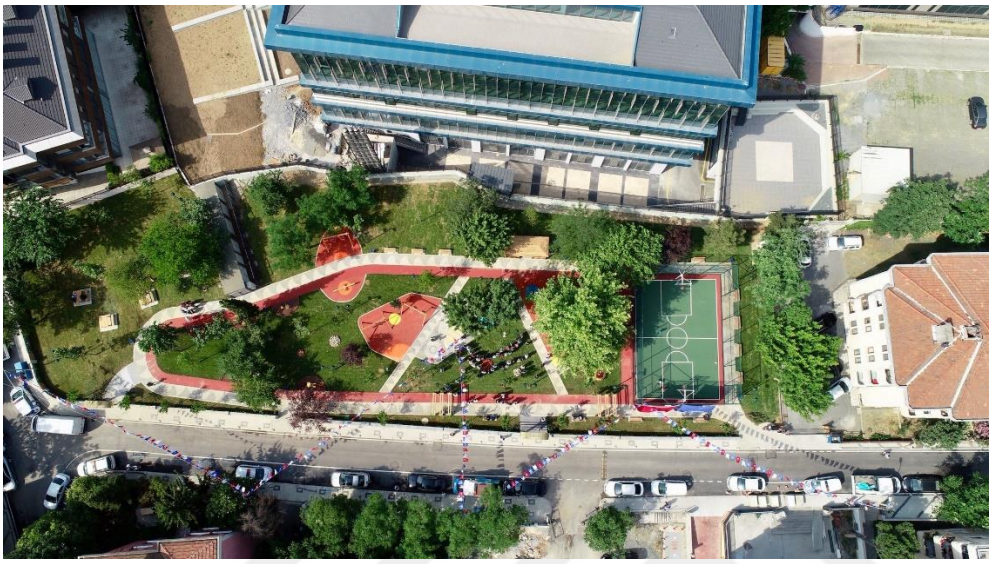

Figure 2.21: Aydin Demir Park, (Url-15).

Site Placement

- The park located adjacent to the street from two sides, with one long side (corner location type).
- The park located in a quiet residential neighborhood in a local street and connected to a commercial neighborhood with a shopping mall and small firm.

Function / Services Area

- Small football court.
- Sports equipment for adults (Figure 2.22).
- A place for pause and rest.
- Different types of Children playing area.

Figure 2.22: Sports equipment in the park (Hammad, 2019).

Key Features

- Pergolas with vines created an image at a different level (Figure 2.23).
- Different types of seating areas and benches.
- Varied type of trees with different heights.
- Different types of paving and colored paths. (Hammad, 2019).

Figure 2.23: Some of the key features in the park (Hammad, 2019).

The reason for considering this park as a pocket park based on guidelines studies and built pocket parks analysis, the reasons are:

- The area of this park is under 5000 sqm.

- This park located in a residential area surrounded by houses and there is a shopping mall and a small firm near it. Moreover, -based on the interview- all the users are from the neighborhood of the park and reaching it by walking.
- The elements and the design of the park are simple, it doesn't contain complex functions or elements.it designed mainly to serve the surrounding residents and to provide sitting, play, resting areas for them. (Hammad, 2019).

2.3 Guidelines Analysis

The second phase of research aims to create a detailed set of rules that would be achieved by classifying the gathered design guidelines in a primary classification. Based on data that has been gathered from researches and case studies which are concerned in pocket parks. It has been noticed that there are shared design criteria that found almost in each pocket park (Abd El Aziz, 2017). These common design criteria can be explained in terms of:

- Area and location.
- Access and linkage.
- Space design.
- Uses and activities.
- Environmental elements.
- Landscape elements.

The detailed design criteria for each term has been explained in [Table 2.1].

Following this, each guideline was analyzed in terms of design criteria of pocket parks as shown in [Tables from 2.2 to 2.8], then as a conclusion, they have been gathered in one table [Table A.1].

Table 2.1: The classification of the gathered design criteria (Abd El Aziz,2017).

Area and Location	● Must not exceed 5000m2 ● Parks should serve a resident -population of approximately 500-1000 persons. ● A Pocket park is 5 to 10 min. walk from target users ● Place the park in front of active rooms in adjacent buildings ● Use vacant land, on small, irregular pieces of land, forgotten and unused spaces. ● Use non-traditional locations: rooftops, building facades or foyers
Accesses and Linkage	● Easy and equitable access with multiple points of entry ● No barriers between the street and the park ● Convenient and safe pedestrian access that is buffered from moving vehicles ● Connect the park to the greenway network and place it in high-density housing areas ● Accessible by both foot and bike, and should not require the use of a car ● Link to other recreational, cultural and community amenities
Space Design	● Defined edges and a focal point ● Ensure clear sightlines across the entire site ● Opened to the street on 2 to 4 sides. ● Welcoming and appealing design to a diversity of users/ offers variety and choice ● Defined identity and represent local communities ● Adaptable / comfortable spaces ● Space walls can become vertical lawns
Uses and Activities	● Provide spaces for physical fitness as basketball courts /tot-lots / climbing structures ● Provide space for mental improvement, and relaxing ● Recreate through playgrounds, opportunities for sitting, and open grassy areas ● Add activities that will activate the park at all times ● Add small event spaces, spaces for meeting friends, taking lunch breaks, and social interaction. ● Add educational spaces as children can gain a better understanding of and appreciation for nature
Environmental Elements	● Use previous surfaces, bio-filter landscaping beds, high-efficiency lighting (LED), and solar-powered amenities. ● Provide ceiling with a tree canopy. ● Provide weather protection, rain garden, and swales ● Spaces should provide sufficient sunlight and ventilation ● Use recycled materials
Landscape Elements	● Avoid blank walls in the space perimeter ● Add water features, gazebos, individual seating, benches, drinking fountains, bicycle racks, trash receptacles, heat lamps, etc. ● Maximize the amount of natural shade ● Provide adequate lighting during night time ● Provide opportunities for public art and attractive hardscape ● Possibility to include an edible garden.

Table 2.2: Bureau, pocket parks Standards.

Pocket park design criteria	Bureau, 2014 standards
Area and Location	• Area: 100 sqm minimum. • Shape: The shape of an open space mainly depends on the site but it is suggested that the width and length of the park should be well proportioned. • The radius of attraction: passers-by or users of the immediate neighborhood. • Location: usually located along adjacent streets.
Accesses and Linkage	• There should be more than one street frontage of the open spaces and at least 6 meters in street frontage.
Space Design	• "Promote a sense of openness and safety by ensuring the views from the parks will not be completely blocked by neighboring structures." • pocket parks emphasize on the 'intimacy and human touch' given to the visitors.
Uses and Activities	• "Brief stop, resting, sitting, casual gatherings, and waiting."
Environmental Elements	• Weather protection and weatherproof covers. • "Canopies and seating are two major facilities in the pocket parks." • "Openness to the sky is another major principle to generate outdoor small open spaces." • Trees shading "can also create a more comfortable microclimate in the pocket park."
Landscape Elements	• "Appropriate lighting should also be provided if possible and they should coordinate with the pedestrian lamps." • "Covers can usually be installed on top of the seating for shades." • "Different types of seats such as chairs, benches, wall seats, and planter ledges will be installed based on the overall design."

Table 2.3: Seattle Washington, pocket parks Standards.

Pocket park design criteria	Seattle Parks and Recreation, 2017 standards
Area and Location	• Area: 1012 sqm maximum. • The radius of attraction: the immediate neighborhood-maximum of 402 meters in distance. • Location: can be in all zones; residential, commercial, or on unused land between roads.
Accesses and Linkage	
Space Design	• "Plans for mini or pocket parks try to use remnants of old landscaping features or other elements from the site's prior use to emphasize cultural or historic importance."
Uses and Activities	• This type of park" sometimes operated for both recreational and utility/infrastructure purposes." • The desired functional areas are improved paths, plaza, or grassy area for informal activity with no sports fields. • The optional areas could be: designed landscape, play area, public art, and viewpoint.
Environmental Elements	• "Possible green stormwater infrastructure and native plants."
Landscape Elements	• Desired assets: "Benches and Improved paths" • Optional assets: "Lighting for safety (rare) and Public art"

Table 2.4: Essex Design Guide England, pocket parks Standards.

Pocket park design criteria	The Essex Design Guide,2018 standards
Area and Location	• Area: not specific.
Accesses and Linkage	
Space Design	• "The materials used should be suitable for use by all ages and levels of physical and mental ability." • Design the park to be "more accessible and worth visiting for all members of the community."
Uses and Activities	• Pocket parks "are usually too small for ball games and may include public art installations." • The parks provide places for sitting and socializing especially for the aging population and those with dementia.
Environmental Elements	• Pocket parks "often offer the greatest opportunity to integrate smart infrastructure and digital technology. Examples of this include recycling or waste management points, or smart street furniture."
Landscape Elements	• "They may be predominantly hard-paved." • "may include public art installations"

Table 2.5: Maryland State in the USA, pocket parks Standards.

Pocket park design criteria	Maryland-National Capital Park and Planning Commission, 2018 standards
Area and Location	• Area: From 405 to 1012 sqm. • The radius of attraction: Serves users from the nearby blocks and "Local Destination"
Accesses and Linkage	• "Connected to public spaces network." • "Provide connectivity to other public spaces and transit."
Space Design	• "Active recreation in smaller scale place"
Uses and Activities	• "Places for quiet contemplation unstructured recreation contact with nature." • "Sunlit small gathering areas and small-scale green areas " • "small play areas"
Environmental Elements	• Maximize sun exposure in locations in between tall buildings
Landscape Elements	• Sunlit small gathering areas with a mix of shaded and sunny seating areas.

Table 2.6: Victoria government Australia, pocket parks Standards.

Pocket park design criteria	Local Parks Program Guidelines, Victoria government, 2019 standards
Area and Location	• Area: 2000 sqm maximum. • Location: "underutilized open space, or suitable for repurposing site."
Accesses and Linkage	• "Easily accessible via road, public transport, or well-linked to bike or walking trails." • "Safe for users; this may include good visibility across the site and proximity to other users/visitors/activity centers."
Space Design	
Uses and Activities	• The parks should "provide recreation and socializing opportunities in a green space."
Environmental Elements	• "Supported by or in proximity to services/amenities e.g. seating, lighting, toilets, access to water and shading."
Landscape Elements	

Table 2.7: City of Thornton State of Colorado, pocket parks Standards.

Pocket park design criteria	Parks, Recreation and recreation facilities element, City of Thornton, 2017 standards
Area and Location	• Area: From 1012 to 20234 sqm. • The radius of attraction: 402-meter radius, serving 2023 sqm per 1,000 population. • Location: it should be located in each new subdivision if not covered by the 402-805 meter service radius from an existing or planned neighborhood park, or "when a major arterial or some other barrier compromises access to a neighborhood park"
Accesses and Linkage	• It has access to the neighborhood. • "Using trails to connect this type of park to Thornton's overall park system is beneficial, but not necessarily expected."
Space Design	• "Surrounded by streets as much as possible."
Uses and Activities	• "Pocket parks should include multi-use lawn areas for picnics and open play area, shelters, and playgrounds." • Preferred to includes an open play area and sport court.
Environmental Elements	• "LED lighting with steel poles at playgrounds and along the trail."
Landscape Elements	• "Picnic tables (2 minimum), benches (2 minimum)" • "Trash receptacles (4 minimum for parks greater than 2 acres)" equals 8094 sqm. • "Dogs waste stations and bike racks"

Table 2.8: Park development Ottawa Canada, pocket park Standards.

Pocket park design criteria	Edmonton's Urban Parks Management Plan, 2016 standards
Area and Location	• Area: 5000 sqm. • The radius of attraction: serves residents in 0.5 kilometers walking distance from their homes and serves 2,250 people. • Location: "local roads or are stopovers along a greenway or trail located on a local or collector roadway"
Accesses and Linkage	• "Pocket Parks are located on a local or collector roadway."
Space Design	• "A Pocket Park's perimeter must have roadway frontage on a minimum of one side so that safety issues related to configuration of park sites can be addressed." • "Park entrance feature."
Uses and Activities	• Pocket parks "are intended for short-term, unstructured recreation and may be utilized at any time by nearby residents or by cyclists, rollerblades, walkers or joggers passing through the neighborhood." • "Unstructured passive and active recreation spaces" • Social gathering spaces and a community garden. • "Tot-lot playground."
Environmental Elements	• "shade structures."

Landscape Elements	• "Social gathering spaces (e.g., plazas, picnic tables, etc.) • Community garden • Bicycle parking/racks • Public art and statuary • Gazebo • Small spray deck • Lighting"

2.4 Built Pocket Park Analysis

To broaden the study and support the database with applicable ideas expand the scope of the collection of criteria. For that purpose, the mentioned built pocket park cases in local and global levels were analyzed according to the previous design criteria and to their design parameters such as area, space design, activities, recreation components and landscape elements as shown in [Tables from 2.9 to 2.17], then as a conclusion, they have been gathered in one table [Table A.2].

Table 2.9: The Design Criteria of Charlie Dorr Mini-park, Berkeley California.

Design Criteria	Charlie Dorr Mini-park, Berkeley California.1973	
Area and Location	• Must not exceed 5000m2 • Typical location type • Surroundings	890 sqm Through Residential Neighborhood
Space design	• Adaptable / comfortable spaces • Space walls can become vertical lawns	
Uses and Activities	• Spaces for physical fitness as basketball courts /tot-lots / climbing structures • Spaces for mental improvement, and relaxing • Open grassy areas • Add small event spaces, spaces for meeting friends, taking lunch	
Environmental Elements	• Provide ceiling with a tree canopy • Sufficient sunlight and ventilation	
Landscape Elements	• Water features (A drinking fountain) • Individual seating /benches • Trash receptacles • Maximize the amount of natural shade • Opportunities for public art and attractive hardscape	

Table 2.10: The Design Criteria of John F. Collins Park, Philadelphia, USA.

Design Criteria	John F. Collins Park, Philadelphia, USA. 1979	
Area and Location	• Must not exceed 5000m2 • Typical location type • Surroundings	364 sqm Through Commercial and residential neighborhood
Space design	• Defined edges and a focal point (A cascade fountain) • Clear sightlines across the entire site • Opened to the street on 2 to 4 sides • Welcoming and appealing design to a diversity of users • Adaptable / comfortable spaces • Space walls can become vertical lawns	
Uses and Activities	• Spaces for mental improvement, and relaxing • Activities that activate the park at all times • Add small event spaces, spaces for meeting friends, taking lunch	
Environmental Elements	• Provide ceiling with a tree canopy • Sufficient sunlight and ventilation	
Landscape Elements	• Water features (A cascade fountain) • Individual seating /benches • Trash receptacles • Maximize the amount of natural shade	

Table 2.11: The Design Criteria of Paley Park, New York, USA.

Design Criteria	Paley Park, New York, USA. 1967	
Area and Location	• Must not exceed 5000m2 • Typical location type • Surroundings	390 sqm Mid Commercial / High-rise residential neighborhood
Space design	• Defined edges and a focal point (Waterfall) • Clear sightlines across the entire site • Adaptable / comfortable spaces • Space walls can become vertical lawns	
Uses and Activities	• Spaces for mental improvement, and relaxing • Activities that activate the park at all times • Add small event spaces, spaces for meeting friends, taking lunch	
Environmental Elements	• Provide ceiling with a tree canopy • Sufficient sunlight and ventilation	
Landscape Elements	• Water features • Individual seating /benches • Trash receptacles • Maximize the amount of natural shade • Opportunities for public art and attractive hardscape	

Table 2.12: The Design Criteria of Sun Hop pocket park Vancouver, Canada.

Design Criteria	Sun Hop Vancouver, Canada. 2013	
Area and Location	• Must not exceed 5000m2 • Typical location type • Surroundings	1000 sqm Corner Commercial and residential neighborhood
Space design	• Defined edges and a focal point (Colorful curvaceous seating element) • Clear sightlines across the entire site • Opened to the street on 2 to 4 sides • Welcoming and appealing design to a diversity of users • Defined identity and represent local communities • Adaptable / comfortable spaces	
Uses and Activities	• Spaces for physical fitness as basketball courts /tot-lots / climbing structures • Spaces for mental improvement, and relaxing • Open grassy areas • Activities that activate the park at all times • Add small event spaces, spaces for meeting friends, taking lunch	
Environmental Elements	• Use high-efficiency lighting (LED), and solar-powered amenities • Provide ceiling with a tree canopy • Weather protection, rain garden, and swales • Sufficient sunlight and ventilation	

Landscape Elements	• Individual seating /benches • Bicycle racks • Trash receptacles • Maximize the amount of natural shade • Opportunities for public art and attractive hardscape

Table 2.13: The Design Criteria of Richmond terrace Yarra, Australia.

Design Criteria	Richmond terrace Yarra, Australia.2014
Area and Location	• Must not exceed 5000m2 600 sqm • Typical location type Corner • Surroundings Historical and Residential neighborhood
Space design	• Clear sightlines across the entire site • Opened to the street on 2 to 4 sides • Welcoming and appealing design to a diversity of users • Defined identity and represent local communities • Adaptable / comfortable spaces
Uses and Activities	• Spaces for mental improvement, and relaxing • Open grassy areas (Two lawns terraces) • Add small event spaces, spaces for meeting friends, taking lunch
Environmental Elements	• Use high-efficiency lighting (LED), and solar-powered amenities • Sufficient sunlight and ventilation
Landscape Elements	• Water features (A drinking fountain) • Individual seating /benches • Bicycle racks • Trash receptacles • Opportunities for public art and attractive hardscape

Table 2.14: The Design Criteria of Pallis pop-up pocket park Stockholm, Sweden.

Design Criteria	Pallis pop-up Stockholm, Sweden.2015	
Area and Location	• Must not exceed 5000m2 • Typical location type • Surroundings	195 sqm Corner Residential neighborhood
Space design	• Clear sightlines across the entire site • Opened to the street on 2 to 4 sides • Welcoming and appealing design to a diversity of users • Adaptable / comfortable spaces • Space walls can become vertical lawns	
Uses and Activities	• Spaces for mental improvement, and relaxing • Open grassy areas • Add small event spaces, spaces for meeting friends, taking lunch	
Environmental Elements	• Use high-efficiency lighting (LED), and solar-powered amenities • Weather protection, rain garden, and swales • Sufficient sunlight and ventilation	
Landscape Elements	• Individual seating /benches • Bicycle racks • Trash receptacles • Opportunities for public art and attractive hardscape	

Table 2.15: The Design Criteria of Floating Merchant pocket park, London.

Design Criteria	Floating Merchant pocket park, London.2017	
Area and Location	• Must not exceed 5000m2 • Typical location type • Surroundings	729 sqm Through Commercial and Residential neighborhood
Space design	• Defined edges and a focal point (Floating park) • Clear sightlines across the entire site • Welcoming and appealing design to a diversity of users • Defined identity and represent local communities • Adaptable / comfortable spaces	
Uses and Activities	• Spaces for mental improvement, and relaxing • Open grassy areas • Activities that activate the park at all times. • Add small event spaces, spaces for meeting friends, taking lunch	
Environmental Elements	• Use high-efficiency lighting (LED), and solar-powered amenities • Sufficient sunlight and ventilation	
Landscape Elements	• Water features (Floating park) • Individual seating /benches • Trash receptacles	

Table 2.16: The Design Criteria of Omoken Kyushu Park, Japan.

Design Criteria	Omoken Kyushu, Japan.2019	
Area and Location	• Must not exceed 5000m2 • Use vacant land, on small, irregular pieces of land, forgotten and unused spaces. • Use non-traditional locations: rooftops, or foyers • Typical location type • Surroundings	68 sqm Ruined space after the earthquake Use the rooftop as terraces Mid Commercial and Residential neighborhood
Space design	• Clear sightlines across the entire site • Defined identity and represent local communities • Adaptable / comfortable spaces	
Uses and Activities	• Spaces for mental improvement, and relaxing • Add small event spaces, spaces for meeting friends, taking lunch	
Environmental Elements	• Weather protection, rain garden, and swales • Sufficient sunlight and ventilation	
Landscape Elements	• Individual seating /benches • Trash receptacles	

Table 2.17: The Design Criteria of Aydin Demir Park, Istanbul, Turkey.

Design Criteria	Aydin Demir Park, Istanbul, Turkey.2018	
Area and Location	• Must not exceed 5000m2 • Typical location type • Surroundings	2500 sqm Corner Commercial and Residential Neighborhood
Space design	• Clear sightlines across the entire site • Opened to the street on 2 to 4 sides • Welcoming and appealing design to a diversity of users • Adaptable / comfortable spaces • Space walls can become vertical lawns	
Uses and Activities	• Spaces for physical fitness as basketball courts /tot-lots / climbing structures • Spaces for mental improvement, and relaxing • Open grassy areas • Activities that activate the park at all times • Add small event spaces, spaces for meeting friends, taking lunch	
Environmental Elements	• Provide ceiling with a tree canopy • Sufficient sunlight and ventilation	
Landscape Elements	• Individual seating /benches • Bicycle racks • Trash receptacles • Maximize the amount of natural shade • Opportunities for public art and attractive hardscape	

3. COMPUTER-AIDED DESIGN

During the last decades, computational systems have been started as a basic foundation in architectural design, leading to rising a new area of study that interacts with design cognition, computation, and generative standards in contemporary design practice (Dino, 2012).

The growth and development of computational design characterized a "computational turn" in building design that revolutionized traditional design processes, which were relied on manual drafting work. Nowadays, computational design challenges traditional architectural design conventions and practices (Rocker, 2006)

3.1 Computer-Aided Drawing, Drafting, and Design (CAD)

Computers -phase one- have been designed in automate assignments that need massive mathematical calculations or repetitive activities like accounting. In phase two computers have been used in increasing the human capabilities of problem-solving with had in some cases unsatisfactory results, this phenomenon usually referred to as the productivity puzzle and Computer-Aided Drafting (CAD) is near to this concept (Landauer,1995; Bhavnani et al.,1996).

It is important to explain what the "D" means in CAD because it has been used to signify "drawing, drafting or design". A computer-aided drawing includes any program uses for produce forms consist of graphical shapes contain lines and curves, "that may or may not be filled by two-dimensional patterns". Computer-aided drafting is a drawing system created to support complex drawings, to ease the professional services to clients like architects. It includes all the abilities that the drawing program has but at the same time, it increases their performance with powerful features that manage the more demanding use made of them. For example, the MicroStation program or extensions are written on top of it, besides providing the basic commands in drawing line and curves, it provides a mechanism to handle regular borders of

drawings through reference files, in other words, it is a database store non-geometrical assigns of building elements, which enable the user to create schedules and other complex develops. Computer-aided design, assist design decision making more than drawing or drafting tools, which usually affect the designer's decisions after they have been taken. It gives more choices, evaluates them, and give feedback based on that. also, it manages restrictions (Flemming et al., 1995; Flemming et al.,1997).

According to Gero (1994), there are two main areas in the development of computer-aided design: "the representation and production of the geometry and topology of designed objects" and "the representation and use of knowledge to support or carry the synthesis of designs". The first category concerns the general use of off-the-shelf computer-aided design tools which used to increase the performance or to automate design and drafting works. The second was the keystone to emerge the generative approaches that consider computation as an aid to the design process and to create design ideas.

3.1.1 Building Information Modelling (BIM).

Building Information Modelling (BIM) has different definitions according to field or organization perspective (Hardin,2009; Eastman et al., 2011).

Autodesk (2003) defines BIM: As an "innovative new approach to building design, construction, and management introduced by Autodesk in 2002". It provides the schedule, cost information, and project design information immediately in a reliable, incorporated, and coordinated way. Furthermore, Autodesk stated that the technologies that BIM requires to be implemented are: Object CAD (3D geometry of buildings) and parametric Building Modelling (real-time self-coordination of information).

Hardin (2009) describes BIM as a process and a way of adapting and creating a new perception of thinking. According to Bentley (2011), BIM is a new approach to design and document building projects. The project life cycle data (design, build, and operations) is considered while defining and simulating building s delivery using integrated tools.

BIM can be considered the intersection of two critical ideas:

- Saving the significant design information in digital form, allow the firms to update, edit, and easily share the data.

- Creating a consistent relationship among digital design information by using parametric building modeling technology, can save money and time also it can improve the productivity and quality of the project (Autodesk, 2003).

3.1.2 Landscape Information Modeling (LIM).

In past times, architecture, urban planning, landscape, and open spaces design were a different term under the same discipline. Nowadays they have become independent topics that differ in technical level and also from a disciplinary and scientific perspective. The landscape represents the structural element that indicates a group of agents that shape a complex system (Cianci and Molinari, 2019). Besides, Landscape design considered an interdisciplinary field where many areas used such as ecology, geography, geology, horticulture, and botany. Thus, the knowledge and data from different fields should be gathered in an information model. The landscape has a biological nature which makes it dynamic in time by its nature, changes in the terrain, weather, ground circumstances, and other "soft" materials have to be taken into consideration. Accordingly, that makes the design of a landscape has not a "final" or "fixed" state, but a process in which the development in a single component should be balanced with other components interactions. When an information model for landscape would be applied, it would make the connection and integration among landscape design and urban and architectural design easier due to the exchanging of information models. This forms an important point, because landscape design is certainly involved in urban structures such as parks, open green areas, public spaces, and the building surroundings are considered part of landscape design. Thus, it would be useful when a link is gathered a Landscape Information Model with architecture, urban design, and landscape design (Achten and Zajíčková1,2013).

A landscape information model composed of two components:

- The information and data about sites (terrain, ground circumstances, weather, micro- and macro-climate, etc.).
- The information and data about landscape objects ("soft" materials such as vegetation, and "hard" materials of built elements). (Achten and Zajíčková1,2013).

The need of landscape information modeling (LIM) has been apparent in designing large parks such as Downsview Park in Toronto, Canada. The idea of LIM has emerged

in a design competition in 1999. The aim was to design the park ecologically dynamic; The competition brief indicated that “The physical conditions of the site and its natural processes provide opportunities to create new as well as old ecologies”. Moreover, “It should anticipate an adaptive management approach in which the effects of interventions are monitored, adjustments are made, and new directions and configurations emerge”. The design of the park was mainly concentrated on setting up the park and simultaneously providing a framework for changing over time (Mertins, 2001; North, 2012). The competition winner from OMA/Bruce Mau Design dealt with the challenge successfully.

The design of Downsview Park was broken in detached pieces managed by many subcontractors (North, 2012). If a Landscape Information Model has been used, it would have allowed professionals from different fields to work together in a one park model, which would make it easier and under control for principals who dealt with various alternatives that were produced (Nessel,2013). The Downsview Park couldn’t achieve the condition that indicates the ability of design to be able to change over time and this should be seen as a wakeup call. As North (2012) mentioned, “It is this critical aspect of time that leading landscape architects understand very clearly... but they are still lagging on solid design practices for orchestrating and developing such landscapes, especially once construction is complete.”

A LIM can provide for landscape architects the ability to create regular sheet sets for each design phase, achieving the needs of dynamic ecosystems and a linear construction procedure. Moreover, it helps in automating routine and repetitive tasks and simplify the administrative work (Nessel, 2013).

3.1.3 Geographic Information System (GIS).

The idea of GIS was first proposed and implemented in the 1960s by a Canadian scholar Dr. Roger Tomlinson (Marble, 1984; Yu et al., 2019).

A geographic information system (GIS) “is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data”. The keyword of this system is Geography, which indicates that part of the data is spatial, where these data related to sites on the earth. Attribute data is usually combined with GIS. It is additional data about each of the spatial features. For example, the actual location of the university is the spatial data. The name of the university, student's

capacity, and other additional information would create the attribute data. These two data types allow GIS to be an efficient problem-solving tool in spatial analysis (Url-16).

It has been widely used in analyzing different geographical phenomena and processes, solve planning, and managing issues related to geographic landscapes (Tang and Zhao, 2000). After several years of development, GIS has been improved into a developed and independent scientific approach such as geographic information science, (Alam, 2012; Li et al., 1993) and has been used in environmental sciences (Izadikhah and Saen, 2016; Seta et al., 2017), computer sciences (Jefferson and Johannes, 2016), and in landscape ecology (Böhm and Popescu, 2016). The benefits of GIS are not limiting in gathering, processing, storing and controlling spatial data, but also offers an effective "platform for anchoring comprehensive multi-level spatial analyses and various mathematical models". Furthermore, it enables understanding landscape spatial design and dynamics, particularly when it includes complex relationships and processes between physical, biological, and anthropogenic processes (Bian, 1996; Johnson, 1990; Wang et al., 2019).

Also, at a landscape level. GIS helps to characterize landscape properties in terms of form, function, and change by determining the "fragmentation, patchiness, porosity, patch density, interspersion and juxtaposition, relative richness, diversity, and dominance" (ICIMOD, 1999; Civco et al., 2002).

3.2 Genetic Algorithms

In the 1980s when computers arrived at each desk, and when designers were able to create complex, fluid, and 'biomorphic' forms by using mighty new graphics and modeling software. Programs for simulating different behaviors of mechanisms and structures provide to engineers "evolutionary" methods to maximize the performance. Earlier, in the 1960s the conceiving of 'genetic algorithms' had begun by computer scientists to help in solving complex computational problems and for providing software semi-automatically. Since the 1990s researchers and experts have been implementing these algorithms into experimental computer systems to develop the designs of buildings and other artworks (Steadman, 2008). Genetic algorithms were developed by John Holland in seeking to understand the adaptive processes of natural systems and to create artificial systems based on these natural systems (Holland,1973).

It is a programming technique, which genetic evolution used as a problem-solving model.

Genetic algorithms used at the beginning of solving structural problems, after that it used in finding solutions to solve optimization problems and research concerns. It used as new and extraordinary conceptual ideas to find innovative solutions in the form of processes and new complex designs can be generated. Moreover, it is a useful tool in "feature selection, image understanding, optimization, evolution, automated programming, machine learning, and teaching behavior of the robot and so on" (Latifi et al., 2016).

3.2.1 The mechanism of genetic algorithm

In a genetic algorithm, a set of problems solutions is provided, where the "fittest" solutions being preferred during a random selection process (Holland,1975).

Genetic algorithms for solving problems are going through three basic rules (operator) selection, crossover, and mutation (Figure 3.1).

Figure 3.1: Genetic operators (Latifi et al., 2016).

Selection: a pair of chromosomes is selected to produce the next generation. The operator interface among two generations where some parts of the current generation are transferred to the next generation. However, the selection process is working randomly.

Crossover: "……this step is a process in which the older generation of chromosomes, mixed and combined, can bring up a new generation of chromosomes."

Mutation: A random change in people generates new people in the population. "…. Mutation makes searching the problem space intact, it is the main task of avoiding the convergence to local optimum mutation" (Gofee et al., 2000). The simple genetic algorithm is summarized in (Figure 3.2)

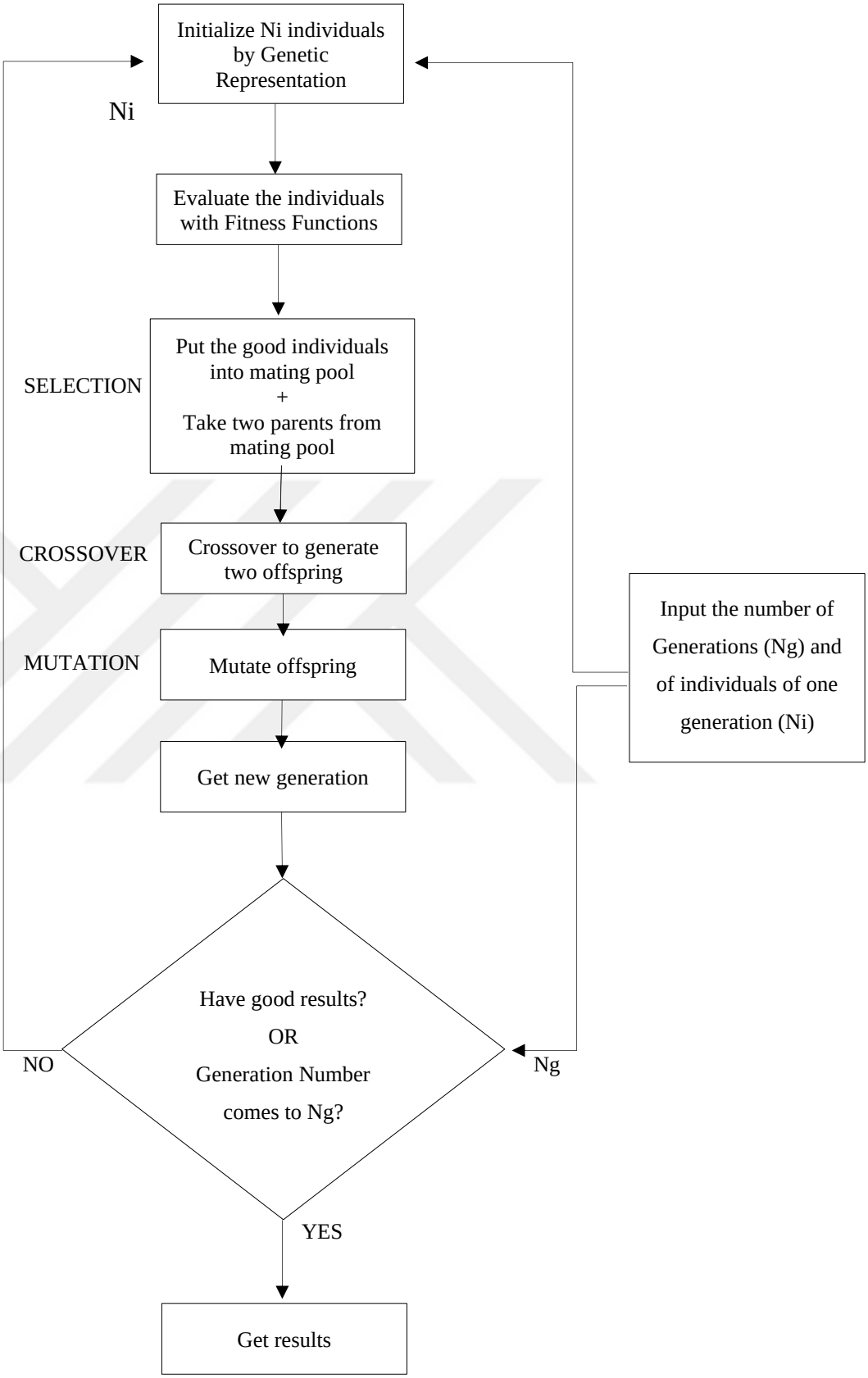

Figure 3.2: The Framework of a Simple Genetic Algorithm (Xu, 2009).

3.2.2 Genetic algorithms in architecture

In architecture, Genetic Algorithms are widely used due to their ability to solve the problem by offering a multiplicity of possible solutions. Unlike other algorithms where the aim is to adjust a manually conceived part or diagram. Moreover, by using the power of the computer that can solve the complex interactions among multiple factors and under multiple restrictions by providing new and unexpected solutions (Narahara and Terzidis, 2006).

Genetic algorithms used in two approaches: “one as an optimizer tool, and the other as a production tool maker”. In the first approach, the concern is being in structural properties problems such as structural performance, mechanical, and thermal. The communication is more with architects and other building specialists. In the second approach, it is giving the designers freedom in concepts and forms. The design is based on the design parameters. Nowadays, designers started to create more complex free forms that are hard to be established by using traditional methods. Thus, using the algorithms and programming codes is developing the architecture field. Modeling by using the generation algorithm is based on numbers, geometry, and calculation which differs from the traditional method. Even in high-volume design freedom, from the beginning, it must be connected to volume specified parameters. As a result, all the resulting routes are linked and exemplified by changing parameters, the route has changed and the received volume calculations are produced (Latifi et al., 2016).

According to Bentley (1999b), to place departments in a London hospital, a genetic algorithm designer program has been used. Where the aim was to create a new design instead of reassigning occupants within an existing layout. However, there were restrictions of the site which means the basic form and number of floors were stated, also, the lifts, entrances, main corridors, and a central atrium were specified too. As a result, the design problems were decreased to that of permuting the positions of departments of known area and within a fixed shell. Different applications have been used for computer-aided design to deal with this type of highly restricted layout task, called “quadratic assignment problems”. Genetic algorithms offer a different type of search technique. Another example of detailed design, Holden and Cangelosi (2005) applied the genetic algorithm to decide the suitable positions of emergency exit signs in a large office building within a given overall layout.

3.2.2.1 Genetic algorithm solver: Galapagos tool

To arrive at an optimized result a trial and error methods are applying, “when automated for specific parameters and results, this technique becomes an effective way to computationally drive controlled results within the iterative design process” in which this allow designers to create optimized parameters resulting in a form, graphic or data that achieve design criteria. Galapagos is one of the software which has been used to ease this process within grasshopper (graphical algorithm editor) which developed by David Rutten with McNeel and Associates (Url-17).

Galapagos is an evolutionary solver for Rhino/ Grasshopper, it is a component inside of grasshopper which optimizes a form that allows it to achieve users’ goals. To achieve that, Galapagos requires a series of options or gens to try out and a defined goal or fitness value. For example, if the designer has five genes that are used to generate an object. That means that there are five numerical values that Galapagos can try within a given range in different combinations. Each combination, or genome, represents a unique object. The thing that distinguishes Galapagos is that it does not test every possible combination of these options to reach the optimum solution. It does it in few times due to the “learning” technique which learns from each successive round of experiments or generations and gradually it reaches or be close to the best answer. So far, Galapagos has been used as a solver for all optimization problems. Nevertheless, there are other components inside the Grasshopper such as Goat and Octopus (Url-18).

Practically, using Galapagos to solve simple problems with a few variables is improbable to provide a surprising result comparing with multi-variable problems that are hard to solve quickly and easily. For example, considering surrounded buildings and specific weather data in a site while testing relevant configurations of the building. The key to reaching good results is about how the problem is expressed. “Ask a stupid question and you’ll get a stupid answer” this applies well with Galapagos. There are two significant parts to creating a Galapagos simulation: “The gene pool and the fitness”; the gene can be understood as the numerical values that Galapagos is working on and try out for the sake of producing the different solutions and scenarios. while the fitness is a “score by which Galapagos will rank each configuration” (Url-18).

3.2.2.2 Project example – Optimization of a hypothetical tower

According to Besserud and Ingram (2008).

This project aims to find the optimal shape for a hypothetical tower with 300 m height, to maximize the benefit from incident solar radiation on the peel of the building. In which the selected tower shape would best suit the deployment of photovoltaic panels to collect the largest amount of solar radiation.

The geometry of the tower under the control of length and point coordinate parameters (Figure 3.3). By using the plan profiles in 6 different positions, the height of the tower was used in order to scan the tower skin. The plan profile for the base was defined in its location and dimensions. To determine the other plan profiles for the other five points, "the shape was parametrically defined by a circular or elliptical polyline which was constrained by two values that controlled the major axis and minor axis lengths." The lengths were limited in a determined range. Also, the center point of the ellipse was free to move in the x and y axes within limits. On each floor of the tower, the 4 geometric parameters were commanded by a value in the genome string which determines either a length for an axis or the coordinates of x and y of the center point.

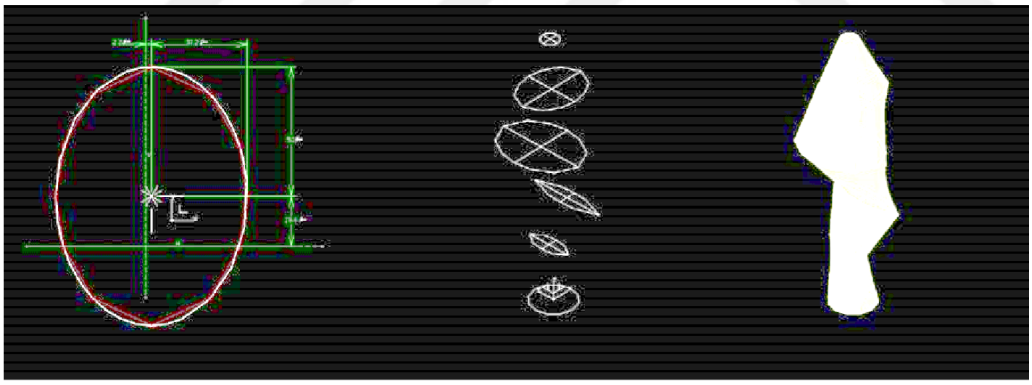

Figure 3.3: Tower genome with length and point coordinate parameters (Besserud and Ingram, 2008).

By applying the genetic algorithm, the generating process went through generate an initial population of 75 genomes, which resulted in 75 different forms of the tower. After that, to calculate the accumulative annual radiation incident on the surface, each tower was connected to the solar analysis module in Ecotect. After the values for floor and skin calculated, the genetic algorithm entered into a repetitive phase determining the selection group of best performance, which will lead to set up the next generation

of genomes and towers through cross-breeding and mutation. Another solar analysis applied to new towers and then determining the new selection group.

The optimizations were run three separate times for two scenarios; one the tower within a context and one without to study the effect of shading. The result founded after three runs, was as follows: “the amount of surface radiation from the first generation to the final generation increased by an average of about 6% and in the 3 runs with context the gain was about 12%.” By comparing these results with a base case geometry of a simple cylinder with the same height and surface area, the first scenario where the context is taken into consideration, optimization was about 27% better. And for the second scenario where the context-free solutions were about 21% better. In both scenarios, the genetic algorithm found optimal results. (Figures 3.4-3.6) show the three runs for the context-free scenario).

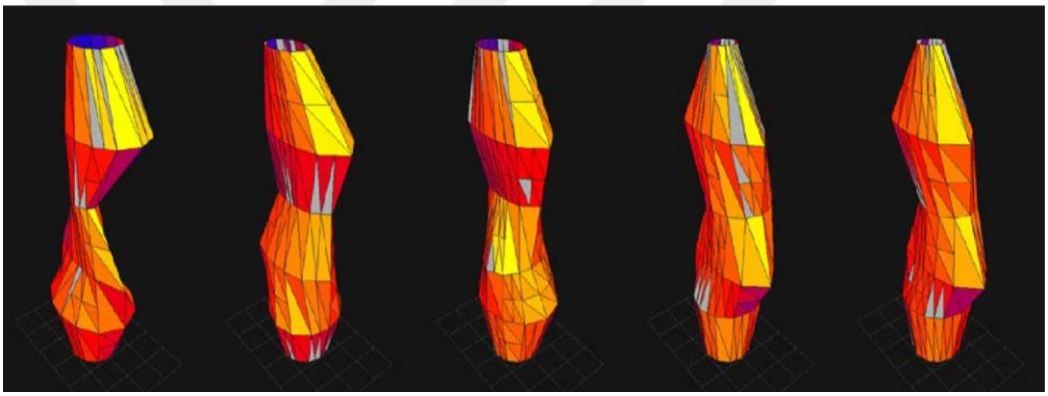

Figure 3.4: Evolution of the tower with no adjacent context in the first run (Besserud and Ingram, 2008).

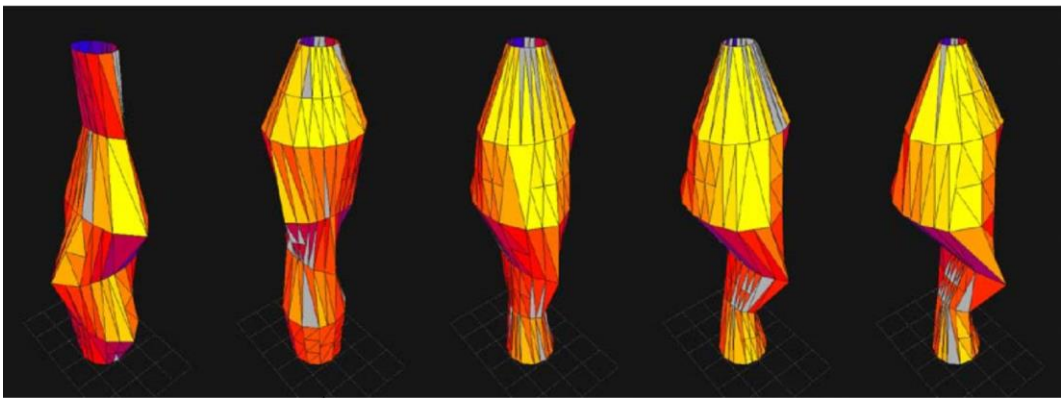

Figure 3.5: Evolution of the tower with no adjacent context in the second run (Besserud and Ingram, 2008).

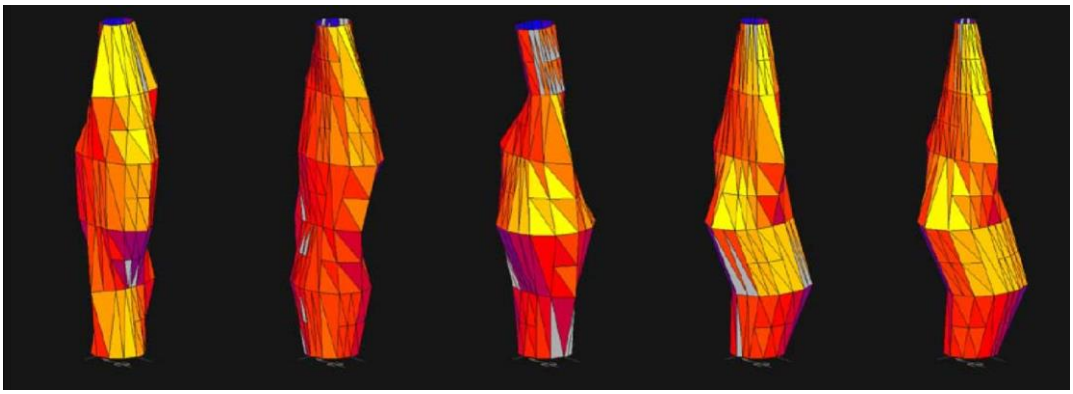

Figure 3.6: Evolution of the tower with no adjacent context in the third run (Besserud and Ingram, 2008).

3.2.2.3 Project example-Informed walkable city model

According to Indraprastha and Putra (2019).

There are new urbanism agenda concepts that have appeared as a response to the modernism theory which led to the vehicle-oriented city, urban sprawl, and other urban problems. Transit-oriented Development, Mixed-Use, and Walkability concepts aim to increase the quality of life of the city residents (Duany, et al., 2000). Walkability is an urban design tool that has been emerged at the beginning of the modern era, which been counted as “a key factor for the vibrancy of the city” (Jacobs, 1961). Moreover, it provides new approaches for urban analysis and design especially in enhancing pedestrians, decreasing the usage of the vehicle, and determining suitable sites for the selected programs.

The project aims to provide a better city analysis tool that can help in the decision-making process on urban planning by “proposing a parametric and data-informed method based on the concept of walkability”. The methodology may be used in suggesting different scenarios and evaluate them based on data-set combinations and rules by using a parametric and repetitive generation of solutions.

The project selected a site in Bogor city in Indonesia where the area is “about 11.85 sq km with 59.45% is built environment with 1.050 million inhabitants.” In a high residential crowded and commercial area at the same time. To analyze the relation among street arrangement and finding suitable areas for amenities to the Walkability score, the studying area has been divided into two parts, and based on the walkability score using amenities factors, the classification of amenity categories has been developed according to the actual and existing condition. Also, the average length of

the block and the number of street intersections have been determined by using Pedestrian Friendliness Metrics parameters.

In the next step, the city map developed into multi-attributes geometric data in Rhinoceros using Grasshopper. The Elk add-on by Timothy Logan (2015) was used to transform OpenStreetMap data into significant attribute points of physical properties like building and street outlines, river outlines, and railway outlines. By applying the parametric process through algorithm development, the points compiled into closed polylines that represent buildings, streets, rivers, railways, etc. (Figure 3.7).

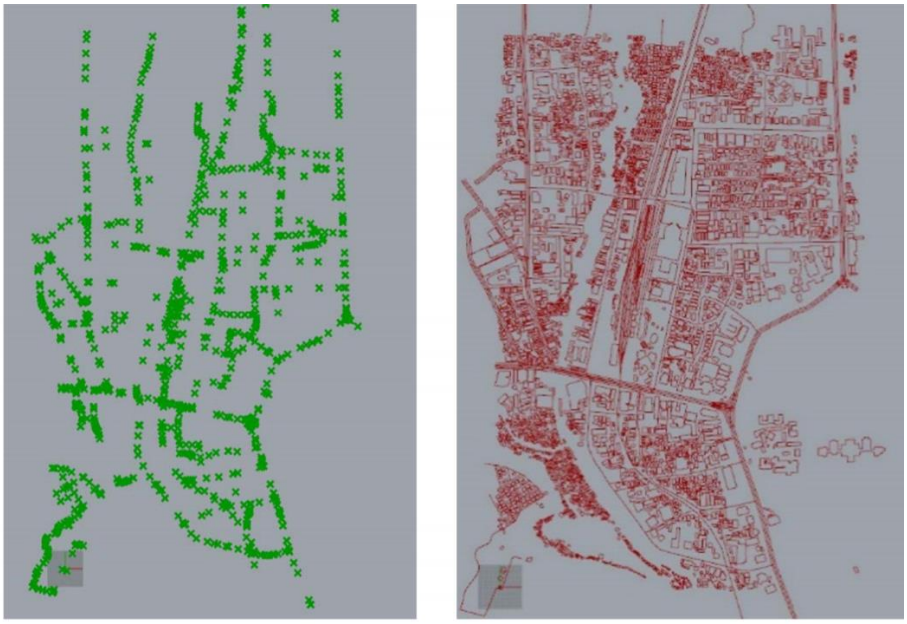

Figure 3.7: Development of Point-based data into Polygon (Indraprastha and Putra, 2019).

After that, a method developed to optimize the walkability score to add a new amenity for a certain area (Figure 3.8). "The parametric method is based on the walk score algorithm with modification on new data set from each determined amenity categories, obtained from a set of origin points." The importance of this method is through a parametric model that allows generating different scenarios of evaluating new optimum locations with determine function based on Walk score categories at any specified area. (Figure 3.9).

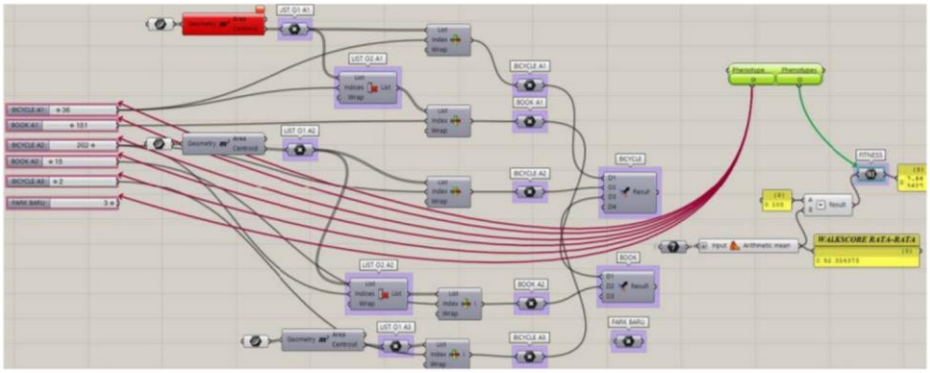

Figure 3.8: Algorithm for the optimization model for a new amenity location (Indraprastha and Putra, 2019).

Figure 3.9: The result of the optimization method determining new Locations for amenities (Indraprastha and Putra, 2019).

3.2.2.4 Project example – Climate façade.

According to Altschul (Url-19).

The success of the project comes from the ability of multi-objective algorithms to be solved and help in designing the façade geometry directly within the digital design environment. Grasshopper provides beneficial applications to achieve the goal. Especially in conditional multi-variable solving field, processing time, geometry formation, and logic building from climatic data sets.

Genetic algorithms can gain knowledge and develop that knowledge in each repetitive analysis run to find an optimized solution. Thus, the algorithm develops in each new run in finding a solution and reduces computation time to reach the result.

Galapagos is a pre-configured command in Grasshopper which is considered as a genetic algorithm solver and "used as a departure point for studying how genetic algorithms could interact with climatic data, and generate optimized geometry using multi-objective search criteria inside the digital design space." To test the suitability of Galapagos to the project, it should interact with climatic data, author optimized geometry, solve multi-objective criteria, and presents solutions by processing many of climate data. Thus, three experiments were performed to test Galapagos's capabilities "to sort through data sets, author geometry from climate data, and optimize with multi-criteria restraints."

The first experiment includes that Galapagos determine the date, month, and time the greatest amount of collective solar radiation was falling on a tilted section of a building façade. The determined date, month, and time worked as the parametric slider adjustments that Galapagos was adjusting and a solar radiation test point produced the comparison to determine whether the fitness function "the maximum" was achieved or not. After running the analysis for two hours on the selected façade portion, the result was that Galapagos determined September 9th at 9:00 am the date that receives the greatest amount of solar radiation (Figure 3.10).

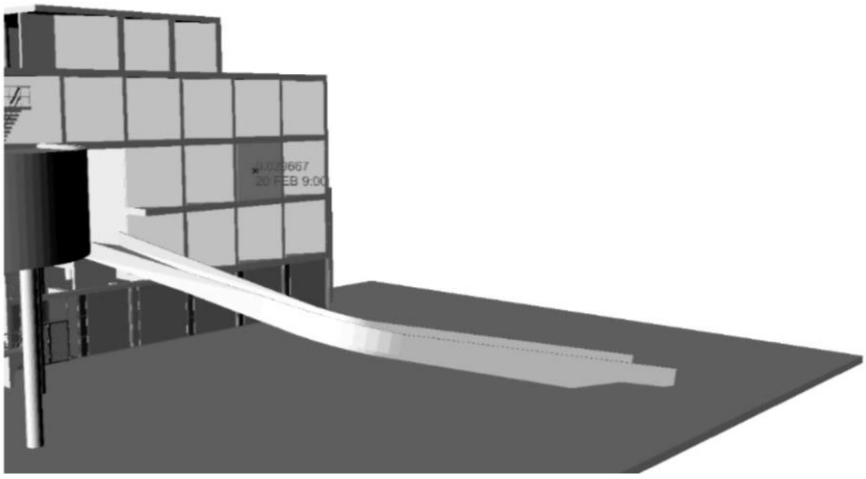

Figure 3.10: Moment of greatest surface solar radiation (Url-19).

The second experiment tested Galapagos's ability to optimize and create geometry from climate data. While the experiment a desired solar radiation value (0.2 kWh/M2)

has been set on a fixed time and date that worked as the fitness function, also geometry parametric were built for vertical fin shading devices. Galapagos can modify “the rotation, width, and depth of each vertical fin independently as it worked towards resolving a solution that obtained the closest average of 0.2 kWh/M2 across the façade sample”. The façade sample turned and rotated to the North-East direction to obtain a variation of solar radiation across the façade (Figure 3.11).

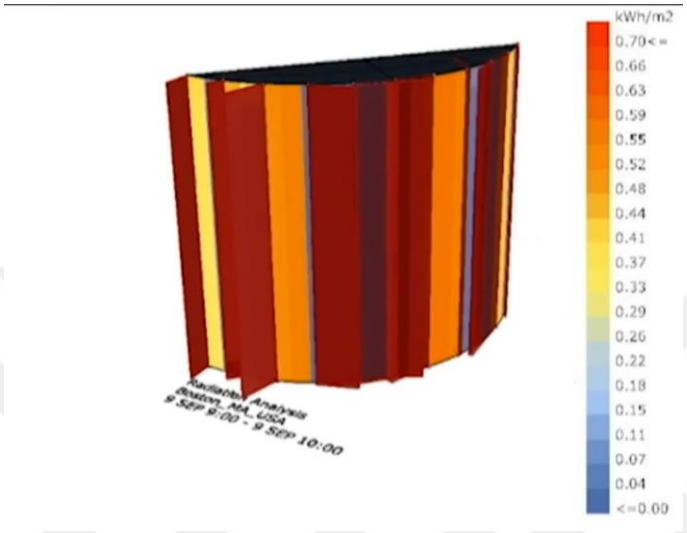

Figure 3.11: Solar Radiation (Url-19).

The third experiment was combining the first and two experiments through examined the Galapagos’ processing of multi-objective criteria. Vertical shading fins were built along a façade with parametric sliders, and a range of months, dates, and times was provided as sliders. The task was to optimize and create façade geometry and determining the ideal date and time for a fitness function of (0.3 kWh/M2) of cumulative solar radiation at the same time.

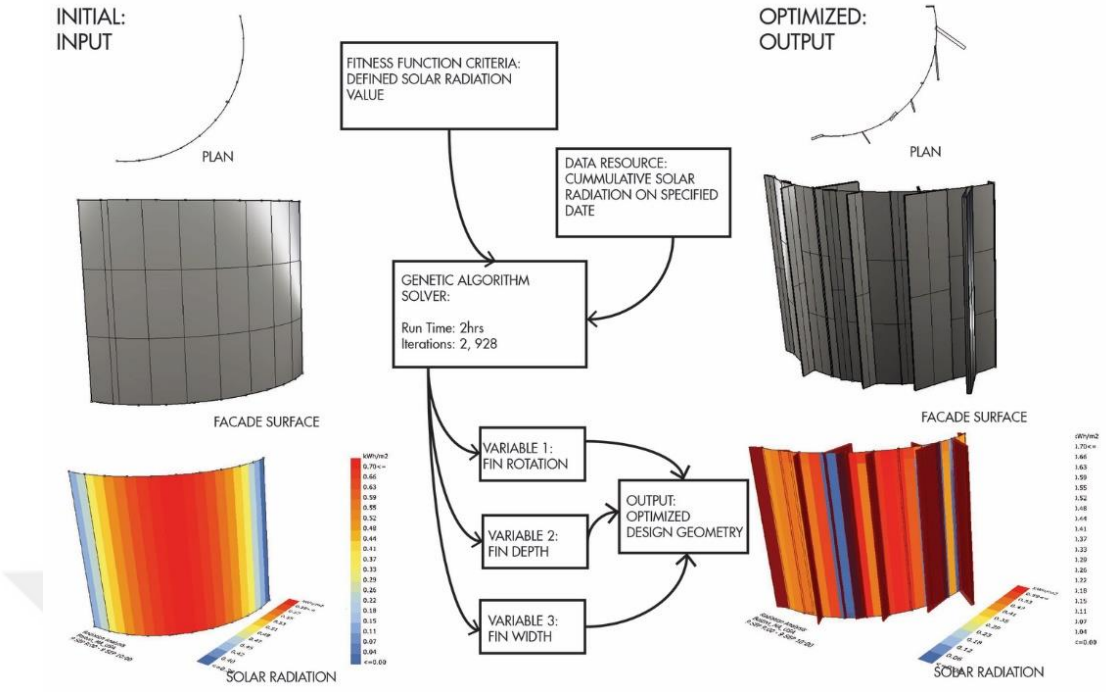

Figure 3.12: The climate facade creation poster (Url-19).

Galapagos tool easies and support the architectural design process. By using Galapagos as a genetic algorithmic solver, the numerical values and performance based on geometry can be created and this can assist architects in climate responsiveness designs by determining parametric relationships and build performative goals to optimize for.

3.3 Parametric Design

3.3.1 Computational design

Generative design systems allow the formation of complex arrangements, for formal and conceptual approaches, by implementing a simple set of operations and parameters. Consequently, this new understanding leads to the emergence of creative modes of design thinking (Ahlquist and Menges, 2011). such as generative modeling, which can be perceived as a cyclical process based on algorithms where inputs and variables can apply in the design algorithms (figure 3.13). By using this process, models can be emerged, developed, and changed based on new inputs or parameters that are applied to the design (Meier, 2012).

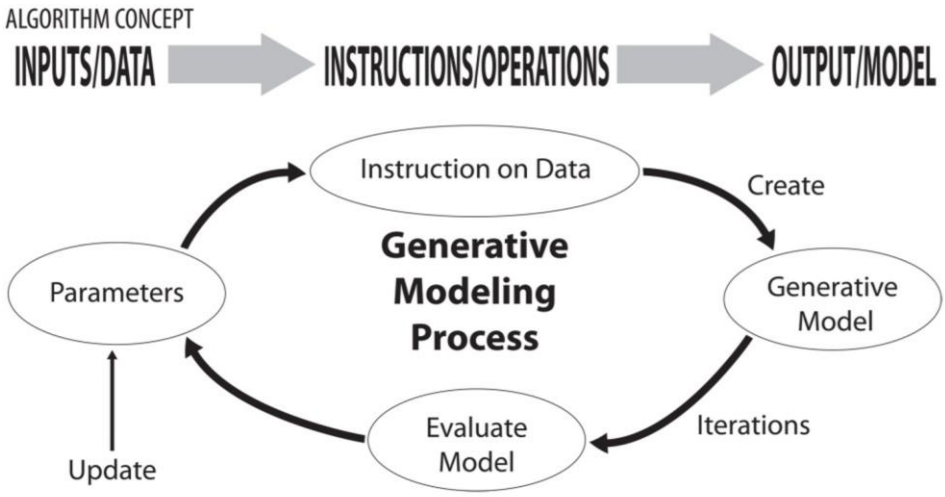

Figure 3.13: The concept of algorithms and generative modeling diagram (Meier, 2012).

Computational Design in Architecture

Many terms have been used to describe computers such as digital, computational, and algorithmic. Thus, when professionals started to implement computers in design, users started to use expressions like digital design, computational design, algorithmic design, and so on. Digital design can describe using computer tools in the design process, while computational design involves the use of computation to develop designs. Also, we can have computational design without the use of digital tools at the same time we can use digital tools without relying on computational design, or we can have both (Caetano et al., 2020).

The relation between computational design in architecture and its importance through the years can be noticed in (Figure 3.14). Which evaluates the relevance between computational design and architecture through measuring the frequency of its use as the main research subject or as a keyword in the literature through time. As shown in the figure the computational design has been significant in architectural scope, especially in the last decade. This may imply the related topics to computational design will grow and maybe dominate in the future (Caetano et al., 2020).

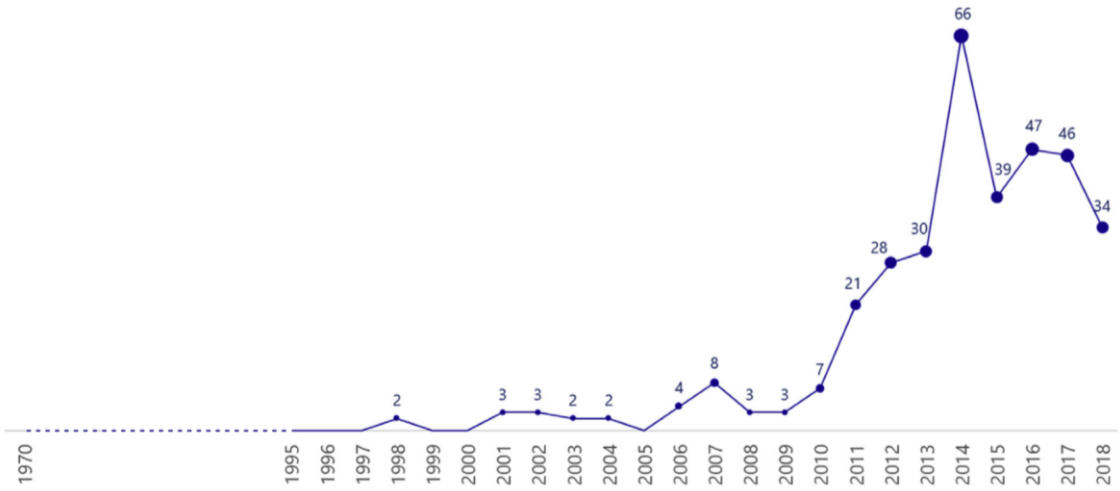

Figure 3.14: The Usage of the computational design term through time.
(Source: Cumin CAD, Science Direct, Scopus, Web of Science, Caetano et al., 2020).

Although the term has appeared only at the end of the 1990s, it emerged before in the 60s as a result of modernist thinking and technological searches (Koutamanis, 2005).

Schützenberger (1954) mentioned that computational design related articles were published before 1960. These movements have been affected other fields such as artificial intelligence (Simon, 1969), cybernetics (Wiener, 1948), and mathematics, that have started to connect between computational design and architectural design considering it as an assisting tool for design problems in a “thinking before acting” manner (Papamichael and Protzen, 1993). Furthermore, the first techniques were put in practice during the 1960s which included basic 2D primitives and new structures like splines. The new graphical methods that related to Sutherland in 1963 in which his thesis was published (Monedero, 2000).

The first integration among computational design and architecture appeared in the 1970s. The first position papers (Eastman, 1975; March and Steadman, 1971; Mitchell, 1979) and Ph.D. theses (Akin, 1979; Yessios, 1973). Moreover, Within the 1970s the free-forms like curves or carved surfaces have developed, the most advanced method used was NURBS non-uniform rational B-splines that refer to an article by Robin Forrest in 1980 From Cambridge University. It was inserted in Auto Cad in 1998 (15 years after it was founded) through an extra module Auto Surf which came with version 13. He also re-defined the terms of curves and surfaces by using polygon vertices instead of polygon sides (Rogers, 2000).

After that, in the 1980s the marketing of the first computer-aided design tools has influenced computational design to became a noticeable and accepted field in architecture (Koutamanis, 2005). During the 1990s, the computational design was an accepted approach with its conferences and journals. Furthermore, the computer-aided design software became famous among architects, due to the automation of repetitive tasks that led to an increase in productivity.

Recently, many deign approaches have been integrating different computation-based methods, such as building simulation, evolutionary optimization, and novel fabrication methods, which means arising new design approaches and expressions (Oxman, 2017)

Computational Design terms

In the last two decades, architects used the computational design model in their works to improve the design process and to explore new and different research methods. Computational design often needs specialized expertise from different areas, that coerce designers to earn knowledge from different fields. As a result of field combinations, various design approaches, and models that led to new terms appearance. As shown in (Figure 3.15), the famous and repeated terms related to computational design were represented and its frequency (Caetano et al., 2020).

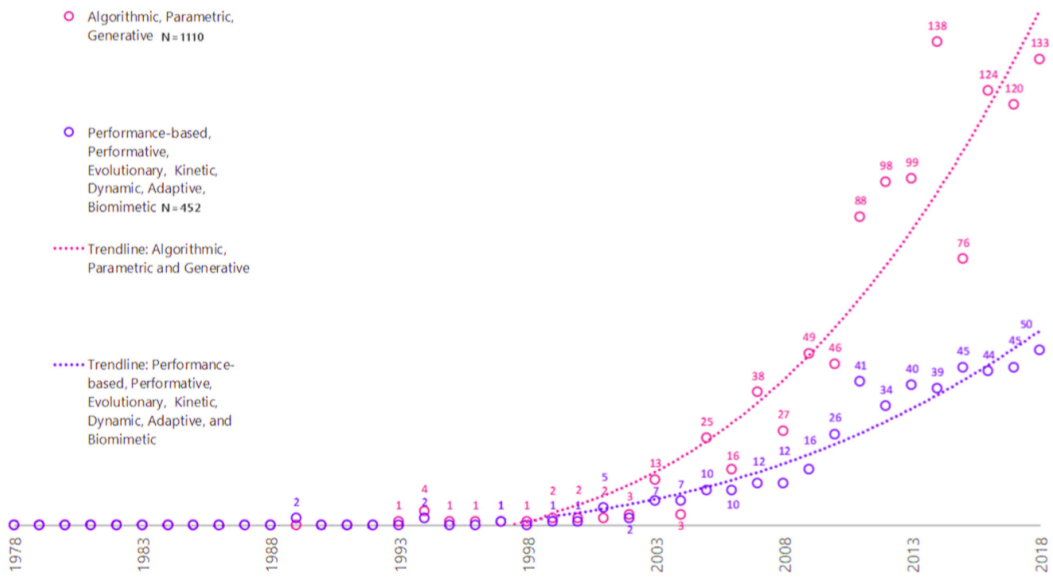

Figure 3.15: Frequency of use of computational design-related keywords between 1978 and 2017 (Caetano et al., 2020).

As can be noticed from the previous figure, the parametric, geometric, and algorithmic design terms significantly increased in the previous years.

3.3.2 Parametric design applications

Parametric systems are based on algorithmic principles fundamentally. Thus, it is important to understand the role of algorithms in design, then explain the parametric system. An algorithm is a limited set of instructions that aim to achieve a clearly defined purpose within a limited number of steps. An algorithm takes one value or a set of values as input, then performs a series of computational steps that transform and process the input, to produce one value or a set of values as output in the final step. A simple example can clarify the idea; a cooking recipe is an informal form of algorithms, considering the ingredients are the inputs, the cooked meal is the output, and the cooking process is the procedural steps to be followed (Dino, 2012).

The importance of algorithms lay in the capability of solving various and different computational problems such as sorting and searching, data structure procedures, combinatorial problems, numerical problems, and computational geometry (Cormen, 2001). By mention procedural workflow, there are three basic control commands which operations based on; sequence (implement instructions in order), selection (choosing which instructions to implement or to exclude according to if-then statements), and iteration (repeating instructions in a linearly or recursively way) (Chang, 2003).

Parametric design is based on an algorithmic construct, it's considered as a subcategory of algorithmic design. From a computation perspective, there is no difference between algorithmic and parametric systems; algorithms work on parameters, and the basic element in the parametric system is the algorithm itself which called the schema or definition. Nevertheless, there is a simple difference among them during the design process in which the parametric system emphasizes the direct editing on the parameter values which makes a change on the design product. Thus, the parameter values can be changed by the designer to manipulate the design geometry to find the optimal design solution (Dino, 2012).

In order to study the evolution of parametric design, the progress in defining and understanding the term of parametric design would be mentioned through the years.

According to Moretti (1971), parametric architecture is the study of "the relationships between the dimensions" of a design based on parameters. The Moretti's definition expanded by considering parametric modeling as a computational representation of

geometric relationships that are “automatically updated and visualized on the screen” when the parameter changes Kalay (1989). In the 90s a similar view continued by focusing on the relevance among the form parameters Monedero (1997). Kolarevic (2003) defined parametric design as a procedure in which the “parameters of a particular design are declared and not its shape” which enable different solutions while keeping the general frame at the same time.

Later, the definitions after 2010 have been influenced by the early 2000s’ perspectives about parametric design. According to Woodbury (2010), the parametric design explores associative geometric relationships to contribute to “the creation, management, and organization of complex digital design models”. Other authors suggested a classification of different types of parametric design methods. For example, Janssen and Stouffs (2015) divided the parametric design into categories based on the types of modeling, such as an object, associative, data-flow, and procedural modeling. Besides, there is another view that narrows the area of the parametric design such as Elghandour et al. (2014) who believes that the parametric design is a code-based design approach that makes the generation of different designs alternatives easy and without needing recreating models manually.

As mentioned in the Oxford Dictionary; the parameter is “a numerical or other measurable factor forming one of a set that defines a system or sets the conditions of its operation,” or is “a limit which defines the scope of a particular process or activity,” and defines the word parametric as “relating to or expressed in terms of a parameter or parameters” (Caetano et al., 2020).

Based on the literature definitions, the parametric design can be explained as a design process based on algorithmic thinking (Jabi, 2013; Jabi et al., 2017) that uses parameters and rules to restrict them (Barrios, 2005; Eastman et al., 2008; Kensek et al., 2015; Marin et al., 2015; Monedero, 1997; Moretti, 1971; Nassar et al.,2003; Hernandez, 2006; Schodek et al., 2005; Szalapaj, 2001; Woodbury, 2010; Yu and Gero, 2015).

In other words, parametric design is a process that describes a design representatively according to parameter inputs (Caetano et al., 2020). For example, to produce different types of an item like a wall, the properties that used to produce the same items are

positions, lengths, heights, and thicknesses. If they replaced by symbolic parameters that have limited domains, the result will be a symbolic representation of a set of walls.

3.3.2.1 Parametric design in architecture

If architecture is considered as a volume in space, the geometry, and mathematics is greatly apparent in its design. Form history time, the form in architecture has related to the geometry. For example, Islamic architecture and decoration shapes used in buildings have been based on math and geometry calculations. which shows a strong connection between architecture with geometry and math (Latifi et al., 2016).

The popularity of the parametric design term in the last two decades indicates the large use of it particularly from architects who adopt using computation in design after experiencing the advantages and the speed of such approaches. The development in the computer architecture field has been improved especially in the 21st century, that helps architects to create new forms by the tools and at the same time the related software has been founded (Caetano et al., 2020).

According to Schumacher (2009) "Parameter the fundamental rethinking and constitute basic elements of architecture...". The use of computation has opened an infinite range of productive power of algorithms. Which enabled architects to create new creative environments and forms with a system of codes and algorithms. Digital modeling and visualization of architectural buildings has become a baseline in the work of architects and significant in architectural education (Majore and Cakula; Kay, 2010).

The software programs have been developed from the original 2-D programs that used to draw the architectural designs, to the software used for computer-aided design which became intelligent 3-D software programs based on parametric modeling. Thus, new movements in architecture have emerged and the field of nonstandard architecture has been determined (Stavric and Marina, 2010).

Many steps have been taken ahead after simple parametric modeling such as generative and genetic algorithms. Different software programs offer graphical algorithm editors such as Coffee and Grasshopper, that are linked to 3-D modeling tools which enable interactive parametric modeling without needs of previous knowledge of programming or scripting requirements. This allows designers to generate a broad range of non-standard designs that can be modified easily and interactively.

In general, the values of parameters contribute to shaping the parametric design form, and equations are used to characterize the relationships between the forms. Consequently, the relation among forms can be determined and the form's behavior under transformation can be specified (mathematically and geometrically). Since the appearance of the parametric design, it has developed the digital architectural design on different levels. Many discourses dived the parametric design into two main types of design; The first one is conceptual parametric design, which defines the parameters of a particular design but not its exact generated shape. through specifying different values to the parameters, different objects or configurations can be developed. The software that usually used for the conceptual design like Maya or Rhinoceros (with Mel or Rhino Script), which offer script editors for parametric design. Maya is software used for animation and capturing but in recent times, many architects have used it for conceptual design purposes. In this method, the programming and scripting knowledge is essential because it relies on mathematical algorithms rather than the interactive design which is not possible in this design approach.

The second type is the constructive parametric design where data is inserted in a predetermined 3d object, such as walls or doors or other repetitive pre-drawn elements. This design approach relies on different computer-aided design packages like Autodesk Revit, Soft Plan, Nemetschek, ArchiCAD, or Chief Architect. this approach aims to reduce the drafting and editing of 2D drawings (Stavric and Marina, 2010).

The parametrically based approach in architectural design provides the ability to search for a completely new level in the form generating process and non-standard objects that can be dynamically transformed to achieve a strong integration of design process with producing various architectural elements or contributing in enriched elements in urban plans scale.

There are many contemporary architectural examples of the parametric design applications such as the Qatar Integrated Railway Project by UN Studio (Figure 3.16) and the Hangzhou Olympic Sports Center by NBBJ Architects (Figure 3.17). In the mentioned cases, designers established parametric programs based on parameter inputs to generate various alternatives for the buildings. Which assisted them in creating and imagining forms by modifying the design parameters (Caetano et al., 2020).

Figure 3.16: The Qatar Integrated Railway Project (Url-20).

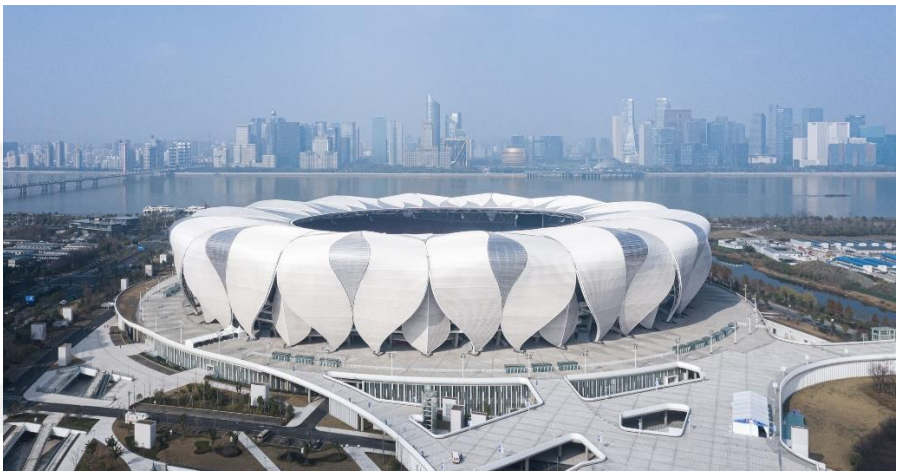

Figure 3.17: The Hangzhou Olympic Sports Center (Url-21).

3.3.2.2 Parametric design in landscape architecture and urban design

According to Meinig (1979) individuals who look to the same landscape point from the same place would observe the same elements like houses, people, cars, lawns, and trees also they would mention the size, shape, and color. However, at the same time, they would recognize all observed objects differently according to their certain ideas or existed perceptions in their minds. Therefore, the landscape has many denotations and contains tangible and abstract elements. The tangible elements include the things people could see through their eyes. In contrast, the abstract elements related to the landscape already existed in people's minds.

Landscape architecture, who is responsible for creating and modifying all elements that form the landscape, trying to achieve and create physical strategies and forms regarding ecological, technical, artistic, and aesthetic requirements. Landscape architects base their work in integrating these factors with architectural elements to

conserve the present forms and data, develop and improve the quality of life (Yılmaz, 2015; Bekci et al., 2015).

In these procedures, they follow particular formal, semantic, physical, and functional design issues (Yılmaz et al.,2016; Eren and Var, 2017). Nowadays, Parametric design is one of these approaches that was used by landscape architects to integrate all the design concerns with many suggestions and alternatives.

Usually, the computers used in landscape architecture in technical calculations in design and presentation usages. However, implicating computers in the design process could improve the design results. Tools and techniques developed with the algorithmic approach aided the design process for the user. The concept of the algorithm could be defined as the combination of steps required to solve a problem and the resulting algorithmic approach constitute the basis of parametric design. In a simple form, a parameter could be explained "as a quantity that could be defined and modified for a condition, and the condition that contains this quantity in any count could be perceived as parametrical" (Eren et al., 2018). According to the design case and situation, the number of parameters could be varied.

In most cases, the geometry modeling approach in parametric design is based on variation settings (Yu et al., 2015). The significant part is the correlation between parameters should be determined well and to manage the parameters on demand. This term is frequently used and it is important in landscape architecture design. Parametric applications enable the architectural conditions to be studied in a three-dimensional environment, instead of two-dimensional or layering techniques usually used. This indicates the essential concept of parametric modeling based on data, variables, and their relationship to other units, leading to responses to changes in input data (Schnabel, 2007).

The volume modeling algorithm-based method differs from the usual method of drawing volumes. In the first method; productive numbers, geometry, and calculations are based, even if the volume of design starts in freedom way, the volume must first be connected to the determined parameters. As a result, the routes are all attached and determined by changing parameters, the route has changed and volume calculations received is produced. Another important point, using algorithmic methods can reduce the total production amount in different related fields such as architecture, engineering,

energy, infrastructure, and urban development. Using expert software such as "Grasshopper" could well fill the gap between the design and construction and other fields as well. Science-based Code-low (CAD / CAM) is attempting to connect between the building industry and architectural design where "Grasshopper" is a tool that can achieve that connection as well (Latifi et al. ,2016).

3.3.2.3 Project example -South Park

Computational tools test the flexibility of analog rules for spatial division within a small park.

Figure 3.18: The South Park San Francisco, USA. (Url-22).

Designer: Fletcher Studio.

Location: San Francisco, USA.

Year constructed: 2017

According to Fletcher (Url-22), The design of the park developed a “pathfinding” tool to collect data from the site and use it to draw the path towards important points (Figure 3.19). Collecting data aims to understand the site needs and embedded in an analog rule set such as land use, park usage, circulation patterns, tree conditions, drainage systems, points of entry, and desire lines. This data was then collected into a “hierarchy of circulation patterns, access points, social nodes, existing trees and structures to retain” thus, to assign the width and position of the central path of the park (Figure 3.20).

Figure 3.19: The design of the park develops a ‘pathfinding’ tool (Url-22).

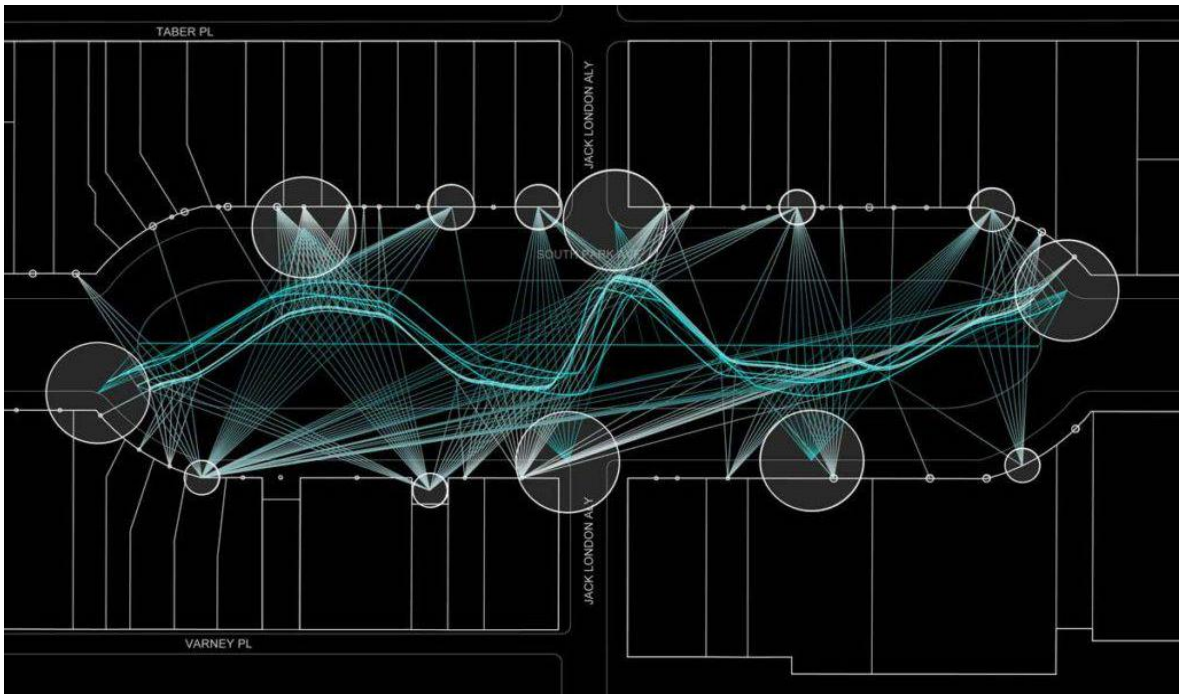

Figure 3.20: Control points of different density are parameterized to manage the alignment of that path which runs through the site (Url-22).

Analog rule sets have many problems; the long time that needs to test and the ‘idiosyncratic moments’ that contribute to the appearance of new and exciting design forms but can also lead designers to disregard some significant principles or failings in their logic. As responding, the system of organization developed on paper was transformed into a Grasshopper script and used to test “the design resiliency” of the diagrammed “tectonic and spatial systems.” As a result, the designers overcome any kinks in their logic while repeating over the design rapidly, plus conserving the previously-established limitations of their design concept.

By translating the rule sets into Grasshopper and refining it through repeated testing, “a live model” - as Fletcher Studio called it - has been developed which: “…..was

responsive, in the sense that various 3-D parameters could be modified and would universally update the entire model. Paving tablet width, length, and distribution could be adjusted by modifying inputs, allowing the entry of exact values, or perhaps more intuitive site-specific adjustments….”.

Parametric design techniques provide a special aid in time-saving, especially through modification occurs in the latter stages of the design process. Moreover, parametric design plays a significant role in detailing and the connected rapid production of sheet files for engagement with stakeholders. According to project landscape architects, the Grasshopper can deal with big strokes and small details at the same time. which saves a lot of time in repeating and editing likewise allow the designers to create detailed outputs much faster than it was before (Figure 3.21).

Despite the potentials that Fletcher Studio found in computational tools, they have concerns about these tools to become all things in a project. “Memory, experience, emotion, and humor are not yet parameters that can be put into a parametric definition,” mentioned David Fletcher (Url-22).

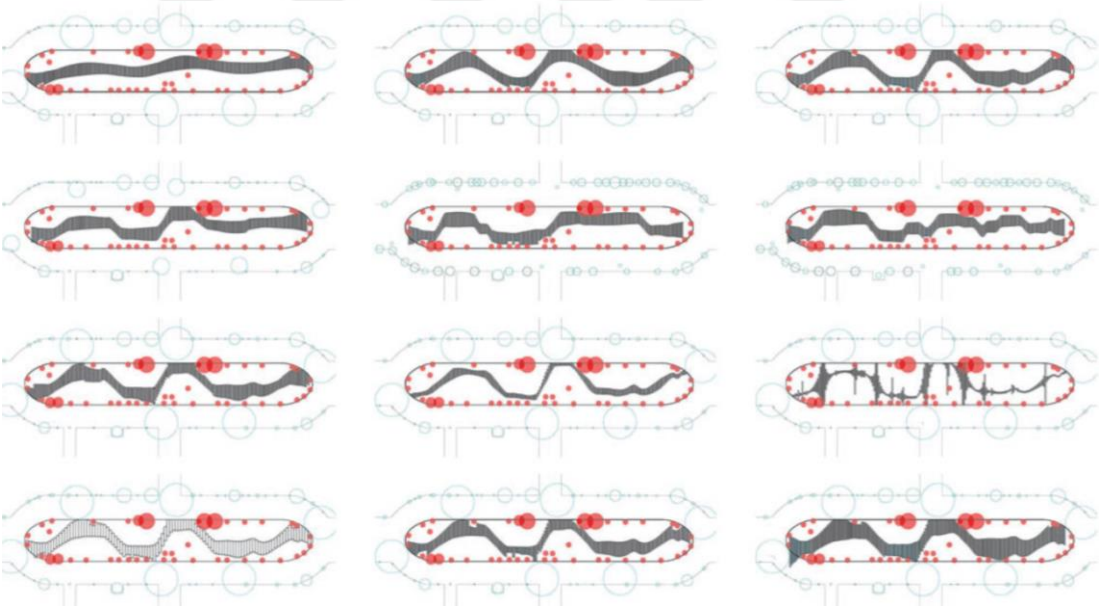

Figure 3.21: Parametric scripting allows for the fast generation of highly detailed design repetitions (Url-22).

3.3.2.4 Project example -The Thyssenkrupp Headquarters

Designer: Zaha Hadid and Patrik Schumacher.

Location: Essen, Germany.

The area: 146100 sqm.

The urban master plan includes office buildings and a multi-functional building, an academy, and a hotel. The design dealt also with an existing building on the site. Which oriented all of the new and old buildings towards one central plaza (Figure 3.22).

The design idea:

It is considered as a landmark architecture with a dynamic sculptural narrative form. The axes span spiral like in all directions shaping a centrifugal field that forms the outline of the buildings and surroundings landscape. The spatial design reflects dune landscapes or glacier areas formed and smoothed by nature (Url-23).

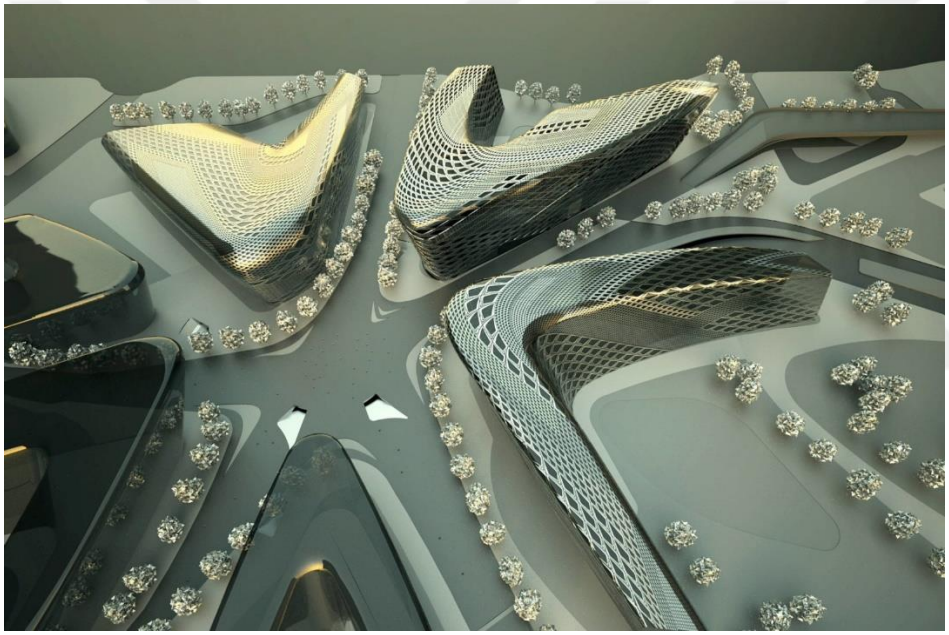

Figure 3.22: The Thyssenkrupp Headquarters project (Url-23).

4. RESEARCH

4.1 Purpose and Scope

Urban sprawl and the rapid increase in population have been converting cities to be dense and crowded. Thus, the pressure on creating or developing urban open spaces has increased. Pocket park as an urban space supplies city with green spaces in small scales. It located usually in residential or commercial neighborhoods to provide a place for entertainment and socializing.

The main purpose of the research is to address the basic guidelines and design criteria for the pocket parks to set rules for parametric design guide as a decision support system which would lead designers, planners, and stakeholders in creating or developing such kind of parks.

The limitations the research faced as mentioned above:

First, the lack of literature and related research that tackling “pocket parks” subjects such as emerging process, definition, park elements, or design criteria. Although the literature review presents various design guidelines that define the limitations and ranges for parameters like size, assets, etc., there is a lack of research on creating design or planning rules to serve as input for computer-aided design or evaluation systems. At that point, this research aims to present a design algorithm that can be adapted to a parametric design tool as a decision support tool for design stakeholders.

Secondly, the number of guidelines and standards mentioned in the pocket parks were little compared with other types of parks, and the mentioned information in some standards includes general design guides without specific requirements and conditions. Thirdly, pocket park’s standards and guidelines in some cases have conflicts or differences in criteria. For example, the size of the pocket park was mentioned in some standards as 1012 sqm maximum (Seattle Parks and Recreation, 2017; Maryland-National Capital Park and Planning Commission, 2018) and the same size mentioned

as the minimum size according to Parks, Recreation and recreation facilities element, City of Thornton, (2017). However, in other standards, the size can reach 5000 sqm (Edmonton's Urban Parks Management Plan standards, 2016; Abd El Aziz article, 2017). Thus, the range of pocket park's size was hard to determine as other parameters too.

4.2 Methodology

For the purpose of building a database for the decision support guide, the research began with a literature review about the pocket park, the emergence circumstances, and definitions. Then based on Marcus's book (1997) pocket park's design recommendations, the main design criteria have been addressed- in addition to other updated standards in the global scope. Furthermore, different pocket park case studies have been analyzed. After that, based on Abd Al Aziz (2017), the mentioned classification has been used in categorizing the standards and guidelines in groups as a primary step. In the next step, a literature review tackled with computer-aided design concepts and related fields such as BIM, LIM, and GIS have been explained within a process of establishing the designing guide and understanding the related data. Then, the concepts of genetic algorithm and parametric design have been mentioned supplied with architecture and landscape applications and examples.

In this section, the previous standards and design guidelines would be developed and recategorized to define parameters for the decision support guide.

4.2.1 Data collection

To create a set of pocket park's design rules, three phases have been stated in the research process:

The first phase was determining the design parameters and general standards of a pocket park for the sake of defining a general database to start from. Based on Marcus's book design guidelines for urban open space (1997), the selected design parameters were:

- The size
- The site selection and placement

- Location Types
- Design Program
- Boundaries
- Play Area
- Site Furniture
- Functional Areas
- Plant Materials and Green Areas
- Surfaces

In addition to Marcus's book, the updated standards and design guidelines were collected in global scope; Hongkong, U.S.A. (various states), England, Australia, and Canada. And in front of each design parameter, according to the standards and their contents, the standards and design guidelines were mentioned for each design parameter. While establishing the database, the research analyzed built pocket parks case studies to broaden the study and support the database with applicable ideas.

The second phase worked with a primary categorizing to ease the process of dealing with collected data. According to Abd El Aziz (2017), there are common design criteria that found almost in each pocket park in terms of:

- Area and location.
- Access and linkage.
- Space design.
- Uses and activities.
- Environmental elements.
- Landscape elements.

Subsequently each guideline from the -mentioned guidelines- was analyzed in terms of design criteria of pocket parks as well as for the built pocket parks.

The third phase consists of two stages, in the first stage, the research established a base of the computer-aided design concepts and related fields which tackled literature review, definitions, and explanations supported by architectural and landscape architecture examples and applications.

The second stage represents defining design guides as design parameters and determines the relations among parameters. Starting from re-categorizing assembled guidelines and manage the data from a point of computer-aided design where the application and assigned data would be used in which the research can restrictive the

programming process to produce a suitable design. This includes merging some and excluding -if needed- to set up the database of the design tool as would be shown in the next section.

The three phases are shown in figure 4.1.

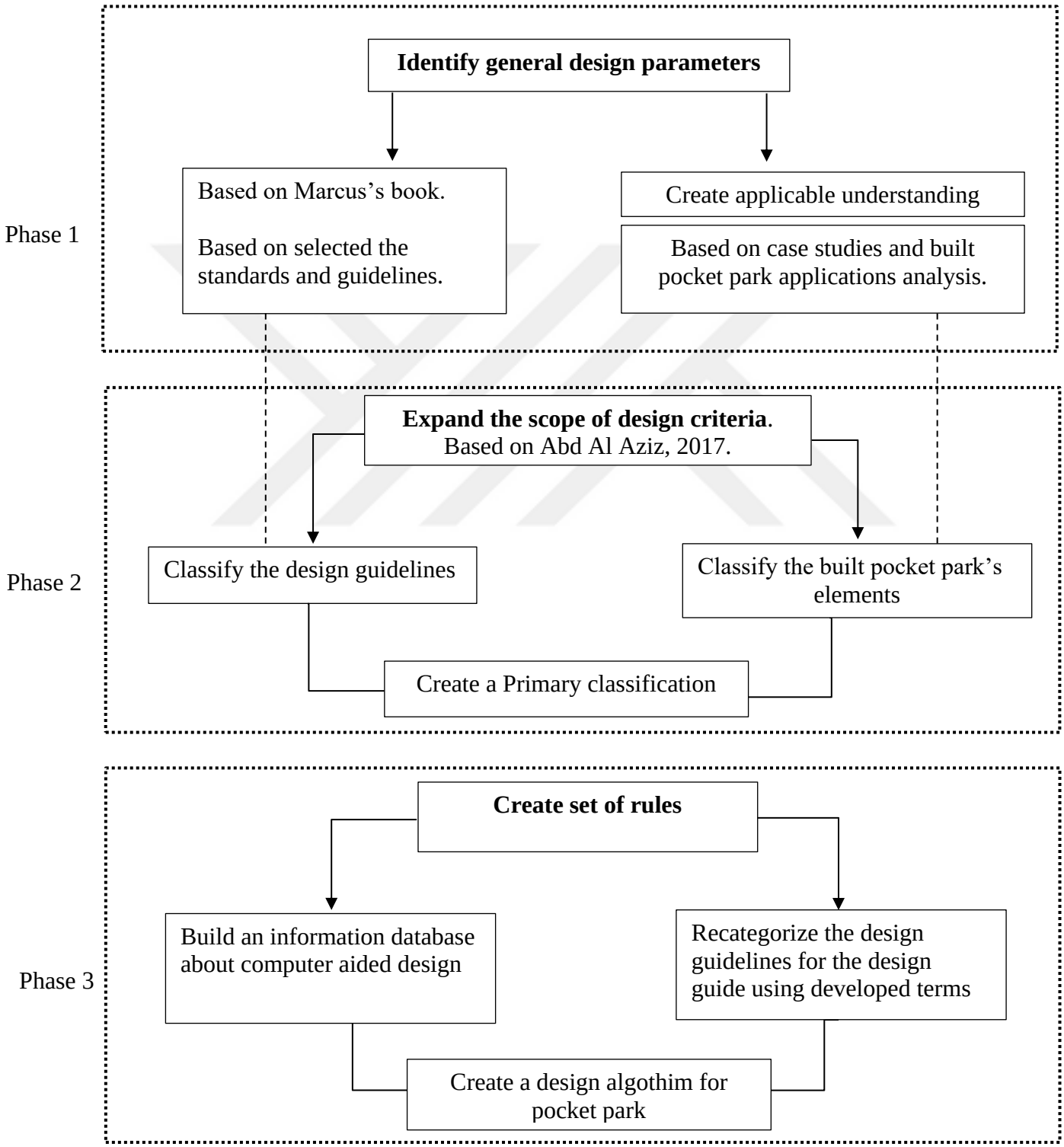

Figure 4.1: The methodology workflow chart.

4.2.2 Data optimization

In this section, within the process of developing the decision support guide database, all the design guidelines have been assembled which founded in the updated guidelines at the global level in addition to Marcus's book design guidelines that he mentioned generally about designing a pocket park.

From the point of computer-aided design, the data has been rearranged and optimized based on developed terms, and to simplify the collected data a summary for each design criteria was given, as a designer can rely on the mentioned information in developing such kind of programming tool that related to pocket park design.

The design parameters that would be used in the programming process have arranged as the following:

- Size.
- Site selection.
- Accessibility.
- Function.
- Design General which includes sub-parameters:
- Boundaries.
- Location types.
- Topography.
- Assets.
- Surfaces.
- Playground.
- Vegetation.

The design parameters and the related guidelines have been assembled from all standards in the tables below [4.1- 4.12] and a summary has been added for each parameter.

Table 4.1: Assembled size guidelines.

Size guidelines	Summary
According to Marcus, (1997): - Usually, they are one to three lots in size. According to Bureau, (2014): - Minimum: 100 sqm. According to Seattle, (2017): - Maximum: 1012 sqm. According to the Essex Design Guide, (2018): - "It can be very small spaces knitted into the built fabric of a town". According to Maryland, (2018): - The average size is 405 – 1012 sqm. According to Victoria, (2019): - Maximum: 2000 sqm. According to the City of Thornton, (2017): - The size is ranging from 1012 to 20234 sqm. According to Edmonton's Urban Parks, (2016): - "Pocket Parks are small, 0.5 hectare" equals 5000 sqm. According to Abd El Aziz, (2017): - "Must not exceed 5000 sqm".	While the most of design standards (Bureau, 2014; Seattle, 2017; Maryland, 2018; Victoria, 2019; City of Thornton, 2017; Edmonton's Urban Parks, 2016; Abd El Aziz, 2017) set a minimum or maximum size for pocket parks, it is more convenient not to define a numeric size for pocket parks. It would be possible to set limits according to the conditions and necessities of the neighborhood. So, the pocket park size should be defined in lots as Marcus (1997) states.

Table 4.2: Assembled site selection guidelines.

Site selection guidelines	Summary
According to Bureau, (2014): - It attracts passers-by or users of the immediate neighborhood. - "There should be more than one street frontage of the open spaces and they are expected to have the similar wide of the open space". According to Edmonton's Urban Parks, (2016): - "parks that are intended to ensure residents have a park opportunity within 0.5 kilometers or a 10-minute walk from their home." - "A single Pocket Park serves 2,250 people". - "Pocket Parks are typically located on local roads or are stopovers along a greenway or trail." - "Pocket Parks are located on a local or collector roadway." According to Maryland, (2018): - "provide connectivity to other public spaces and transit." - "serves neighborhood/district and connected to public spaces network and to be the local destination". - " This park type will serve residents, workers, and visitors from the nearby blocks" According to Victoria, (2019): - "underutilized open space, or suitable for repurposing". According to Seattle, (2017): - "The Geographic range of users is the immediate neighborhood – less than ¼ mile in distance "equals 402 m". - "Pocket parks can be in all zones and surrounded by residences, small commercial, non-arterial streets or on unused land between roads". - "The built environment percent developed should be 70-100%." According to the City of Thornton, (2017):	- Based on the standards, the site should serve the nearby neighborhood (Maryland, 2018; Marcus,1997; Bureau, 2014). - Which specified in 402 meters according to (Seattle, 2017; City of Thornton, 2017), four-block radius (Marcus,1997), and 500 meters (Edmonton's Urban Parks, 2016). - The park should be opened to the street at least from one side (Bureau, 2014; Abd El Aziz,2017; Edmonton's Urban Parks, 2016).

- The service area should be a 402-meter radius to serve 2023 sqm per 1,000 population. Also, it has to have access to neighborhoods. - Pocket parks should be located in each new subdivision if not covered by the 402-805 meter service radius from an existing or planned neighborhood park, or when a main arterial or other barriers that prevent users to reach the park. According to Abd El Aziz, (2017): - "Parks should serve a resident population of approximately 500-1000 persons." - "Connect the park to the greenway network and place it in high-density housing areas." - "Opened to the street on 2 to 4 sides." - "Place the park in front of active rooms in adjacent buildings." - "Use vacant land, on small, irregular pieces of land, forgotten and unused spaces." - "Use non-traditional locations: rooftops, building facades, or foyers." According to Marcus, (1997): - The location of minipark is important because it determined the type of users and the time of use and activities. - "... a park with special facilities not found nearby attracts users from larger areas as neighborhoods too. - To determine the program of a mini-park it is important to analyze the area within a four-block radius around the site.	

Table 4.3: Assembled accessibility guidelines.

Accessibility guidelines	Summary
According to Abd El Aziz, (2017): - "Convenient and safe pedestrian access that is buffered from moving vehicles." - "Accessible by both foot and bike, and should not require the use of a car." - "Pocket park is 5 to 10 minutes' walk from target users." - "Easy and equitable access with multiple points of entry /No barriers between the street and the park."	- The pocket park should be accessible by walking (10 minutes maximum) from target users (Abd El Aziz, 2017; Marcus, 1997; Edmonton's Urban Parks, 2016).
According to the Essex Design Guide, (2018): - The site should be "accessible and worth visiting for all members of the community". According to Marcus, (1997): - The site design should consider people with disabilities. - "sites not within walking distance of potential users may be suitable for specialized use". - A minipark should be located so that users from a four-block radius can reach it by walking and without crossing a major street. - Bicycles should be considered in the early design process whether it will be in the park or not. According to Edmonton's Urban Parks, (2016): - "A Pocket Park's perimeter must have roadway frontage on a minimum of one side so that safety issues related to configuration of park sites can be addressed".	- The pocket park should be accessible for all members of the community including people with disabilities (Essex Design guide, 2018; Marcus, 1997).

Table 4.4: Assembled function guidelines.

Function guidelines	Summary
According to Edmonton's Urban Parks, (2016): - "A small park to accommodate passive recreation activities (e.g., reading, birdwatching, talking, etc.) - "Social gathering spaces" - "Community garden" - "Unstructured active recreation activities (e.g., frisbee, catch, etc.) The prohibited development: - "sports fields and sports fixtures, community halls, recreation facilities of any kind, parking, permanent washrooms, outdoor ice hockey rinks or basketball /tennis courts - "They are intended for short-term, unstructured recreation and may be utilized at any time by nearby residents or by cyclists, rollerblades, walkers or joggers passing through the neighborhood." - The main functional areas include unstructured passive and active recreation spaces, social gathering spaces like a plaza, community garden, and a small playground. Plus, small water designed area, public art, and statuary, walkways/trails, and bicycle parking/rack. According to Abd El Aziz, (2017): - "Adaptable / comfortable spaces." - "Provide space for mental improvement, and relaxing." - "Add activities that will activate the park at all times." - "Defined identity and represent local communities." - "Spaces should provide sufficient sunlight and ventilation." - "Ensure clear sightlines across the entire site." - "Avoid blank walls in the space perimeter." - "Use recycled material." - "Provide adequate lighting during night time." According to Seattle, (2017): - The optional program includes small community gatherings. According to Maryland, (2018): - "contemplative areas supported by social gatherings and active recreation in smaller scale flexible program". Moreover," a place for quiet contemplation, unstructured recreation, contact with nature." According to Victoria, (2019): - The main functions include a seating area, toilets, access to water, and shading. - "ideally already identified in an approved open space, precinct structure or recreation plan that has undergone community engagement, and demonstrates a need (i.e. lack of open space in the area). According to the City of Thornton, (2017): - "Pocket parks can serve the needs of surrounding neighborhood residents for playgrounds and informal gathering spaces when a neighborhood park is not available."	- "Pocket parks can serve the needs of surrounding neighborhood residents for playgrounds and informal gathering spaces when a neighborhood park is not available." (City of Thornton, 2017). - According to (Maryland, 2018; Edmonton's Urban Parks, 2016), the pocket park should provide social gathering spaces like plaza and community garden. - The pocket park should have a recreation plan and provide passive recreation activities such as reading, birdwatching, talking, etc. (Edmonton's Urban Parks, 2016; Victoria, 2019; Abd El Aziz, 2017). - According to (Edmonton's Urban Parks, 2016) the prohibited developments are: - "sports fields and sports fixtures, community halls, recreation facilities of any kind, parking, permanent washrooms, outdoor ice hockey rinks or basketball tennis courts). - There is a need for space which has sufficient sunlight and ventilation and contact with nature (Maryland, 2018; Abd El Aziz, 2017)

Table 4.5: Assembled design general guidelines.

Design general guidelines	Summary
According to Marcus, (1997): - "User spaces should take priority over visual spaces. - Users should be able to see all the activities and facilities that the park has from the entrance. - Children prefer a varied and interesting environment. They prefer to move from activity to another and variety in choices. This can be achieved by providing a possible diversity in spaces, surfaces, levels, and plant species. - Providing some passive "secret "places away from the street. - Specified the users of the surrounding area is essential because of the design based on the type of the residents; children, teenagers, adults, or elderly. After the group of users stated, the designers should point priorities of use to reduce possible collisions among the users. According to the Essex Design Guide, (2018): - The park may include public art installations and smart infrastructure. According to Maryland, (2018): - "They can provide areas to eat" - Include sunny seating small scale green areas; "contact with nature… small scale green areas." - "maximize sun exposure in locations in between tall buildings. According to the City of Thornton, (2017): - "Pocket parks should include multi-use lawn areas for picnics and open play area" - "Natural Area: Optional." According to Abd El Aziz, (2017): - "Use previous surfaces, bio-filter landscaping beds..." - "Provide…. rain garden, and swales" - "Link to other recreational, cultural, and community amenities." - "Welcoming and appealing design to a diversity of users/ offers variety and choice." According to Victoria, (2019): - "provide recreation and socializing opportunities in a green space"	- According to (Marcus,1997), it's important to Specified the users of the surrounding area, because of the design based on the type of the residents; children, teenagers, adults, or elderly. Besides, it is significant to offer a suitable design with variety and choice (Abd El Aziz, 2017). - The park should "Link to other recreational, cultural, and community amenities." (Abd El Aziz, 2017). - The park should include areas to eat and sunny seating small scale green areas (Maryland, 2018). - "Pocket parks should include multi-use lawn areas for picnics and open play area" (City of Thornton, 2017).

Table 4.6: Assembled design general- Boundaries guidelines.

Design general- boundaries guidelines	Summary
According to Marcus, (1997): - The boundaries of a mini-park should be clearly defined. - Miniparks are very small in size so two and often three sides are usually bounded by adjacent residential buildings. - The vertical planes of adjacent buildings should be creatively covered as possible. - A low, attractive fence and may add a gate along the street side to direct the pedestrian movement along pathways and to keep children inside the park. According to Abd El Aziz, (2017): - "Defined edges and a focal point." According to the City of Thornton, (2017): - "Mini-park boundaries requirement is: "3-rail fence when adjacent to residential lots".	- The boundaries of a park should be clearly defined (Marcus, 1997; Abd El Aziz, 2017). The considerations: - The vertical planes of adjacent buildings should be creatively covered as possible (Marcus, 1997). - "3-rail fence when adjacent to residential lots" (City of Thornton, 2017).

Table 4.7: Assembled design general- Location types guidelines.

Design general- Location types guidelines	Summary
According to Marcus, (1997): - Corner lots: The site design in corner lots should benefit from its exposure to passes by on two of its four sides. This can be achieved by: 1. Several access points and especially a pathway that makes the park used as a shortcut across the corner. 2. A fence or boundaries design with a sitting area like benches that allows passerby pedestrians to sit and take a rest facing the street. 3. Add plants and trees to give a green experience for vehicle drivers. - Mid-block lot: The disadvantages are: the location of the entrance onto the street that is only one house lot wide can be easily passed by without noticing the existence of a park. In some cases, in a mid-block location, there is only one entrance. Also, a site that is about 2.5 to 4 times as long as it wide gives a comfortable feel, while one that is about 5 or 6 times as long as it is wide can feel very uncomfortable. The advantages of this location are: The calm place can be designed for elderly people and more protected from traffic and cars if it designed for children. Moreover, the park can be protected from the wind. - Through-block lot: It has many advantages, it connects two streets and two neighborhood and allow children and adults to walk directly among home and school, or shops. - The disadvantage is that it may become a throughway for speeding bikes	- According to Marcus (1997), pocket parks can be in 3 conditions regarding the surrounding building: - Corner lot: The first condition refers to be opened in two streets. - Mid-block lot: The second condition refers to be surrounded by buildings from three directions. - Through-Block: The third condition refers to be located in between two buildings.

Table 4.8: Assembled design general-Topography guidelines.

Design general-Topography guidelines	Summary
According to Marcus, (1997): - The site topography playing a role in determining the activities that may the park include. A site with mature trees and varied topography seems larger and can include walking, sunning, and picnicking activities. - A hilly site has potentials for amphitheater or earth slide. - A flat empty site is suitable for paved walking which suits elderly, disabled people, children with bikes, and parents pushing a baby stroller. According to Bureau, (2014): - "it preferably to be on flat land."	- The site topography determines the activities and the design of the park. where the varied topography site can include: walking, sunning, and picnicking activities. - A hilly site has potentials for amphitheater or earth slide. and a flat site is suitable for paved walking which suits the elderly, disabled people, children with bikes, and parents pushing a baby stroller (Marcus, 1997).

	- According to (Bureau, 2014) the park “preferably to be on flat land.”

Table 4.9: Assembled design general-Assets guidelines.

Design general-Assets guidelines	Summary
According to Abd El Aziz, (2017): - “Add water features, gazebos, individual seating, benches, drinking fountains, bicycle racks, trash receptacles, heat lamps, etc.” Plus “...high-efficiency lighting (LED), and solar-powered amenities.” - “Provide weather protection”. - “Recreate through playgrounds, opportunities for sitting, and open grassy areas.” - “Provide opportunities for public art “ - “Add small event spaces, spaces for meeting friends, taking lunch breaks, and social interaction.” According to Marcus, (1997): - Site furniture should be designed or brought according to users of the park. - A drinking fountain may be added to the design by taking into consideration the young children; a step for them or another lower fountain. Also, it is preferable to be next to the sand area with a spigot. - In the limited budget cases; play equipment, benches, and a water fountain have the priority -unless in high crime areas- then lighting elements come. - Litter cans are important especially in front of the activity area and the entrance of the park. - Provide mixed-use tables and benches. There are two cases in which picnic tables are highly utilized: in an average density residential neighborhood and when the park near to a high school. - The lighting element could be a good addition to the pocket park. - If possible, toilets should be provided in a pocket park, especially for children's use. But due to heavily constructed toilets, they are almost eliminated from the program. - weather conditions in his designs. A park that provides sheltered areas to protect from the sun is attracting more users than open ones. Parents prefer to sit in convenient areas in summer and winter and watch their children playing. According to Bureau, (2014): - “Different types of seats such as chairs, benches, wall seats, and planter ledges will be installed based on the overall design”. - “Appropriate lighting should also be provided if possible” - “Use: Brief stop, resting, sitting, casual gatherings waiting, and weather protection.”	- The priority of the park's assets in a limited budget is: play equipment, benches, and a water fountain (Marcus,1997). - The park should provide a convenient sitting and socializing areas (Bureau, 2014; Abd El Aziz, 2017; Edmonton’s Urban Parks, 2016; Essex Design guide, 2018; Victoria, 2019; Maryland, 2018). - The desired assets are: Benches (Seattle, 2017; City of Thornton, 2017; Abd El Aziz, 2017, Marcus,1997; Bureau, 2014) and picnic tables (Marcus, 1997; Edmonton’s Urban Parks, 2016; City of Thornton, 2017) in (Seattle,2017) picnic tables are optional. - Providing weather protection as shelters (Marcus,1997; Bureau, 2014). - Adding a water feature element has been mentioned in these standards (City of Thornton, 2017; Abd El Aziz, 2017, Marcus, 1997; Edmonton’s Urban Parks, 2016; Victoria, 2019).

- "weather protections and places for causal gatherings, Therefore, canopies and seating are two major facilities".

According to Seattle, (2017):

- "Assets (desired – size dependent): Benches"
- "Assets (optional): Lighting for safety (rare), Picnic table"
- "Assets (desired – size dependent): improved paths, plaza, or grassy area for informal activity (no sports field)."
- "Assets (optional): designed landscape, play area, public art, and viewpoint. no parking area."

According to Victoria, (2019):

- "Already supported by or in proximity to services/amenities e.g. seating, lighting, toilets, access to water and shading."

According to the City of Thornton, (2017):

- "Picnic tables (2 minimum), benches (2 minimum), trash receptacles (4 minimum for parks greater than 2 acres" equals 8094 sqm.
- "Dogs waste stations, bike racks and LED lighting with steel poles at playgrounds and along trails"
- "Pavilion: Preferred, required for parks greater than 2 acres" equals 8094 sqm.
- "There is no need for water features."
- "Pocket parks should include multi-use lawn areas for picnics and open play area, shelters, and playgrounds."

According to Edmonton's Urban Parks, (2016):

- The desired site furniture is: "Social gathering spaces (e.g., plazas, picnic tables, etc.), bicycle parking/racks, sliding hill, Gazebo or shade structures, lighting, and Social skating/snowbank rink."

According to Maryland, (2018):

- "Sunlit small gathering areas with a mix of shade and sunny seating"
- The feature of the functional areas should be sunlit small gathering areas with a mix of shaded and sunny seating small scale green areas. Plus, a small play area.

According to the Essex Design Guide, (2018):

- "provide places for sitting and socializing."
- "Park should include sitting and socializing areas; they can be particularly important for the aging population and those with dementia." · "Such small-scale spaces often offer the greatest opportunity to integrate smart infrastructure and digital technology …. Examples for this, recycling or waste management points, open-access wi-fi networks."

Table 4.10: Assembled design general- Surfaces guidelines.

Design general-Surfaces guidelines	Summary
According to Marcus, (1997): - "Different surface materials should be used for different purposes". Hard surfaces like asphalt are preferable to be used from children to play with wheel toys. Older children use hard surfaces for ball games, running games, and so on. Adults also use the hard-surface areas to wheel baby carriages and people with disabilities can use it to move around the mini-park easily. Bricks and concrete could be also used. - A soft surface such as sand should be used under play equipment to be safe for children during the playing. Grass consider as soft surface too, it often used for rolling down on slight slopes. According to the Essex Design Guide, (2018): - For paving: predominantly hard-paved should be suitable for use by all ages and levels of physical and mental ability. According to Abd El Aziz, (2017): - "Provide opportunities for….and attractive hardscape."	- Surfaces should be suitable for different ages and uses; hardscape surfaces preferably for people with disabilities and kids play areas like courts. whether soft surfaces may be used under play equipment for safety issues (Marcus,1997; Essex Design guide, 2018).

Table 4.11: Assembled playground guidelines.

Playground guidelines	Summary
According to Marcus, (1997): - For large mini-park (Four to six house lots in size) play areas for preschool and older children are usually separated. But for a small mini-park, the best option is to have one divide combined play area with equipment. - If the park design can have just one play area it's better to locate it toward the back of the park. but it's important to take into consideration when the park is too deep or in L shape this area may be used for illegal activities. - Scaled-down play equipment like slides, swings, or climbing blocks, it's important for 3 years and above. - Sand under and around the play equipment to provide a safety step and a play material for young children. - A water fountain may be added to let children make clay. Also, the sand area should be in the sun to dry quickly after rain. - Benches around the play area in different locations to be used from adults to supervise. - After many observations applied to different mini-parks, there has been found that there is a relationship between the diversity of play equipment and the park's use. According to the Essex Design Guide, (2018): - These kind of parks "are usually too small for ball games" According to Seattle, (2017): - The play area is an optional program for the mini-park According to Maryland, (2018): - "Small play areas or game area" According to the City of Thornton, (2017): - "The ages 5 to 12 with accommodations for 2 to 5 years with multiple elevated and ground level, upper body, spinners" - "Swings (4 minimum) " - "Slides (2 minimum - 1 slide must be 8' in height) "equals 2.4 meters. - "Climbing play components with overall shade."	- The playground should be separated into preschool and older children's areas when the pocket park is (4-6 house lots in size) (Marcus,1979). - For small pocket parks, there should be one divided combined area with equipment accommodates children from 2-5 years and children from 5-12 years (Marcus,1997; City of Thornton, 2017 Edmonton's Urban Parks, 2016).

- No softball/baseball field - "Open Play Area: Preferred. 225' x 300' playfield, site-specific" equals 77.7x 91.4 meters. According to Edmonton's Urban Parks, (2016): - "Tot-lot playground (requires Maintenance Agreement)" - The outdoor ice hockey rinks, basketball courts or multiple tennis courts are prohibited in small parks According to Abd El Aziz, (2017): - "Provide spaces for physical fitness as basketball courts /tot-lots / climbing structures." - "Add educational spaces as children can gain a better understanding of and appreciation for nature."	

Table 4.12: Assembled vegetation guidelines.

Vegetation guidelines	Summary
According to Marcus, (1997): - In some case plants or "keep-off" ground cover could be used to separate spaces or for the places where people should not go. - Grass for rolling on should be planted on a little slope. - The trees should be climbable. - Deciduous trees are preferable. - Trees must be placed to give some shaded sitting areas on both benches and lawn areas. - Children usually need shaded areas to play especially in hot days at the same time adults enjoy their time in lawns on sunny days. - The tree should be sited for shade in the afternoon times particularly in summer. - "Vegetation is much appreciated by city-dwellers even if they do not use the park" - Ground covers used usually to keep users off should not be planted in mini-park unless there is a reason to keep them off a particular part in the site. Ground covers which used for a purpose just to be seen have no place in a mini-park, except if the park designed passively just for sitting and looking. - All plant species must be "tough, impervious to trampling, fast-growing and not poisonous" - Planted areas should have raised borders from the hard surface that adjacent to. According to the Essex Design Guide, (2018): - "Small areas of grass can be difficult to maintain and should be avoided but, where appropriate, carefully chosen native planting can be used instead…. while planting should seek to stimulate a range of senses." According to Seattle, (2017): - The natural area is not essential but if existed native plants should be used. According to Bureau, (2014): - "At least 30% of the area of small open spaces should be placed with vegetation such as trees and shrubs. Existing natural habitat or trees should be the highest priority to be preserved." According to Victoria, (2019): - The natural environment "Not going to significantly impact wildlife or existing vegetation of developed…not contaminated" According to Edmonton's Urban Parks, (2016):	- The importance of green areas is to provide natural shade. Trees should be placed to provide shade for sitting areas and play areas (Marcus, 1997; Abd El Aziz, 2017). - The native plants should be chosen in green areas (Bureau, 2014; Seattle, 2017; Essex Design guide, 2018) - The mentioned ratio of green areas is 30%; "At least 30% of the area of small open spaces should be placed with vegetation " (Bureau, 2014) and 70 trees/10000 sqm (Edmonton's Urban Parks, 2016).

- The green spaces desired development is: “Naturalized landscape development (e.g., butterfly gardens, sensory gardens, community berry patches, etc.) These may require Partners in the Parks agreement.” - About the planting area: “Tree planting should be “70 trees per hectare” equals 70 trees/10000 sqm. - “Unique cultural landscapes” can be added and it requires maintenance agreement. According to Abd El Aziz, (2017): - “Maximize the amount of natural shade.” - “Provide ceiling with a tree canopy.” - “Space walls can become vertical lawns.” - “Recreate through …….and open grassy areas” - “Possibility to include edible gardens.”	

5. CONCLUSION AND RECOMMENDATIONS

The necessity of providing green spaces is rapidly increasing. Many studies tackled the need of providing such spaces captured in terms of the social, environmental, and health benefits that urban open spaces offer to residents. While the constraints of creating green open spaces are many such as limited municipal budgets, development priorities problems, and urban sprawl that increase the pressure on space for development. Pocket parks can improve the urban green structure within the cit'y capability. It considerd the smallest type of urban parks, which can fit within the city context without the demands that large parks would need.

To design a collective unifying framework to the urban space, there is a need for combining computational design tools within the design process. The computer-aided design allows designers to deal with more complex problems. Furthermore, offers a wide range of options and alternatives in short times besides it's more cost-effective.

With the aid of computer-aided design, it is possible to understand the interaction between different design parameters which affect forming the urban space, particularly in the early design stages, when the inputs are determined and the process of trial and error started, this makes the computational design tool capable to create design alternatives automatically.

This thesis produces information on designing guides, standards, and databases related to pocket parks for the sake of developing a decision support guide. The first step related to urban parks developing process by tackling the urban parks brief history in the United States and Europe which led to pocket park appearance.

Then a detailed section addressed pocket park's definitions and emerging theories based on Marcus's book design guidelines for urban open space (1997) and American Society of Planning Officials report "No.299" (1967). The second step addressed pocket parks design guidelines and design parameters that the parks should have. The research started with determining the pocket park's design guidelines generally based on Marcus's book (1997), in addition to a group of updated standards and guidelines

that were collected in global scope; Hongkong, U.S.A. (various states), England, Australia, and Canada. Within setting up process a nine built pocket parks application from books, guidelines, and other from articles and websites, at local and global levels have been analyzed and studied for the sake of broadening the research, support the database with applicable ideas and to expand the scope of the collection of criteria.

Subsequently, to ease the process of dealing with collected data, a primary categorizing raised from the common design criteria of the gathered design guidelines has been created based on Abd El Aziz's research (2017). The next step aimed to establish an understanding of computer-aided design ideas and related fields. This has been achieved through a research study covered the literature review for the emerging, definitions, and mechanism of working for related concepts such as Genetic algorithms, parametric design, and others. The study included architecture and landscape architecture applications and examples in each section to support the mentioned data and illustrated it. In the last step, after arranging the big picture and dealing with the related parts and concepts that the research aimed to cover. The research defined a set of design guides by working with assembled data and re-categorize them from a point of computer-aided design that could restrictive the programming process to produce a suitable design. Developed terms addressed to represent new design parameters for the guide tool, included all related and gathered guidelines. Besides, a summary for each design criteria was given too, as a designer can rely on the mentioned information in developing such kind of programming tool that related to pocket park design. In the last section the relation among design parameters tackled with a focus on setting up pocket park design rules which would assists planners, designers, and stakeholders in improving the performance of pocket park design as well as developing small urban open spaces in cities.

The main finding to highlight is that this study has made the first attempt in collecting and creating a unique database of design guidelines for the pocket parks along with addressing design parameters that the parks should have. The second attempt is developing all the collected design guidelines to represent inclusive guidelines that include all of them in one parametrical design guide that can be used in the computer-aided designs related to the pocket parks. This could provide a powerful opportunity that municipalities could develop cities green infrastructure by adopting alter unexploited areas to the pocket park where that would otherwise remain unused.

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APPENDICES

APPENDIX A: Tables

Table A.1: The pocket park design criteria and guidelines.

Design Criteria	Bureau Hong Kong	Seattle Washington	The Essex Design Guide England	The Maryland State in the USA	Victoria government Australia	City of Thornton State of Colorado	Park development Ottawa Canada
Area and Location	Area: 100 sqm minimum. Shape: The shape of an open space mainly depends on the site but it is suggested that the width and length of the park should be well proportioned. The radius of attraction: passers-by or users of the immediate neighborhood. Location: usually located along adjacent streets.	Area: 1012 sqm maximum. Radius of attraction: the immediate neighborhood-maximum of 402 meters in distance. Location: can be in all zones; residential, commercial, or on unused land between roads.		Area: From 405 to 1012 sqm. The radius of attraction**:** Serves users from the nearby blocks and "Local Destination"	Area: 2000 sqm maximum. Location: "underutilized open space, or suitable for repurposing site."	Area: From 1012 to 20234 sqm. The radius of attraction: 402-meter radius, serving 2023 sqm per 1,000 population. Location: it should be located in each new subdivision if not covered by the 402-805 meter service radius from an existing or planned neighborhood park, or "when a major arterial or some other barrier compromises access to a neighborhood park"	Area: 5000 sqm. The radius of attraction: serves residents in 0.5 kilometers walking distance from their homes and serves 2,250 people. Location: "local roads or are stopovers along a greenway or trail located on a local or collector roadway"

Table A.1(continued): The pocket park design criteria and guidelines.

Design Criteria	Bureau Hong Kong	Seattle Washington	The Essex Design Guide England	The Maryland State in the USA	Victoria government Australia	City of Thornton State of Colorado	Park development Ottawa Canada
Accesses and Linkage	There should be more than one street frontage of the open spaces and at least 6 meters in street frontage.			"Connected to public spaces network." "Provide connectivity to other public spaces and transit."	"Easily accessible via road, public transport, or well-linked to bike or walking trails." "Safe for users; this may include good visibility across the site and proximity to other users/visitors/activity centers."	It has access to the neighborhood. "Using trails to connect this type of park to Thornton's overall park system is beneficial, but not necessarily expected."	"Pocket Parks are located on a local or collector roadway."
Space Design	"Promote a sense of openness and safety by ensuring the views from the parks will not be completely blocked by neighboring structures." pocket parks emphasize on the 'intimacy and human touch' given to the visitors.	"Plans for mini or pocket parks try to use remnants of old landscaping features or other elements from the site's prior use to emphasize cultural or historic importance."	The materials used should be suitable for use by all ages and levels of physical and mental ability." Design the park to be "more accessible and worth visiting for all members of the community."	"Active recreation in smaller scale place"		"Surrounded by streets as much as possible."	"A Pocket Park's perimeter must have roadway frontage on a minimum of one side so that safety issues related to configuration of park sites can be addressed." "Park entrance feature."

Table A.1 (continued): The pocket park design criteria and guidelines.

Design Criteria	Bureau Hong Kong	Seattle Washington	The Essex Design Guide England	The Maryland State in the USA	Victoria government Australia	City of Thornton State of Colorado	Park development Ottawa Canada
Uses and Activities	"Brief stop, resting, sitting, casual gatherings, and waiting."	This type of park" sometimes operated for both recreational and utility/infrastructure purposes." The desired functional areas are improved paths, plaza, or grassy area for informal activity with no sports fields. The optional areas could be: designed landscape, play area, public art, and viewpoint.	Pocket parks "are usually too small for ball games and may include public art installations." The parks provide places for sitting and socializing especially for the aging population and those with dementia	"Places for quiet contemplation unstructured recreation contact with nature." "Sunlit small gathering areas and small-scale green areas " "small play areas"	The parks should "provide recreation and socializing opportunities in a green space."	"Pocket parks should include multi-use lawn areas for picnics and open play area, shelters, and playgrounds." Preferred to includes an open play area and sport court.	Pocket parks "are intended for short-term, unstructured recreation and may be utilized at any time by nearby residents or by cyclists, rollerblades, walkers or joggers passing through the neighborhood." "Unstructured passive and active recreation spaces" Social gathering spaces and a community garden. "Tot-lot playground."

Table A.1 (continued): The pocket park design criteria and guidelines.

Design Criteria	Bureau Hong Kong	Seattle Washington	The Essex Design Guide England	The Maryland State in the USA	Victoria government Australia	City of Thornton State of Colorado	Park development Ottawa Canada
Environmental Elements	Weather protection and weatherproof covers. "Canopies and seating are two major facilities in the pocket parks." "Openness to the sky is another major principle to generate outdoor small open spaces." Trees shading "can also create a more comfortable microclimate in the pocket park."	"Possible green stormwater infrastructure and native plants."	Pocket parks "often offer the greatest opportunity to integrate smart infrastructure and digital technology. Examples of this include recycling or waste management points, or smart street furniture."	Maximize sun exposure in locations in between tall buildings.	"Supported by or in proximity to services/amenities e.g. seating, lighting, toilets, access to water and shading."	"LED lighting with steel poles at playgrounds and along the trail."	"shade structures."
Landscape Elements	"Appropriate lighting should also be provided if possible and they should coordinate with the pedestrian lamps." "Covers can usually be installed on top of the seating for shades."	Desired assets: "Benches and Improved paths" Optional assets: "Lighting for safety (rare) and Public art"	"They may be predominantly hard-paved." "may include public art installations"	Sunlit small gathering areas with a mix of shaded and sunny seating areas.		"Picnic tables (2 minimum), benches (2 minimum)" "Trash receptacles (4 minimum for parks greater than 2 acres)" equals 8094 sqm.	"Social gathering spaces (e.g., plazas, picnic tables, etc.) Community garden. Bicycle parking/racks.

"Different types of seats such as chairs, benches, wall seats, and planter ledges will be installed based on the overall design."		"Dogs waste stations and bike racks"	Public art and statuary. Gazebo. Small spray deck. Lighting."

Table A.2: The built pocket parks design criteria.

	Design Criteria	Charlie Dorr Mini-park, California	John F. Collins Park, USA	Paley Park, USA	Sun Hop Vancouver, Canada	Richmond terrace, Australia	Pallis pop-up Sweden	Floating Pocket park, London	Omoken park, Japan	Aydin Demir Park Turkey
Area and Location	Must not exceed 5000 sqm.									
	Use vacant land, on small, irregular pieces of land, forgotten and unused spaces.									
	Use non-traditional locations: rooftops, or foyers.									
	Typical location type.	Through	Through	Mid	Corner	Corner	Corner	Through	Mid	Corner
	Surroundings.	Residential Neighborhood	Commercial and Residential Neighborhood	Commercial / High-rise Residential Neighborhood	Commercial and Residential Neighborhood	Historical and Residential neighborhood	Residential Neighborhood	Commercial and Residential Neighborhood	Commercial and Residential Neighborhood	Commercial and Residential Neighborhood

Table A.2 (continued): The built pocket parks design criteria.

	Design Criteria	Charlie Dorr Mini-park, California	John F. Collins Park, USA	Paley Park, USA	Sun Hop Vancouver, Canada	Richmond terrace, Australia	Pallis pop-up Sweden	Floating Pocket park, London	Omoken park, Japan	Aydin Demir Park Turkey
Space Design	Defined edges and a focal point.									
	Clear sightlines across the entire site.									
	Opened to the street on 2 to 4 sides.									
	Welcoming and appealing design to a diversity of users.									
	Defined identity and represent local communities.									
	Adaptable / comfortable spaces.									
	Space walls can become vertical lawns.									

Table A.2 (continued): The built pocket parks design criteria.

	Design Criteria	Charlie Dorr Mini-park, California	John F. Collins Park, USA	Paley Park, USA	Sun Hop Vancouver, Canada	Richmond terrace, Australia	Pallis pop-up Sweden	Floating Pocket park, London	Omoken park, Japan	Aydin Demir Park Turkey
Uses and Activities	Spaces for physical fitness as basketball courts /tot-lots / climbing structures.									
	Spaces for mental improvement, and relaxing.									
	Open grassy areas.									
	Activities that activate the park at all times.									
	Add small event spaces, spaces for meeting friends, taking lunch.									

Table A.2 (continued): The built pocket parks design criteria.

	Design Criteria	Charlie Dorr Mini-park, California	John F. Collins Park, USA	Paley Park, USA	Sun Hop Vancouver, Canada	Richmond terrace, Australia	Pallis pop-up Sweden	Floating Pocket park, London	Omoken park, Japan	Aydin Demir Park Turkey
Environmental Elements	Use high-efficiency lighting (LED), and solar-powered amenities.									
	Provide ceiling with a tree canopy.									
	Weather protection, rain garden, and swales.									
	Sufficient sunlight and ventilation.									
	Use recycled materials.									

Table A.2 (continued): The built pocket parks design criteria.

	Design Criteria	Charlie Dorr Mini-park, California	John F. Collins Park, USA	Paley Park, USA	Sun Hop Vancouver, Canada	Richmond terrace, Australia	Pallis pop-up Sweden	Floating Pocket park, London	Omoken park, Japan	Aydin Demir Park Turkey
Landscape Elements	Water features.									
	Individual seating /benches.									
	Bicycle racks.									
	Trash receptacle.									
	Maximize the amount of natural shade.									
	Opportunities for public art and attractive hardscape.									
	Possibility to include an edible garden.									
Notes				The park considered a pocket park archetype.	-2014 National CSLA Award of Excellence Award. - 2017 Urban Design Award, Vancouver.	- It was a finalist in the 2015 Think Brick Awards. - Awarded a 2015 AILA Design Award.	Designed sustainable.			

CURRICULUM VITAE

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- 2019 A landscape design project proposal for “Sarajevo university campus”. Worked as a researcher and designer in the project.
- 2018 “Development Strategies Guide-Book, Case Study of Uskudar square”. Worked with a team as a researcher in the project.
- 2015-2017 Freelance Architectural and civil engineering work.
- 2015 worked as an Architect.