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Understanding Walkability Criteria in High-density Communities: A Case Study in Alexandria, Egypt

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ABSTRACT

Walkability has recently been a major topic and an essential attribute in the sustainability approach to urban design and planning. Studying urban dimensions and qualities in a specific context is essential to developing walkability criteria, as each environment has its conditions and spatial scale that affects walkability scenarios differently. This paper studies the main criteria contributing to successful walkable environments in high-density communities. The methodology consists of developing detailed walkability criteria by studying urban qualities related to three dimensions: morphological/visual, functional, and social. Each urban quality is analyzed by stating its definition, assessment method and studying its condition in high-density communities. The assessment methods are based on quantitative and qualitative indicators depending on the nature of the criteria, which include imageability, transparency, scale of enclosure, complexity, connectivity, land use mix, legibility, as well as pedestrian comfort and safety. Providing tools to upgrade walkability in a city like Alexandria in Egypt is another objective of this study. Walkability criteria are tested on a typical city center street where buildings of every age and condition are mingled, and which is similar to many other Alexandria streets, thus, the results and recommendations can contribute to enhancing the walkability of everyday streets in the city.

Index-words: *Walkability, High-density, Urban dimensions, Urban qualities, Alexandria.*

I. INTRODUCTION

The concept of walkability was proposed by researchers at the beginning of the twenty-first century and received substantial attention, especially in the fields of health and transportation. Walkability is a term used to describe built and social environment aspects that have impacts on health, energy balance, and physical activity (Tobin *et al.*, 2022). The topic was then soon integrated into interdisciplinary studies and urban design. Residential density is a generally accepted factor that encourages people to choose walking as their means of mobility (Wang *et al.*, 2022). Thus, planners and designers should integrate walking into people's daily lives through the design of a pedestrian-friendly environment, as providing walkability in high-density contexts helps achieve a healthier, safer, and more sustainable environment (Li, 2015). Population density can be defined as the number of people per land area where the land area is measured in square miles or square kilometers (Rosenberg, 2019). According to Socio Economic Data and Applications Center (SEDAC), the world population density is categorized into six categories, the highest category is above 1000 persons/ km^2 (SEDAC, 2020). Therefore, in this research, high-density means population density above 1000 persons/km^2. High-density communities have several benefits and problems. This environment increases opportunities for walking due to the presence of near destinations. On the other hand, it causes the quick spread of diseases and air pollution due to traffic congestion, negative impact on mental health, and urban temperature rise (Udell *et al.*, 2014), (Kent, 2015), (Dawodieh, 2017).

To get people out of their cars and walk, inclusive walkable urban spaces that suit most types of users need to be designed because each type of users has its specific needs and priorities to walk (Udell *et al.*, 2014). Moreover, time is an essential dimension in walkability criteria because urban aspects are related to temporalities and the environment is perceived and used differently at different times of day, night, and seasons (Carmona *et al.*, 2003). Besides, walking appears negligible if it is assessed in terms of travel distance. However, it should be measured

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in terms of travel time, trips, or even outdoor exposure to public spaces and social infrastructure because the pedestrian experience is affected by public exposure as walking has slower speeds than motorized transport due to spending time waiting at bus stations, loading bays or standing in front of stores windows (Ang, Taclendo *et al.*, 2023). This confirms the need for new approaches and new criteria to tackle the most urgent environmental and urban design challenges. The main aim of the study is to contribute to creating a successful vital walkable environment in high-density urban areas. The main research questions are what the urban dimensions and qualities that affect walkability criteria are, how to evaluate walkable urban qualities and dimensions of walkability criteria, and how to reach a better walkable environment in high-density communities. The methodology in this paper consists of detailed walkability criteria derived from a literature review based on several references such as Carmona *et al.*, 2003; Ewing & Handy, 2009; Clos, 2013; Tibbalds, 2000; Lynch, 1960 and others through studying urban qualities that are provided from three dimensions: morphological/ visual, functional and social. Each urban quality is studied through illustrating its definition, assessment method and studying its conditions in high-density communities. Then applying the criteria on Syria Street in Alexandria City as a case study to study factors that help in improving walkability in the city.

A. Walkability Criteria in High-density Communities

Ewing and Cervero proposed the five D to measure walkability: Density, Diversity, Design, Destination accessibility and Distance to transit (Ewing & Cervero, 2010). In line with this approach, a large body of research focused on evaluating the degree of walkability according to the following criteria: characteristics of the near environment including accessibility, security, and the quality of the environment, the urban network including density and diversity of land use, destinations, and activities, the willingness of people to walk including comfort, legibility, safety and efficient modal interchanges (Cerema, 2021). Hence, it is important to create localized walkability criteria that respond to local contexts instead of adapting international codes to respect the sense of place and the specific requirements that need to be understood and analyzed (Sulaiman, 2020). The proposed criteria in this research include all the physical and psychological attributes that were revealed in the recent literature to increase people's willingness to walk. The criteria are classified into three main dimensions, including morphological and visual, functional and social dimensions (Fig. 1) based on Carmona *et al.*, 2003; Ewing & Handy, 2009; Clos, 2013 and others.

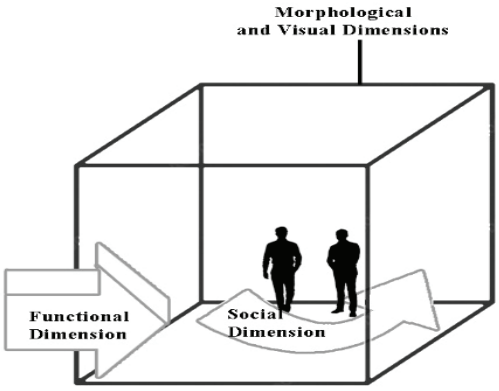
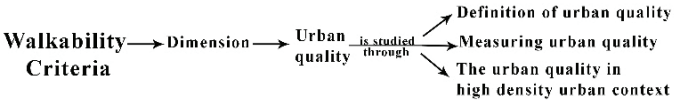


Fig. 1. Walkability criteria in high-density communities (Source: The researchers based on Carmona et al., 2003, Ewing & Handy, 2009; Clos, 2013 and others).



Each dimension is investigated through specific urban qualities and each urban quality is studied by stating its definition, methods of assessment and showing the urban quality condition in high-density urban communities (Fig. 2).

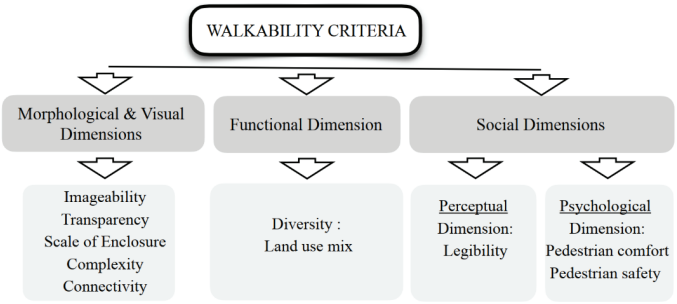


Fig. 2. Methodology of studying each dimension in the mentioned criteria of the research (Source: The researchers).

1. Morphological and Visual Dimensions

Morphological and visual dimensions are the first section in the research criteria, and they are investigated by studying five urban qualities as illustrated in (Fig. 1), which are imageability, transparency, scale of enclosure, complexity, and connectivity. These qualities are classified into

three categories, which are urban qualities that are related to the user, surrounding buildings, and the street network. Imageability, transparency, and complexity are related to the scale of buildings while scale of enclosure quality is related to both the scale of buildings and users, and connectivity is an urban quality that is related to the street network.

a. Imageability

Imageability is an urban quality that makes the elements of the physical environment easily recognizable to people through shape, color, and arrangement (Lynch, 1960). Some indicators help in the evaluation of imageability, such as counting special recognizable features like the number of courtyards, and major landscape features, calculation of the proportion of historic building frontage, number of buildings with identifiers and buildings with non-rectangular shapes, and observing the presence of outdoor dining areas (Clemente *et al.*, 2005), (Ewing *et al.*, 2013). Imageability in high-density can be enhanced through creating open green spaces (Udell *et al.*, 2014). Moreover, in denser cities, there are flexible methods to create a recognizable landmark, which enhances imageability by benefiting from existing buildings of exceptional design qualities and elements of the cityscape (Hong Kong 2030+ Planning Department, 2016).

b. Transparency

Transparency can be defined as an urban quality that allows visual connection and public engagement beyond the façade through glass windows, which provides interest and activity for pedestrians along sidewalks (The San José City Council, 2004). The evaluation of transparency in urban spaces can be derived from indicators such as the proportion of windows at street level, which allow visual connection between users of public space and what is beyond the buildings' facades, proportion of street wall, and active uses in public space (Clemente *et al.*, 2005). In crowded spaces, blurring borders in urban spaces and creating clear visual connections, which provide a sense of openness are priorities (Shi *et al.*, 2014).

c. Scale of enclosure

Scale of enclosure can be defined as a physical urban quality that refers to the ratio between the width of a particular space to the height of its walls and it considers that the urban environment should be designed for people and not just for vehicles (Tibbalds, 2001). Scale of enclosure can be assessed using several methods. In this research, two evaluation methods are mentioned. The first method is the ratio between the height and width of the street. The ideal recommended height-to-width street ratio is 1:1 and the minimum ratio is 1:2 according to Jacobs (1996) as cited in Ewing (1999). The ratio of 1.5:1 between the height and width of the street creates claustrophobic space based on Hedman and Jaszewski's (1984) (Kahraman & Cubukcu, 2017). The second method is assessed through indicators such as recording the number of long sight lines, proportion of windows at street level, average of building heights, and number of small planters, and pieces of furniture in the street (Clemente *et al.*, 2005). In compact urban contexts, openness and less enclosed open spaces are priorities. Each outdoor activity has its requirement of enclosure of space so the functionality of open space should be studied to determine enclosure of space and its design (Shi *et al.*, 2014). To achieve a more human-scaled city in high-density communities, cities should be attractive at eye level (Harrouk, 2020). A plinth is the ground floor of a building, which is the most effective part at eye level. Plinths set 90% of the building's contribution to the experience of the environment (Karssenberg *et al.*, 2016).

d. Complexity

Complexity is the urban quality that describes the extent of visual elements and information in the surrounding environment, which describes the richness of a particular scene (Kaplan & Kaplan, 1989). High complexity is achieved when the urban design elements are not too similar, ordered, and predictable but when the pedestrians are provided with interesting things to see. Complexity is evaluated through some indicators such as the number of buildings, basic and accent colors of buildings, public art (murals, sculptures, and landscape works), and the presence of outdoor dining. These factors indicate the degree of visual information received by the user in urban space (Clemente *et al.*, 2005).

e. Connectivity

Connectivity is the quality that refers to the density of street connections and the directness of street links (Victoria Transport Policy Institute, 2017). Connectivity can be measured in several methods. The first method is by measuring the directness of available routes from numerous origins to particular destinations (Clos 2013 cited in Elfouly, 2017). An index of 1.0 is the best possible rating while an

average value of 1.5 is considered acceptable (Clos, 2013).

Pedestrian Route Directness Index= Actual Walking Distance / Direct Distance. The second method is a Composite Street Connectivity Index (CSCI) that compiles quantitative measures including land allocated to streets (LAS); street density (SD); intersection density (ID) and it is calculated using this formula based on Clos (2013) as cited in Elfouly (2017). The closer the CSCI to 0, the less connected is the street network of a city, while the closer the CSCI to 1, the more connected is the street network of a city. The CSCI method is used to compute connectivity for cities (Clos, 2013).

UN-CSCI = 1/3 [LAS + SD + ID]

The third method is a simple most commonly used quantitative method. This method is the one used in measuring connectivity in the case study because the other two methods are used on a larger scale and for comparing cases with numerous origins to particular destinations. The larger the number produced by the index indicates the greater the street connectivity (ONESTL, 2021). Link is defined to be the pathway segment between two nodes. 1.4 is the minimum required ratio of a walkable community (Clos, 2013).

Link-Node Ratio=Links/Nodes

High densities provide comfortable walkable distances to destinations. It is observed that new settlements have lower urban density than in the city core. Thus, one of the approaches to improve this is by providing better sustainable urban development in new communities that are closer to cities through providing mixed land uses and transport options rather than the car. In addition, one of the upgrade approaches is providing service lanes, more spaces for walking, and cycling, well-maintained pavements, pedestrian crosswalks, and bridges (Clos, 2013).

2. The Functional Dimension

It is the second dimension of the walkability criteria. It is understood through studying diversity, which is achieved by land use mix in urban space.

Diversity (Land use mix): Mixed land use is the presence of a variety of uses close to each other, which enhances walking (Transportation Efficient Communities, 2022). Diversity of land uses and pedestrian populations provides vitality in urban space (Garau & Annunziata, 2022). The formula below is used to help in measuring land use mix, but it has some limitations because it cannot indicate the types and distribution of land uses (Mavoa *et al.*, 2018). In this formula, H = land use mix score, pi = the proportion of the area covered by land use i against the summed area for land use classes of interest (including i), and n is the number of land use classes of interest (Frank *et al.*, 2005 cited in Christian *et al.*, 2011).

$$H = -1(\sum_{i=1}^{n} pi * ln(pi))/ln(n)$$

Increasing density in compact contexts provides access to a variety of needs with shorter travel distances, which enhances walkability (Udell *et al.*, 2014). However, density brings land uses together, thus it is essential to consider the land use distribution along the streets to avoid overpopulation in one focal point. In compact cities, it is needed to reinvent urban spaces vertically and horizontally. Obsolete industrial sites, former landfills, and quarries can be regenerated. In addition, optimizing uses of vacant lands, spaces underground, and under flyovers for compatible uses can help in upgrading land use quality in compact contexts (Hong Kong 2030+ Planning Department, 2016).

3. The Social Dimension

The social dimension is the third section of walkability criteria in the research as illustrated in (Fig.1) and it is studied through two dimensions, which are the perceptual and psychological dimensions.

4. The Perceptual Dimension

The perceptual dimension is analyzed by studying legibility, which is necessary for the user to assimilate and read urban space.

Legibility is an urban quality that helps users easily understand and move in urban spaces, which can be evaluated in multiple ways. One of the evaluation methods is by marking existing paths, nodes, landmarks, edges, and districts on a map and analyzing them to provide recommendations for readjusting the design of those elements in the urban context when possible (Lynch, 1960). There are other indicators for evaluation such as the presence of lighting of roads at night, repeated remarkable signs along the streets, and using the rhythm of trees to

define the continuity and discontinuity of the road (Nia, 2017). In compact contexts, enhancing legibility can be achieved by simplifying the building facade character, which facilitates the illustration of the full image (Nurgandarum & Anjani, 2020). Grouping similar destination zones whether in form or function helps in the understanding of place (Karssenberg *et al.*, 2016). In compact spaces, it is essential to design clear environments to reduce confusion by creating clear connections and using regular shapes in defining boundaries (Shi *et al.*, 2014).

5. The Psychological Dimension

The psychological dimension is discussed by studying pedestrian comfort and safety, which affects how a user can feel and experience the pedestrian space.

a. Pedestrian comfort

Pedestrian comfort can be described as a positive emotional reaction to external surroundings, which gives a pleasant experience for the pedestrian (Ovstedal & Ryeng, 2002). Pedestrian comfort is studied using three categories, which are privacy, environmental design, and street design.

First, privacy can be achieved through visual and auditory aspects. Visual privacy can be evaluated by observation of space hierarchy between public and private spaces (Carmona *et al.*, 2003) and pedestrian density, which is considered comfortable if the range is from 6 to 12 people per minute per meter (Jacobs, 1996 cited in Matan). Auditory privacy is evaluated by measuring noise level. According to WHO, 45 decibels have been considered the city's safe noise level (Bhat, 2010). Secondly, shades and wind flow affect thermal comfort. One of the indicators that a route has sufficient shade is that pedestrians should be able to walk 20 minutes from origin to destination and 20% to 60% is the shade coverage for a comfortable route (Bork, 2019). To improve wind flow, it is recommended to align the streets in a parallel orientation or up to 30 degrees to the wind direction and to link open spaces where possible in the urban form (Ng, 2010). Thirdly, comfort can be achieved through street design including seat location, access to public transport, footpath design, street slope, curb ramps, and cleanliness. It is recommended to put seats at regular intervals every 100 meters (Ewing, 1999). Moreover, the walking distances from the bus stop to the destination points are acceptable if 1000 meters maximum and it is comfortable if below 400 meters (Burke & Brown, 2007 cited in Tanzil & Gamal, 2021). Footpath width should be from 1.8 to 4.5 m to be comfortable (Ewing, 1999), (Smith *et al.*, 1987). It is recommended that the slope (height to length) of a ramp be designed between 1:12 to 1:20 to be comfortable for most users. The slopes between 1:12 and 1:16 can have a maximum horizontal length of 9.14 m without a landing, while slopes between 1:16 and 1:20 can have a horizontal run up to 12.19 m before requiring a landing. These recommended ranges for slopes provide comfort for different types of users, especially the disabled (Maddock, 2020). Curb ramps are recommended to be placed to provide a smooth transition from the sidewalk to the street and crossings for the elderly and disabled with a maximum slope of 1:12, minimum width of 121.9 cm, and overall depths of 121.9, 152.4 cm (Doss, 2023). Street cleanliness is achieved through providing well-distributed dustbins, which enhances users' comfort.

In high densities, the hierarchy of spaces can be achieved through elevating buildings' ground floor or recessing building entrances. Noise can be controlled through sound absorbance, diffusion, and masking (Kahraman & Cubukcu, 2017). Redistribution of land uses in crowded areas is recommended to spread pedestrian density around where more people can comfortably walk and still have space to breathe (Alter, 2020). Making variations in buildings' heights and splitting the large solid building mass into multiple partitions help improve wind flow (Yang *et al.*, 2020). It is recommended in residential areas to separate sidewalks and vehicle traffic by a planting strip or an additional buffer zone that ranges between 30 and 60 cm (Aktan & Özyavuz, 2022).

b. Pedestrian safety

Pedestrian safety is the extent to which the pedestrian can walk without the fear of the occurrence of accidents or crimes (Roberts, 2018). Pedestrian safety is measured through some indicators such as traffic signal spacing, crosswalks, stop bars, safety islands, speed limits, and street lighting standards.

Traffic conditions such as vehicle volume and pedestrian crowds can be controlled through regulations such as speed limits, speed bumps, and traffic calming schemes (Liang *et al.*, 2023). Traffic signal spacing is recommended to be from 400 to 800 meters, especially in arterial roads, and suburban and developing rural areas, while in downtown areas it is often about 150 meters (Smith *et al.*, 1987). According

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to Aberdeen Pedestrian Transportation Plan (APTP), crosswalks should be located with traffic signals, at non-signalized school zones, and uncontrolled intersections with no traffic signals. Crosswalk widths should be 1.8 meters minimum and ideally three meters in downtown areas. In addition, a stop bar should be located at a distance from 4.5 to 9 meters back from the crosswalk to increase visibility (APTP, 2011). Narrowing the crossing distance at street intersections is recommended to facilitate street crossing (Smith *et al.*, 1987). A pedestrian safety island is a solution for wide roads with three or more lanes of traffic (National Association of City Transportation Officials, 2013). On the other hand, speed bumps should be applied on one-lane streets (New York City Department of Transportation, 2020). It is recommended that the safest speed for cars is 30km/h in high pedestrian areas, 40km/h for local roads, and 60km/h or more on arterial roads (Victoria Walks, 2022). It is found that just a 5% cut in average speed can result in a 30% reduction in fatal crashes (Claris *et al.*, 2016). Street light poles standards vary according to street type. Sidewalks standard light poles range from 4.5 to 6m in height. Narrow streets light poles range from 8 to 10m in height while taller poles of height 10 to 12 m are used for wider streets. Moreover, spacing between light poles should be 2.5–3 times the pole height (National Association of City Transportation Officials, 2016).

According to Jane Jacobs, one of the main principles that contribute to crime prevention is to increase activities and "eyes on the street" (Jacobs, 1992). This is achieved in high-density communities through the presence of more mixed land uses that attract people at various times of the day (Matan, 2011). In compact contexts and mixed land-use areas, pedestrian-vehicle crashes may increase because of the increase in the number of pedestrians and cars (Lee *et al.*, 2013).

II. CASE STUDY: ANALYSIS OF WALKABILITY CRITERIA IN SYRIA STREET IN ALEXANDRIA, EGYPT

The morphology of Alexandria has evolved over its long history of 25 centuries. Its planning is based on Hippodamian principles where the streets are laid out in an orthogonal gridiron configuration. The city extends 24 Km from Abukir east to Ras-El-Tin west and 36 Km to the west borders of the governorate till Sidi Kreir, so from east to west the city is approximately 60 Km wide. While it extends from the North to the South for a maximum of only 5 Km for its larger parts (Zahran *et al.*, 1984). Alexandria has limited opportunities for horizontal expansion. Its linear form is caught between the Mediterranean Sea and the Mariut Lake with other water bodies south. Valuable agricultural lands bound the city from the east, while in South-West of the city, various industries are spread out. Alexandria is situated principally along five longitudinal axes: The Corniche Road (Tariq El Guish), the tramline, Abukir Road, Port Said Street, and Al-Mahmoudiah Canal (today an urban expressway). The Corniche Road is one of the most longitudinal and important axis roads in the city. It was developed during the end of the twentieth century from 1998 until 2002 to be widened to at least six lanes and up to ten lanes in some areas to accommodate the growing traffic (Yehia, 2007).

Syria Street in Alexandria is one of the main streets that connects the three main arterial roads, which are Abukir Road, Corniche Road, and Abd-ElSalam Aref Road (the tramline in Roushdy district) (Fig. 3).

Fig. 3. Syria Street in Roushdy district (Source: Google Maps, 2022, edited by researchers).

Syria Street is approximately 750 meters in length and 14 meters in width. It is a busy street with its various land uses, which attracts a variety of users daily. Moreover, the street is located near Stanley Bridge, which is one of the important landmarks and destinations in the city.

The main aim of choosing this location as a case study is that Syria Street can be considered a typical city center street with distinctive features. Its distinctiveness is due to its location, which is near Stanley Bridge, connecting the three main arterial roads of Alexandria, and the presence of a considerable number of historical buildings. Thus, if the streets are categorized in general considering their degree of character and imageability, Syria Street is neither a Local Street with no distinctive features nor what can be called a « Great Street » with outstanding architecture, historic value, tourist attractions, and landmarks. The main reason for

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choosing the case study of this category is that Alexandria includes a large number of similar city center streets that need to be improved and that face the same problems. Hence, the recommendations of Syria Street can be applied to other streets and can help in understanding and analyzing them.

According to the studied criteria, the urban qualities are evaluated to study the strengths and weaknesses related to walkability in the street and provide recommendations. Some qualities are evaluated by comparing the measured value in Syria Street with the standard or Recommended Ranges (RR) of urban indicators, as mentioned in the earlier part of the research. Other qualities are studied through survey, observation, and qualitative analysis of urban indicators of Syria Street.

The studied walkability criteria are analyzed in Syria Street through morphological and visual, functional, and social dimensions.

A. Morphological and Visual Dimensions

Morphological and visual dimensions in Syria Street are analyzed using the urban qualities previously cited and compared with recommended ranges, as explained earlier.

1. Imageability

This quality is evaluated using some recognizable indicators in Syria Street such as the presence of courtyards, plazas, and parks, major landscape features, proportion of historic frontage, presence of buildings with identifiers and non-rectangular buildings, and outdoor dining areas. Through observation, Syria Street contains no plazas nor recognizable courtyards. There are not any outdoor cafés or restaurants on street level. On the other hand, some trees are observed in some zones but no major landscape features are observed in the rest of the rest of the street (Fig.4).

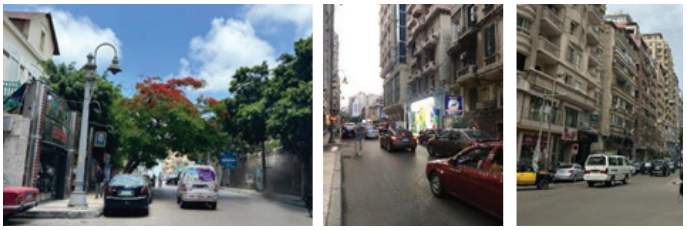

Fig. 4. The presence of trees in some areas of Syria Street and their absence in other parts of the street (Source: The researchers)

The presence of historical frontages increases the imageability of the street, which helps in enhancing walkability. This appears on Syria Street as it contains eight listed buildings. Syria Street can be described as a street that possesses two different characteristics regarding architecture and density. For the most part, the buildings bordering the Street are conventional and characterless, with no particular distinctive architecture. Apartment blocks are rising to 10 to 15 floors and include commercial spaces on the ground floor and the upper first floors. At the same time, other parts of the Street are constituted by villas with gardens. Eight of these villas are listed in the Catalogue of Architectural and Urban Heritage of Alexandria (Governorate of Alexandria, 2007). Under the Unified Building Law 119 for 2008 and the Heritage Conservation Law 144 for 2006, the following map shows Syria Street in red and the other main roads surrounding it in yellow. The buildings highlighted in blue are listed on the « City level » in the Catalogue, which corresponds to level II (in the British System), level I, being the highest exceptional value. The buildings in violet are listed as « Local level ». Most of these villas, which are eclectic in style, were built in the first half of the twentieth century. These buildings of architectural and historic value have a great role in reflecting the sense of place and identity of Alexandria and affect the imageability of the street (Fig.5).

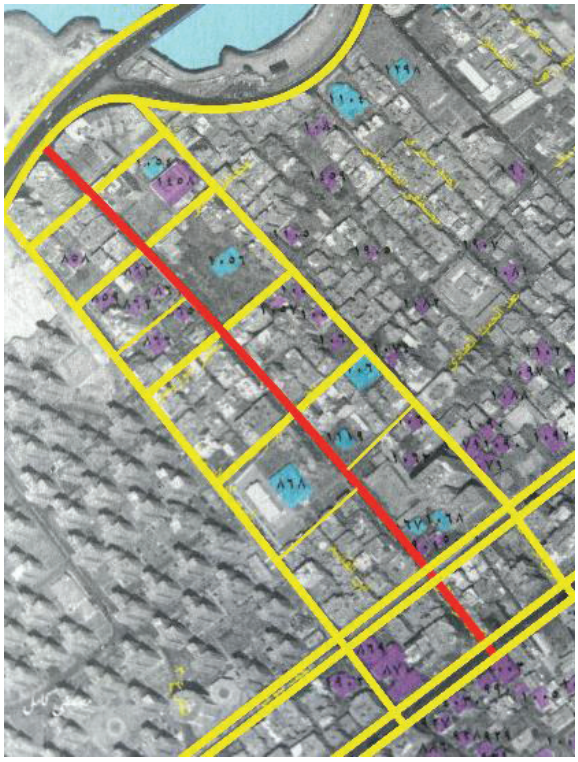

Fig. 5. The buildings in blue are listed on the « City level » in the Catalogue and the buildings in violet *are listed as lesser«* Local level » in Syria Street (Source: based on Governorate of Alexandria, 2007).

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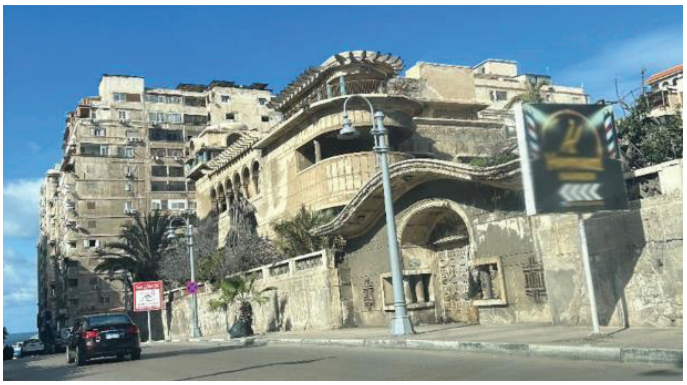

Fig. 6. Qasr El Orouba is an example of listed villas bordering Syria Streets which is architecturally distinctive by its Islamic and Early Modern influences (Source: The researchers).

Among the listed villas bordering Syria Streets, the Palace of Orouba « Qasr El Orouba » is distinctive with its Neo-Islamic eclectic style and Early Modern influences. The Palace code is 1056 in the Catalogue and is classified as « City level » for its unique architectural value (Governorate of Alexandria, 2007, p.142). Unfortunately, the Palace is abandoned. A project of rehabilitation and adaptive reuse could be regenerating Syria Street (Fig.6). As so rightly put by Jane Jacobs, "New ideas must use old buildings » (Jacobs, 1992, p.188). Fig.7 shows the original page of the Heritage Catalogue showing the Data concerning another listed villa (Code 861) located on Syria Street. The following form is an identification of the building code, name, type, address, and the building classification standards, which show that it has a distinctive architectural style.

2. Transparency

This quality is evaluated through indicators such as the proportion of windows at street level, street wall, and active uses of Syria Street. At the ground floor level, commercial spaces with glass transparent windows are observed which enhances the visual connection between pedestrians outside and the inside spaces (Fig.8). The proportion of windows at street level on both sides is assessed to be approximately 65% along the street as blocks lengths on both sides of the street are approximately between 620 and 640 meters and the lengths of the transparent façades on both sides are approximately between 345 and 485 meters.


إستمارة بيانات المباني التراثية المشار إليها بالقانون 144 لسنة 2006
التحديث الأول - سنة 2019
كود المبنى 861
الحى شرق
رقم العوايد 65 شياخة بولكلى
ملاحظات
اسم المبنى فيلا
عنوان المبنى 29 سوريا
اسم المالك الحالى عيسى العيوطى وعلاء ومنى عيسى العيوطى
اسم المالك الأصلى ارنست مويكر
معايير تصنيف المبنى المبنى ذو طراز معمـــارى مميـــز
التفسير المبنى ذو طراز معمـــارى مميـــز
صورة المبنى
توصيف المبنى فيلا
استخدام المبنى الأصلى
ملكية المبنى خاص
عدد الأدوار الفعلية
سنة إنشاء المبنى
الحالة الإنشائية للمبنى
اسم المهندس المعمارى
اسم المهندس الإنشائى
اسم المقاول
مدة تواجد المستخدمين
العناصر التى يجب الحفاظ عليها
الحالة القانونية للمبنى
العمارة و التشطيبات
استخدام المبنى الحالى
وضع المبنى
ارتفاع المبنى بالمتر
النظام الإنشائى
مادة البناء الرئيسية
سقف المبنى
هل يوجد حديقة
التغييرات الحادثة للمبنى
تاريخ حدوث التغييرات
الخدمات (الكهرباء, الصرف, التغذية بالمياه, الغاز)
المراجع و الوثائق المتحدثة عن المبنى
محيط المبنى
خريطة المبنى
رقم الخريطة الموقع بها المبنى داخل خرائط مبانى الحفاظ فى مجلد التراث 14

Fig.7. The page of the Heritage Catalogue showing the data concerning another listed villa (Code 861) located on Syria Street (Source: Governorate of Alexandria).

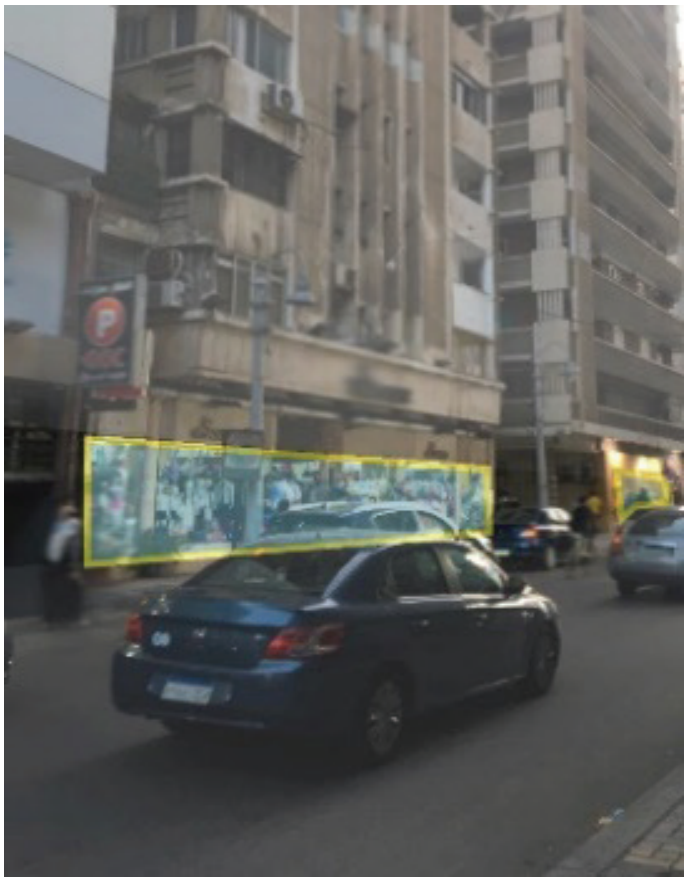

Fig. 8. Glass facades on the ground floor at Syria Street (Source: The researchers).

On the other hand, the proportion of the street wall is the proportion of the length of the street on both

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sides made up of the street wall. In Syria Street, the proportion of street walls is high because most of the street is lined with buildings on both sides. Active uses can be defined as shops, restaurants, public parks, and other uses that generate activity and provide significant pedestrian traffic. Thus, active uses in Syria Street are considered high because the main land use on both sides of the street is commercial. Except for the fences and blank walls surrounding the gardens of the private villas (Fig. 6 and Fig. 7).

3. The Scale of Enclosure

It is measured through two methods. First, through indicators such as the presence of long sight lines, pieces of street furniture and small planters, and the proportion of windows at street level. Second, through calculation of the ratio between the heights of buildings to the width of the street. Through observation, long sight lines are interrupted along the street due to the presence of obstacles on the sidewalks. Syria Street contains elements of street furniture such as flowerpots, huge banners, street vendors, and pedestrian scale lights but it does not include seats and enough trashcans. These elements contribute to pedestrian comfort and cleanliness, and they need to be upgraded. The proportion of windows at street level is assessed to be approximately 65% along the street, as mentioned before. The height of buildings in the street ranges between 4.5m to 42m and the width of the street is about 14m. This means that the average ratio (H/W) varies between 1:3 and 3:1 (Fig.9).

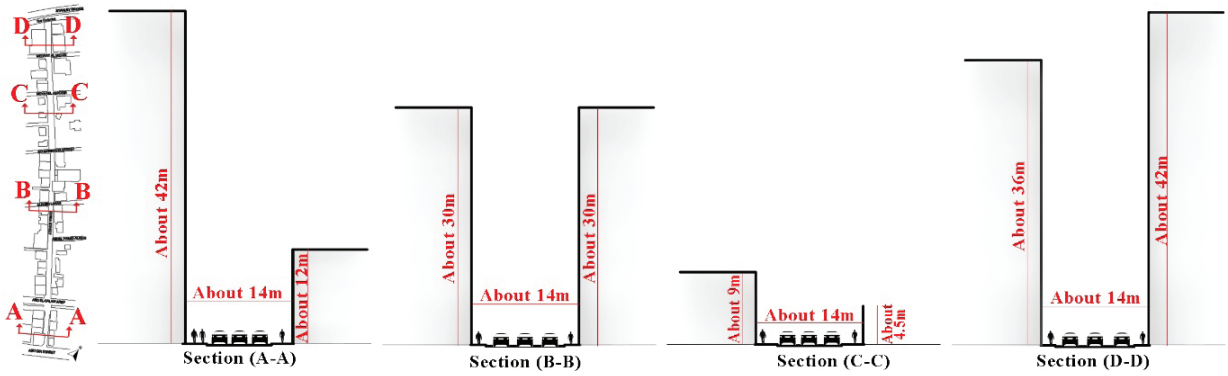

Fig. 9. Enclosure in Syria Street (Source: The researchers).

Thus, only some areas in the street are within the recommended ranges, as in section C-C (in Fig.9). The ideal recommended (H/W) street ratio is 1:1 and the minimum ratio is 1:2, according to Jacobs (1996) as cited in Ewing (1999). The ratio of 1.5:1 between the height and width of the street creates claustrophobic space based on Hedman and Jaszewski's (1984) (Kahraman & Cubukcu, 2017).

4. Complexity

It is evaluated through indicators such as the number of visible buildings on both sides of the street within the study area, basic and accent building colors, the presence of outdoor dining area, and public art pieces such as monuments, sculptures, murals, and any artistic display in Syria Street. Through observation and survey of Syria Street, the average number of visible buildings is about 7 buildings of different design facades. This is considered a good degree of complexity. Variable basic and accent building colors are observed in the street. Syria Street contains no outdoor dining areas or public art pieces. Thus, outdoor dining areas and public art pieces should be added to enhance complexity.

5. Connectivity

It is evaluated in the case study using the third method by calculating the ratio between links to nodes which is the most suitable method of evaluation of connectivity of the case study because the other two methods are used for measuring connectivity of streets with multiple start points and particular destination or for larger scales than one street. Link is defined to be the pathway segment between two nodes. From the analysis of the connectivity map of Syria Street and surrounding streets, as shown in (Fig.10), it is illustrated that the Link-Node Ratio = 62 links /34 nodes = 1.8. This is considered an acceptable ratio for connectivity of a walkable community because the minimum required ratio of a walkable community = 1.4 (Clos, 2013).

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Fig. 10. Connectivity and legibility existing map for Syria Street (Source: Google Maps 2022, Osama 2017, AlZuabi, 2018 and edited by researchers).

Another factor that affects connectivity in the street is the presence of obstacles on footpaths, such as elements that are not placed in appropriate places, which affects the pedestrian walking experience. For example, light poles, huge advertisement banners, outdoor merchandise of shops, parked motorcycles, and ATM kiosks, as several banks are located on the Street (Fig.11).

Fig. 11. Different kinds of obstacles on sidewalks of Syria Street (Source: The researchers).

a. The Functional Dimension

The functional dimension in the case study is illustrated by studying the diversity of land uses, which is a main urban quality that is achieved through land use mix in urban space, which enhances walkability and pedestrian experience. Illustrating land uses of the street on a land use map is the selected method of evaluation in the case study because this specifies types and distribution of land uses along the street, which achieves efficient analysis of land uses of Syria Street. Moreover, measuring land uses on the scale of a street is easier to illustrate on a land use map, and the formula mentioned before is needed to measure land use mix for larger scale neighborhoods.

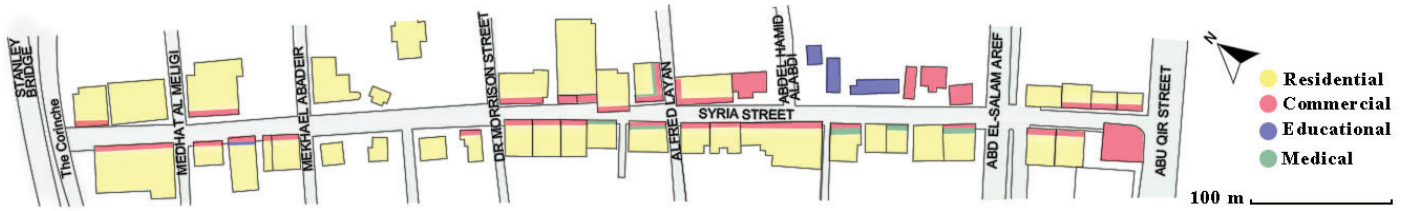

Fig. 12. Land use map for Syria Street, Alexandria City (Source: Google Maps 2022 edited by researchers).

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From the land uses map of Syria Street (Fig.12), it is clear that there is a variety of land uses including residential buildings, shops, schools, and medical and administrative buildings. This mix of land uses attracts more users and enhances walkability in the street.

b. The Social Dimensions

Social dimension is studied in the case study through two dimensions as illustrated before, which are the perceptual and psychological dimensions.

1. The Perceptual Dimension

Perceptual dimension is studied in Syria Street through studying main urban quality, which is legibility that helps users understand the urban space better and move easily from one place to another without confusion.

Legibility is measured through a qualitative method that depends on observation and site analysis of Syria Street to define strong and weak points. It can be assessed by marking existing paths, nodes, landmarks, edges, and districts on a map, and analyzing them helps to suggest recommendations for readjusting the design of those elements in the urban context. Furthermore, some other indicators help in the evaluation of legibility such as the presence of lighting of the roads at night, the presence of repeated remarkable signs along the streets, and using the rhythm of trees to define the continuity and discontinuity of the path. From the legibility map of Syria Street (Fig.10), it is observed that in each of Syria, AlMoaaskar Alromani, Roushdy streets, an extra intermediate landmark, and more nodes can be added especially in the distance between Abdel Salam Aref and Al Corniche roads. Hence, it is recommended to visually connect between those arterial roads that are already considered reference points or landmarks. Besides, lighting in the street needs to be upgraded and added, as some areas are dark at night (Fig. 13).

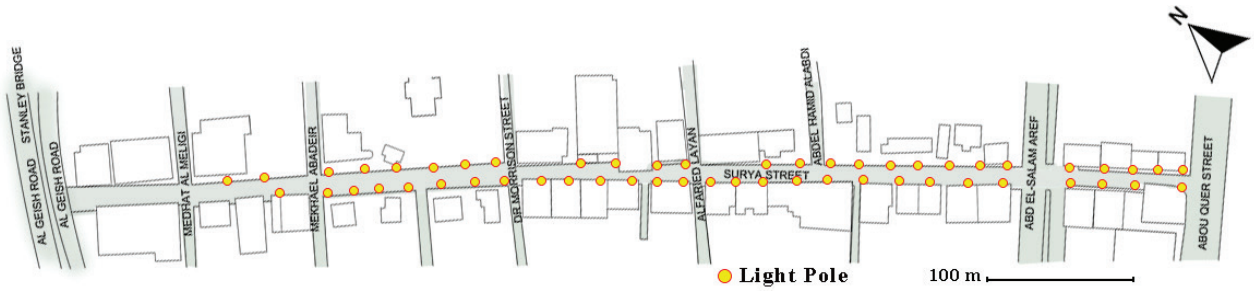

Fig. 13. Light pole locations through Syria Street (Source: Google Maps, 2022 and edited by researchers).

Moreover, some trees and planters are observed in some zones and missing in other parts of the street, and there are street name signs and traffic signs.

2. The Psychological Dimension

The psychological dimension in the case study is analyzed in Syria Street through studying two main urban qualities, which are pedestrian comfort and safety, which upgrades walkable spaces and pedestrian experience.

a. Pedestrian Comfort is studied through the evaluation of several indicators such as the hierarchy of spaces, pedestrian density in space, city's noise, percentage of shade coverage, buildings' orientation and wind movement, seat position, access to public transport, footpath width and slope, cleanliness, and curb ramp. Through observation, it is observed that there is a hierarchy of spaces in Syria Street; for example, entrances of residential buildings are recessed to create a transitional space between public and private zones (Fig.14).

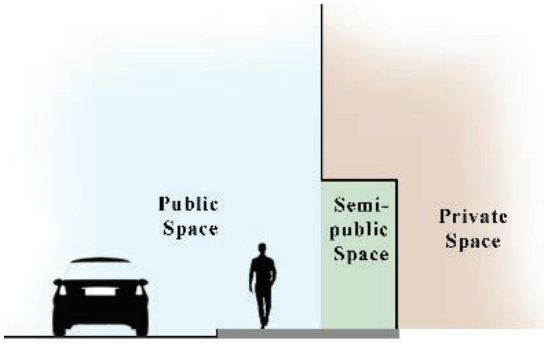

Fig. 14. Showing hierarchy of spaces in the street from public to semi-public to private spaces through recessed entrances (Source: The researchers).

Moreover, pedestrians have been counted several times per minute per meter for every

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100 meters using a stopwatch on both sides of the street day and night during weekdays and weekends (Fig.15). The average number of pedestrians is approximately 6 to 7 persons per minute per meter at day during both weekdays and weekends, which is within the recommended ranges because the common appropriate level is between 6 and 7 people per minute per meter (Jacobs, 1996, Whyte, 1988 cited in Matan, 2011). It is observed that the number of pedestrians is higher during the day than at night because the average number of pedestrians is approximately 2 to 3 persons per minute per meter at night. This occurs due to the absence of restaurants and cafes along the street and the closing of shops at night. The main active point at night is at the beginning of the street from AbuKir Road due to the presence of a shopping mall in that area. Furthermore, it is observed that pedestrian density increases in commercial zones of the street.

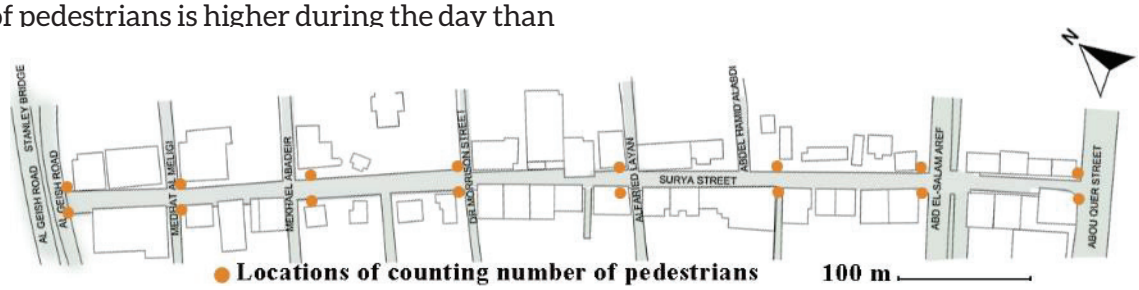

Fig. 16. Wind movement direction with Syria Street orientation (Source: Windy.App 2022, edited by researchers).

Good shading is observed in regions with trees and high-rise buildings, and it decreases in regions with low-rise buildings and no trees. Furthermore, buildings are nearly parallel to the wind direction, which allows the wind to flow along the street (Windy.App, 2022) (Fig.16).

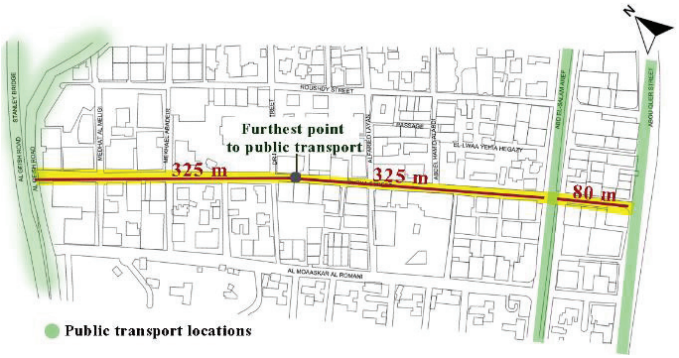

Fig. 17. Public transport locations (Source: (Google Maps, 2022 and edited by researchers).

Another indicator is that the access to public transport is straightforward and the furthest point to public transportation stops is 325 m (below 400 m), which is a comfortable distance for walking. As explained in the map below, the public transportation means are located in Al Corniche such as bus stations and microbus stops, besides Abdel Salam Aref, which includes the Tramline (Fig.17).

Fig. 18. Syria Street slope (Source: Google Earth and edited by researchers).

In addition, footpath width ranges from about 1.8m to 2.7m, which is considered within the recommended ranges. Through analysis of Google Earth, it is shown that the slope of the street is almost flat except in two areas. The slope of the yellow zone as shown in (Fig.18) before Alfred Layan Street is in the recommended range but needs more landings to be comfortable. The slope (H/W) of the zone at the end of the street near Al Corniche Road is more than 1:20, which is comfortable for walking.

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Moreover, the street needs more dustbins to enhance cleanliness in the street and make it easier and more convenient for users. Curb ramps are observed on some sidewalks and missing on others. There is a total absence of seats along Syria Street, which significantly undermines the quality of the street, in terms of comfort, especially for the elderly and the persons with reduced mobility.

b. Pedestrian Safety is studied through analysis of indicators such as traffic signal spacing, crosswalk locations and widths, stop bar, safety island locations, narrowing crossing distance at street intersections, speed limit in built-up areas, and light pole height. In Syria Street, there are three traffic signals located on the three arterial roads and one between Abdel Salam Aref and Al Corniche roads. This means that the distance between the first two signals is about 150 m, the second is about 250 m and the third distance is about 400 m. The recommended range for traffic signal spacing is 400 to 800 m in arterial roads, suburban and developing rural areas, and 150 m in downtown areas. Thus, one more traffic signal is recommended along the street in the distance between Abdel Salam Aref and Al Corniche roads. There are no crosswalks, stop bars, or safety islands observed on Syria Street. Moreover, no narrowing crossing distance at street intersections is observed to make pedestrians' crossing easier. The speed of vehicles is assessed through survey and observation. It is evaluated by using two methods. First, through observation and recording of car speed while riding several times through the street with the same speed as other cars and the second method is by using the equation of (Speed= distance/time). Therefore, the time taken by a car to travel a certain known distance is calculated using a stopwatch and then the speed is calculated.

The average speed of vehicles during the day in the street is approximately between 30 to 40 km/h and during heavy traffic speed can be less. This speed lies within the recommended ranges because 30 km/h is recommended in high pedestrian areas and 40km/h in local streets. Light poles on sidewalks of the street are about 4.5 m to 5 m in height, which is within the recommended ranges (4.5 to 6m on sidewalks, 8 to 10m on narrow streets, and 10 to 12m on wider streets). In addition, the spacing between poles is about 15 m, which is about 3 times the height of light poles as in the recommended ranges (National Association of City Transportation Officials, 2016). However, some areas need more light poles.

TABLE I
EVALUATION OF WALKABILITY CRITERIA USED IN THE CASE STUDY (SYRIA STREET, ALEXANDRIA) (Source: The researchers)

Urban Dimension	Urban quality	Evaluation of Syria Street
Morphological dimension	Imageability	
	Transparency	
	Scale of Enclosure	
	Complexity	
	Connectivity	
Functional dimension	Land use Mix	
Social dimension (Perceptual)	Legibility	
Social dimension (Psychological)	Pedestrian comfort	
	Pedestrian safety	

From the evaluation of the urban dimensions and qualities in Syria Street (Table I), The outcomes are that the land use mix is satisfying, which helps in encouraging walkability. Moreover, transparency, connectivity, and legibility are good but can be upgraded. On the other hand, imageability, scale of enclosure, and complexity are rather sufficient to sustain street safety and public contact but can also be improved. Yet, the street is poor at pedestrian comfort and safety, which are critical and need serious improvement to increase walkability. These lacks are a handicap and have badly undermined the street convenience for pedestrians. Some of the qualities included are evaluated through qualitative and quantitative indicators together and other qualities are evaluated through either qualitative or quantitative indicators. For instance, measuring imageability is qualitative, measuring connectivity is quantitative, and measuring comfort is both qualitative and quantitative.

III. RECOMMENDATIONS

According to the previous evaluation of Syria Street, some recommendations are provided to enhance walkability as spatial features are thought to have an impact on a person's decision to walk. Some recommendations can be easily applied while others are difficult to implement and can be considered a long-term goal.

Recommendations that can be easily applied for the short term:

- Attention to detail and careful coordination between traffic engineers and planners are prerequisites to creating pedestrian-friendly streets, especially considering the importance of providing a good mix of land uses and connectivity.
- Greater consideration must be given to street furniture: renovating and designing more adapted pavement and curbs, greenery, especially trees, and seats (preferably shaded). Some elements must be added and increased such as the number of trashcans.
- Crosswalks must be added to the street to increase the degree of safety. Marked crosswalks are most effective as motorists and pedestrians can identify them easily.
- Removing all obstacles on the sidewalks such as parked motorcycles, and merchandise in front of shops, and designing appropriate locations for ATM distributors, planters, streetlights, and huge street-level advertising billboards. Placing the advertising poles in appropriate locations and reducing their large number would improve the flow of pedestrians. It is also possible to combine lighting and advertising poles in one element.
- Disposing of all debris or elements obstructing the flow of pedestrians on the sidewalk is the responsibility of Municipal Governments that must apply fines for irregularities, especially concerning occupying public roads and sidewalks.
- Upgrading the ground floor design of the street, in terms of functions and activities, to achieve a vibrant experience for users at eye level and considering the activities at night, not only by day. Restaurants, cafés, or theatres would enable the street to be more vibrant at night.
- Adding an intermediate landmark in the distance between Abdel Salam Aref and Al Corniche roads to visually connect between arterial roads that can be considered as reference points.
- The sloped part before Alfred Layan Street needs more landings to be added to make it smoother for walking.
- Adding crosswalks, stop bars in the street, and more lighting in the observed dark zones at night and providing narrow crossing distances at street intersections to improve safety.
- Expanding the width of sidewalks by minimizing on-street parking, when opportunities arise.

Recommendations for long-term goals:

- Increasing intermodal networks and cycling lanes in the neighborhoods and on the border scale of the city.
- Introducing guidelines in policies to encourage people to use public transit in their commute. These guidelines must be included in local planning documents.
- The Government must encourage public-private partnerships, which can contribute to enhancing the quality of the physical street environment. This can be done through renewal and renovation projects. For instance, the Governorate could provide incentives for developers to renovate pavements and pedestrian amenities to enhance the street comfort, safety, and image.
- Providing incentives for developing vacant lots towards an urban green network accessible to all residents complemented by a network of squares and other small outdoor places for active living in the streets.
- The Governorate and Planning Authorities should be working with investors to develop strategies concerning the adaptive reuse of abandoned listed villas in efficient ways to explore a variety of pedestrian-friendly approaches and land-use mixed developments on the scale of the neighborhood.
- Planning policies must strengthen public awareness to promote walking.

IV. CONCLUSION

The present research has shown that people's willingness to walk depends on accessibility to nearby transportation, compact development with varied destinations, path quality, safety, attractiveness of the built environment, and sense of comfort and convenience. The research also confirmed the fact that a dense concentration of people is one of the necessary conditions for flourishing city diversity

(Jacobs, 1992, p.205). To deepen the understanding of the urban qualities and their indicators explained in this research, the walkability criteria were classified into morphological/visual, functional, and social dimensions. Each dimension included a number of urban qualities. In addition, each urban quality was studied by stating its definition, measuring methods, and demonstrating how this quality works in high-density communities. The case study of Syria Street was selected to represent a typical city center street in Alexandria that includes a mix of listed villas and conventional common apartment buildings. This is the case for most streets in the city centers of Alexandria. The walkability criteria are then applied to the street. Thus, the strong and weak points of the street are analyzed. This is illustrated through the findings provided from the case study, which clarify that the land use mix is satisfying in the street. While transparency, connectivity, and legibility are good and can be enhanced. Imageability, scale of enclosure, and complexity need improvement. On the other hand, after studying pedestrian comfort and safety in the street, those two criteria are critical and need to be seriously addressed.

According to this analysis, some recommendations were provided to enhance walkability conditions. How people perceive and experience the local environment is significantly impacted by their walking conditions. Therefore, to reclaim the city for people, the Government must focus on the dimensions that encourage people to traverse a city on foot. Local authorities need to acquire the necessary knowledge of planners and urban designers to support the decision-making process so each city and even each street can create its own solutions.

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