

Gated Community Walkability Design Efficiency Model

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Abstract It has been crystal clear that Gated Communities became one of the most noticeable urbanization features that have recently spread massively in the Egyptian Real Estate Market with the expansion of Greater Cairo. The Gated Communities phenomenon became noticeable in Egypt due to several motives such as developing sustainable and healthy communities. They must promote walkability as their mobility network because walkability is an essential tool in implanting Sustainable Healthy Gated Communities. Walkability has always been correlated with human health and well-being, and the walking behavior is massively influenced by the gated community's urban design. A low rate of walkability affects human health, well-being, and quality of life. Since Gated Communities in Egypt don't promote walkability, due to the lack of specialized sustainable urban design principles and patterns for it. This study aims to: define and clarify the sustainable urban design principles and patterns specialized for Gated Communities to promote walkability. GCWDEM is a model to be inducted that bears the ability to measure the design efficiency of gated communities' walkability principles. This innovated model will have the ability to be integrated within the design process as a proactive approach, or to be applied to the existing projects as a reactive approach.

Keywords Walkability, Gated Community, Pedestrian Quality, Urban Healthy Community, Sustainable Urban Design

urbanization features is the interest in Gated Communities who had recently spread massively in the Egyptian Real Estate Market with the expansion of Cairo Metropolitan Region [1]. The phenomenon of Gated Communities "residential compounds" started in Egypt at the beginning of the 20th century due to several motives, such as seeking for better quality of life, better air quality, less sound pollution, providing healthy and sustainable communities, offering more safety and security from the city, etc. The Gated Communities must have walkable environments since walkability is an essential tool in implanting Sustainable Healthy Gated Communities. The Gated Communities must promote walkability as their mobility network, by developing an efficient and effective pedestrian circulatory network and motivative walkable environment [2]. Having an efficient and effective pedestrian circulatory network will provide walkways that act as a spiderweb in connecting the Gated Community together. Walkability has numerous therapeutic social and health benefits such as increasing social interactions among residents and improving resident's human health, well-being, mental health, emotional health, etc. The walkable environment can provide better air quality, safety and security, wellbeing supportive environment, lower levels of stress and anxiety, increased self-esteem, better mood, social relationships, social interactions, cultural identity, etc. [3]. As a matter of fact, the gated communities in Egypt don't promote walkability as it should be designed due to the lack of specialized sustainable urban design patterns for it. A low rate of walkability affects the residents' health, mood, quality of life, social life, etc. Based on the former analysis, the main aim of this paper is to define and clarify the sustainable urban design patterns and principles specialized for Gated Communities to promote walkability. In this paper, a

1. Introduction

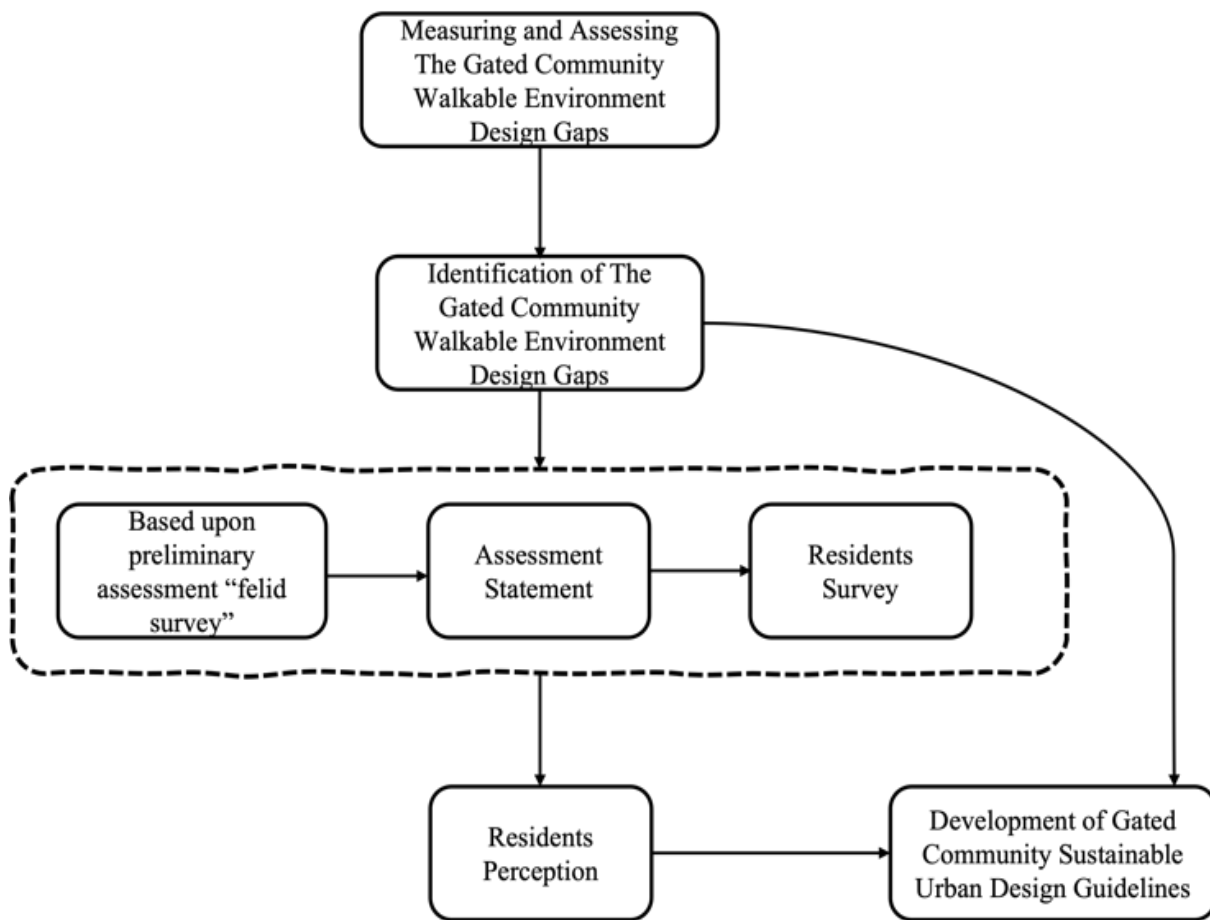
Nowadays in Egypt, one of the most noticeable

model is to be inducted that bears the ability of measuring the design efficiency of Gated Communities walkability principles (GCWDEM). GCWDEM model will have the ability to be integrated with the design process as a proactive approach, or to be applied to the existing project as a reactive approach. Finally, this research paper will conduct a practical case study by applying this model on Beverly Hills Compound, and as a result the model efficiency will be concluded.

communities, and investigates its contributions on social health, human health, and well-being. Based on the profound theoretical and analytical studies, the principles of sustainable urban design patterns for Gated Communities are to be concluded. Based on that, Gated Community Walkability Design Efficiency Model (GCWDEM) is an innovated inducted model that bears the ability to measure the design efficiency of Gated Communities walkable environment principles. Furthermore, the efficiency of the concluded model is to be tested in a practical case study within the Egyptian Urban Context (Figure 1).

2. Methods

This study studies, the concept of walkability and gated



Source: Authors

Figure 1. Research Structure and Method

3. Walkability as a Sustainable Urban Design Tool

Table 1. Walkability Benefits on the Built Environment

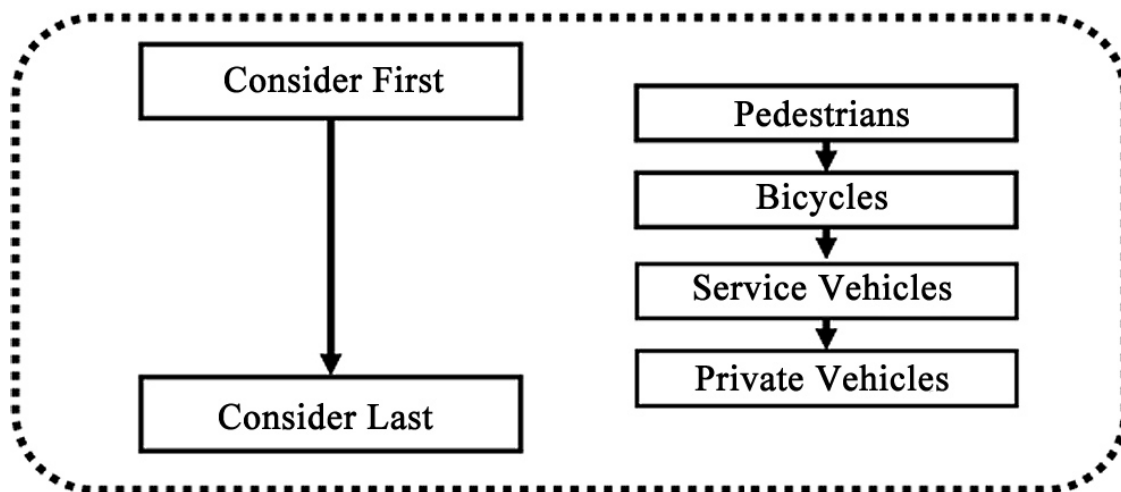
Economic Benefits	Social Benefits	Environmental Benefits
Traffic Jam Reductions	Enhanced mobility for non-drivers that will result in equity benefits	Energy Efficiency
Parking Services Cost Savings	Improved public health, fitness, and well-being	Diminished sound pollution
Consumer Affordability and Savings	Risk reduction for other street users	More sustainable development (wildlife protection)
Reducing Driving Responsibilities	Improved trust and relationship between the users.	Improved the air quality
Local Economic Growth	More activities and interactions between the users	Improved environmental quality

Source: Authors after the following [6]

Walkability is one of the physical activity basic types that can maintain an active lifestyle and has numerous therapeutic effects [4]. Walkability is always correlated with various social health and human health advantages and benefits. Nowadays, the urbanists are looking forward toward more sustainable walkable environments, since walkability is one of the sustainable environment main characters, and it is an essential tool in implanting a sustainable urban healthy community. Walkability has been highlighted as a means of combating obesity. For instance, people who live in walkable environments have much better health and mood, than the people who live in low walkable environments [5]. Physical activities are essential in enhancing social health and human health. For instance, the more walkable the environment is, the more

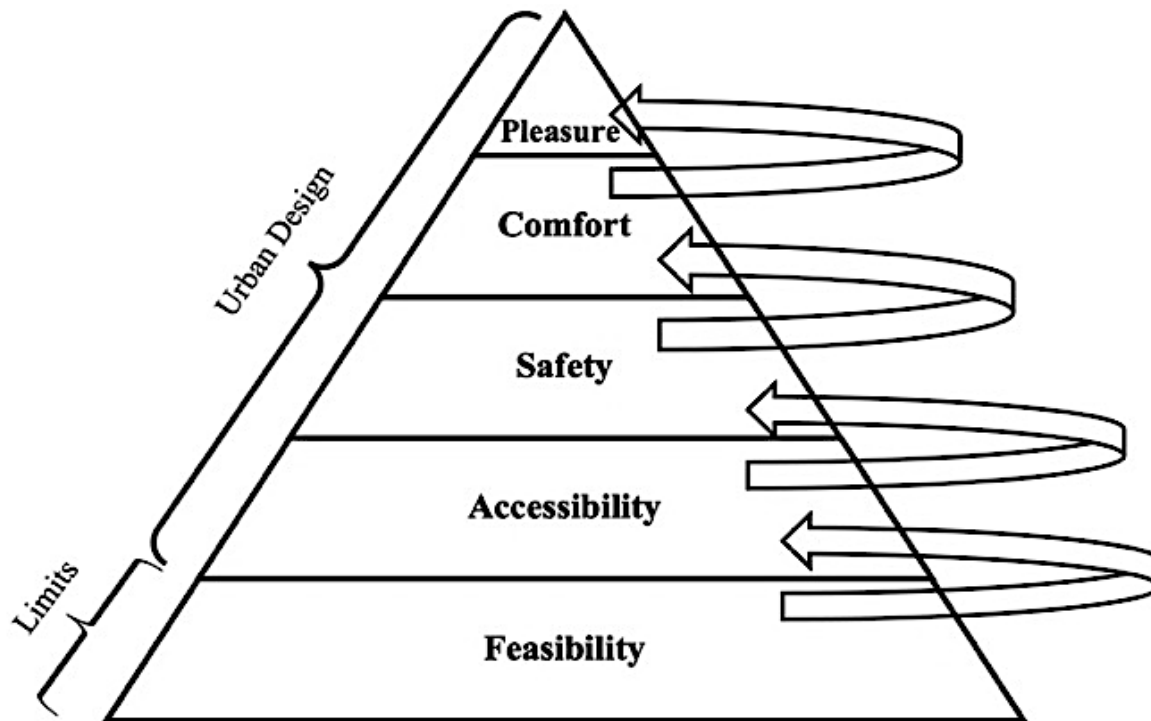
there will be social interactions, relationships, and trust between the residents. There are various benefits of walkability, and these benefits are divided into three main categories that are the economic, social, and environmental [6]. The following table describes each one of these categories in detail (Table 1).

There are mainly two ambitions for walking not only one, which are walking for transportation and walking for recreation [3]. Walking for transportation refers to walking to reach a certain destination, while walking for recreation refers to walking with the sole for meditation, recreation, physical exercise, etc. Each type of walking is influenced by different characteristics of the neighborhood. That's why there is a strong bond between the gated community urban design patterns, and its walking behavior and overall walkability [7]. The more the neighborhood is sustainably designed, the more it will be healthy and walkable. The urban designers and Gated Communities developers must consider more the human scale and needs to give the environment back to the people [7,8]. Walkability is the preliminary human transit method, and it embeds the interaction in the surrounding environment and the pedestrians. The action of walking can be considered for several motifs such as optional (meditation and recreation), necessary (shopping and commuting), and sociable (reading, talking, and sitting). Walkability is affected by both the neighborhood connectivity and safety in parallel, and it is influenced by the feeling of safety, security, and comfort. Therefore, walkability is a vast topic that consists of numerous indicators and variables [8]. The term walkability can be used to describe how much traversable, safe, and compact an environment is [9]. Walking for restoration helps a lot in reducing stress and anxiety, increasing fitness, losing weight, and improving social interactions [5]. The following figure comprises the Gated Community Road user's hierarchy (Figure 2).



Source: Authors after the following [10]

Figure 2. Gated Community Road Users Hierarchy



Source: Authors after the following [13]

Figure 3. Hierarchy of Pedestrians Needs in Gated Communities (P.820)

Gated Communities urban design can support and encourage walkability by maintaining the pedestrians' safety and comfort. Walkability is marvelously significant in helping to achieve social sustainability, better human health, well-being ultimately [11]. Walkability is a strong component of social sustainability because it is an important activity that enhances human health and originates from the approach of sustainability and urban design, due to the strong bond between the vitality and quality of the pedestrian environment in the Gated Communities. Merriam Webster simply defined walkability as an environment that is suitable and motivative for walking, because walkability is a green transportation mode, and it makes the environment more livable and vivid [12]. There is a developed measurement scale based on previous studies that is used to know how much a neighborhood is walkable [2]. This will of course help in enhancing the environment to be more walkable and sustainable. Finally, walkability has numerous and unlimited health, economic, social, and environmental benefits. Although walkability is a mode of sustainable transportation, nowadays it becomes an important urban function that provides a sustainable and healthy lifestyle. Walkability is an important approach in designing Sustainable Healthy Gated Communities. There are some main needs for pedestrians to have a pleasant walk such as safety, comfort, accessibility, etc. [13]. These pedestrian needs are directly influenced by the Gated Community urban design. They are comprised based on their hierarchal importance as given in Figure 3.

4. The Notion of Gated Communities

Gated Communities are mainly characterized by gates, fences, and walls [1,14]. Gated Communities originated in the late 1950s, when the middle and upper socio-economic homogeneity began to occupy large land tracts. First, it started to be a trend in the United States spreading out to Latin America, then to Europe, and finally to the rest of the world [15]. Gated Communities are an advanced form of urban design neighborhoods which are characterized by separated walls, fences, and gates from the rest of the community [10]. The phenomenon of Gated Communities started in the early 1980s along the beaches as vacation villages [14]. Then, since the mid-1990s, this phenomenon started to occur in Cairo Metropolitan Region when the Egyptian government established new urban communities for the aim of providing housing services, and more opportunities in healthier environments than the city [16]. This phenomenon was the target of having sustainable communities, but unfortunately it resulted in a dramatic change in the Egyptian cities and faced huge socio-economic challenges. The phenomenon of Gated Communities increased due to globalization and became an important trend in both the Egyptian Real Estate Market and the prospective homebuyers. The Egyptian Gated Communities should offer its residents' special social prestige, and satisfaction to the desire to enjoy a better quality of life. Numerous studies stated that the global spread of Gated Communities has been triggered by the United States experience [16]. The notion of Gated

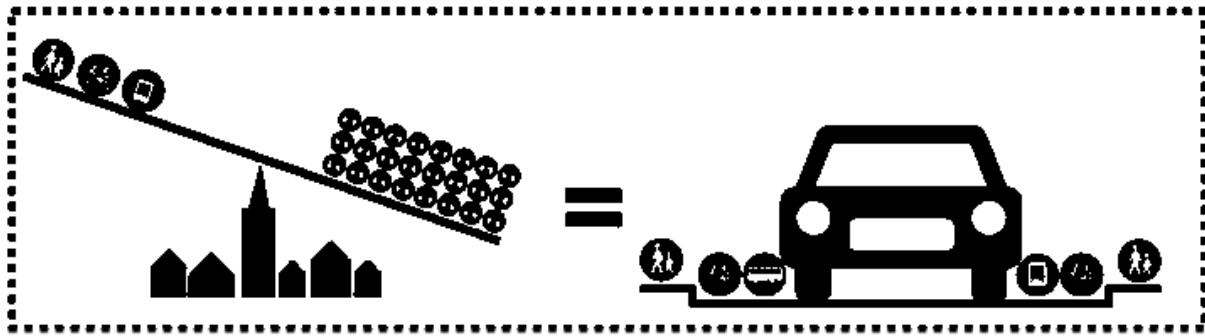
Communities is to establish sustainable healthy communities that respect the society relationship among the economy, ecology, and equity. In numerous ways the advantages of sustainable Healthy Gated Communities are mainly underlined in the definitions and characteristics of urban design sustainability, such as good quality of life, green open spaces, good air quality, easily accessible, less sound pollution, safety and security, lower crime rates, sense of community, comfort, connectivity, equality, etc. Most frequently, Gated Communities are residential areas that are enclosed by gates, walls, and fences with landscape to provide only a physical entry barrier. This is done to provide more control, and more safety and security for these private spaces. Successful Gated Communities usually consist of residential streets, numerous shared amenities and facilities, and comfy safe walkways and sidewalks [17]. Gated Communities must provide urbanism sustainability, integrity, and livability. The physical characteristics and tools of sustainable urban design are the urban aspects, functional aspects, social aspects, economic aspects, and environmental aspects that can be used to develop the most efficient and effective urban design guidelines specialized for gated communities. The Gated Communities are divided into three types [18]. First, lifestyle communities that focus on leisure activities with restoration and recreational facilities, shared amenities, and services. This type may also include golf communities. Second, prestige communities are developed to serve as a symbol of elite and status for image-conscious residents. This type of residential space is home to the most affluent members of society. Third, security zone communities are close off public streets to non-residents because they reflect the fear of the outsiders who disrupt the neighborhood. Although the other types offer security measures, in the security zones communities, the residents themselves participate in erecting barriers. Blakely and Snyder General Typology for Gated Communities became an international classification that every urbanism follows. These three types are described in the table 2.

The driving keys for people living in gated communities are safety and security concerns, good quality of life, the search for a sustainable environment, and healthy lifestyle [19]. For example, good quality of life is maintained and enhanced through sustainable urban design guidelines that promote Healthy Gated Communities. The gated communities are an important pattern of the urban developments that have a strong impact on the urban form and function, and its residents' daily activity patterns. Gated Communities plays a dominant role in reshaping the urban life. They must provide streets characterized with livability, connectivity, attractiveness, comfort, and accessibility to promote walkability. Gated Communities are highly important in the Egyptian Housing Market since they can be used to provide better quality than living in the city, more safety and security, more healthy environments, more sustainable communities, and more walkable environments [20]. The Gated Communities in Egypt are having huge gap between theory and practice due to the lack of specialized sustainable urban design guidelines for the Gated Communities Developments to follow. Nowadays, the Egyptian Gated Communities are characterized by the lack of continuous signing to potential destinations, lack of pedestrian signage, unshaded sidewalks, lack of street furniture, dim street lighting, low air quality, sound pollution, low safety and scenery, lack of tree canopy, and unattractive atmosphere. Consequently, these aspects highly and badly affect the Gated Communities walkability rate because they make the residents choose car dependability rather than walkability [21]. This study develops a model that consists of sustainable urban design patterns specialized for Gated Communities to promote walkability, to achieve better quality of life, and to be healthier and more sustainable. A Gated Community that never sleeps is a walkable one, because walkability is what makes the Gated Community livable and vivid.

Table 2. Gated Communities General Typology

Type	Features	Subtypes	Characteristics
Lifestyle	These Gated Communities highlight common facilities and amenities for leisure class with shared interests. This may flashback urban villages, small-town nostalgia, resort villages, or luxury villages.	Retirement Golf and Leisure Suburban New Town	Age-related complexes with a suite of both activities and amenities. This shared access to amenities for the purpose of an active lifestyle. This master-planned Gated Communities with a suite of amenities and facilities are often in Sunbelt.
Prestige	These Gated Communities mirror the desire for image, control, and privacy. They focus on exclusivity over community, with few shared facilities and amenities.	Enclaves of rich and famous Top-fifth developments Executive middle class	Guards and security for privacy to restrict access to celebrities, and very wealthy and attractive locations. The secured access for the nouveau-riche often has guards. Restricted access is usually without guards.
Security Zone	These Gated Communities reflect fear. It involves gates and retrofitting fences on public streets to control its access and increase its privacy.	City Perch Suburban Perch Barricade Perch	Restricted public access in inner city area to limit crime or traffic, with closed access to some streets to provide more control.

Source: Authors after the following [18]



Source: Authors after the following [22]

Figure 4. How the Gated Communities Designed Nowadays

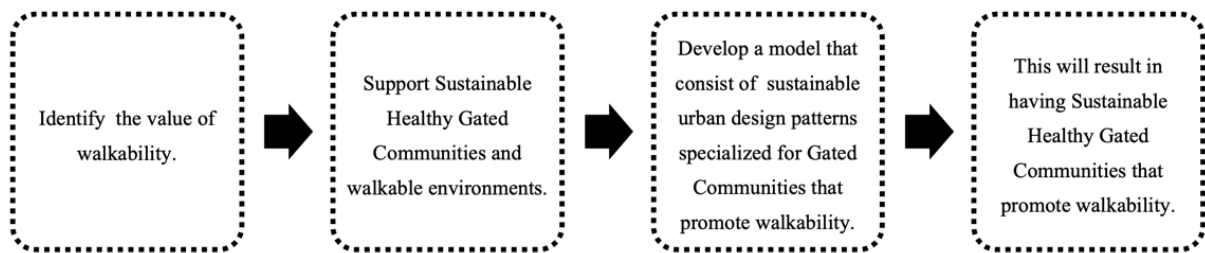
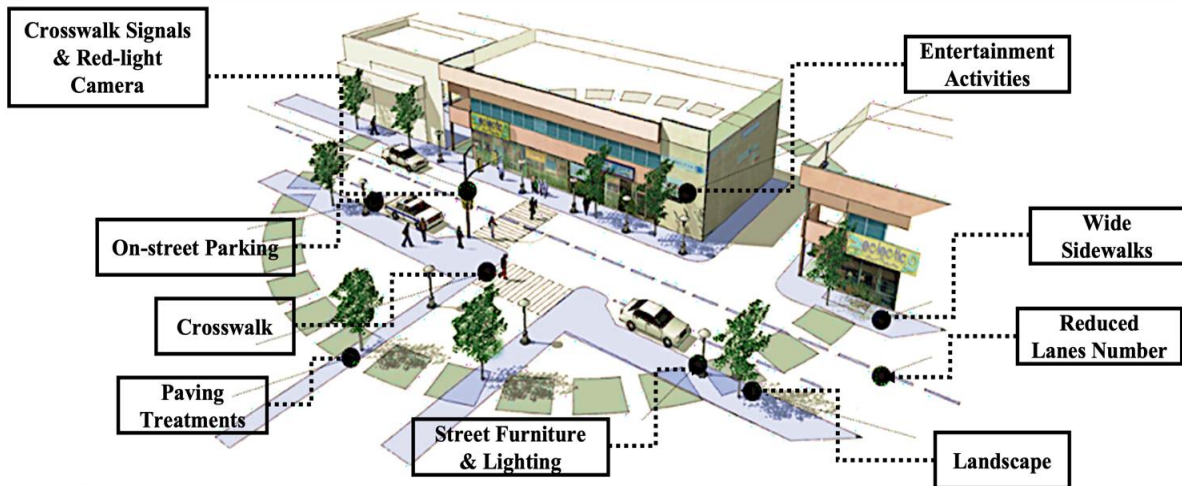


Figure 5. Source: Authors, the Process to Improve the Pedestrian Quality of Walkable Environments in Gated Communities



Source: Authors after the following [25]

Figure 6. Some Physical Characteristics of Pedestrian Street (P.340)

5. Gated Communities Sustainable Urban Design

Without a walkable pedestrian network, the sustainable urban design patterns will not work their magic [23]. Gated Community Pedestrians expressed their concerns about walking in their environment, due to the lack of Gated Communities efficient sustainable urban design patterns [4]. The Gated Communities urban design patterns strongly affects the lifestyle, quality of life, human health, well-being, ultimately, physical activity, and its residents'

walking behavior. Based on the former analysis, there is a suggested process to improve the pedestrian quality of the Gated Communities (Figure 5).

The urban design patterns have a powerful influence on the Gated Community's walkability rate [15]. The sustainable urban design patterns are a mix of land planning and zoning, engineering street standards, and other alternatives. They are used to determine the Gated Community Street accessibility and layout, pedestrian and cycling infrastructure, interactions between the public spaces and buildings, and provision of the landscape and

tree distribution along the streets [24]. The sustainable urban design patterns can influence physical activity, human health and well-being, and quality of life. Walkable Gated Communities that are identified by high residential, and land-uses diversity are known by providing well-connected detonations for walking that are accessible, beautiful landscape, and designed at a pedestrian scale (Figure 6) [25].

Sustainable urban design patterns play an important role in the social health, human health, and well-being. Walkability is always correlated with the perfection of the Gated Community urban design. The World Health Organization (WHO) defined human health as a state of mental, physical, and social well-being [5]. Walkable Gated Community can reduce stress and anxiety levels, improve residents' sleeping quality and physical activity levels. Sustainably urban designed Gated Communities will have efficient and effective social interactions among the residents that lead to a sense of familiarity and trust. There are two main factors that affect the pedestrians' decision to walk which are the journey distance, and security and safety levels [26]. There are another two main factors that affect the pedestrians' decision to walk which are physical environmental factors, and psychological factors that result from the urban design patterns [2]. There is a strong bond between walkability and human health.

There are seven main aspects for a sustainable Healthy Gated Community that makes it more walkable for its users [27]. Which is the land use, safety, walking and cycling ease, comfort, accessibility, and environment beauty. Using sustainable urban design patterns will help in implanting effective and efficient Walkable Healthy Gated Communities because the current Gated Communities are unwalkable, unattractive, monotonous, dull and it seems like a Gated Desert [28]. Sustainable urban design patterns will help create an efficient and effective walkable environment, safe atmosphere, and better quality of life [12]. Gated Communities streets must be "Woonerf" simply streets for living. Woonerf is a Dutch urban planning concept term used to describe a space that is created and shared by pedestrians, bicyclists, and low-speed motor vehicle. It helps in creating a very low automobile volume environment, and more public spaces for socializing and interacting [29]. Woonerf streets are generally appropriate to implant healthy, vivid, and walkable Gated Communities. Walkability is not only influenced by the street's accessibility and connectivity, but also by other urban design dimensions of the Gated Community [30]. The following table describes the attributes that affect the Gated Communities walking behavior and overall walkability rate (Table 3).

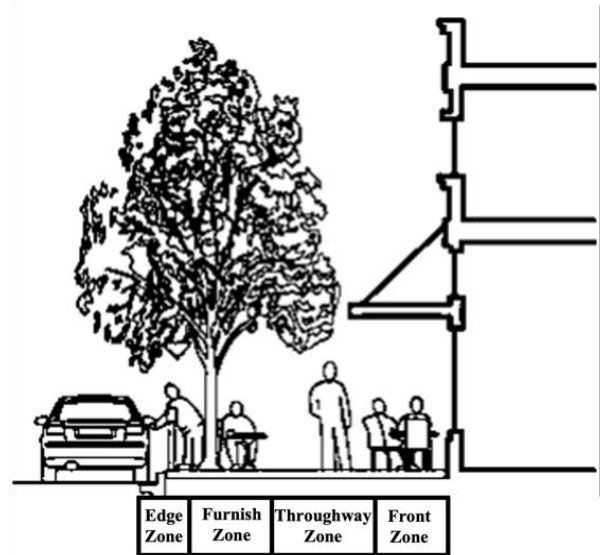
Table 3. Walkability Attributes Description

Attributes	Walkability Variables	Detailed Description
Connectivity	Well-Connected Sidewalks and Number of Walkways	Sidewalks to be well-connected. The available number of walkways to different destinations
Convenience	Convenient Walking to Shopping, to Open Spaces, and to Transit.	Convenient walking to facilities, amenities, and shopping. Convenient walking to open spaces and leisure facilities. Convenient walking to transit stops.
Accessibility	The number of Shopping Facilities, Entertainment Facilities, and Transit Routes.	The number of stores, shops, supermarkets, etc. The number of restaurants, coffee shops, etc. The number of transit routes.
Safety	Security From Crimes and Traffic Safety.	Neighborhood security from different crime levels. Safety from traffic while walking.
Spatial Scale	Space Openness, Open Space Size, Buildings Scale, Crosswalk Width, and Sidewalk Crowdedness.	Openness of surrounding spaces while walking. The size of the neighborhood open space. The scale of the surrounding building while walking. Crosswalk's width and crowding on sidewalks while walking.
Spatial Appearance	Façade Continuity, Street Furniture, and Business Diversity.	Continuity building facades and landscape. The richness of street furniture along the sidewalks. The variety of first-floor shops along the sidewalks.
Environment Quality	Green Spaces Quality, Sidewalk's Quality, Noise Exposure, Sunshine Exposure, Streetlight Exposure, Canopy and Shelter, and Outdoor Facilities Quality	The quality of green spaces and landscape. The clean sidewalk without potholes and barriers. Neighborhood noise level. Exposure to sunshine while walking and to streetlight while walking. The quantity of provided canopies and shelters, and street furniture quality.
Social Environment	Neighborhood Interaction and Neighborhood Relationship	Interactions between the neighbors while walking, and it is easy to see neighbors engaging in leisure activities (shopping, chatting, playing, exercising, and strolling).

Source: Authors after the following [30]

Since everyone’s dream is to live in healthy communities, GCWDEM model is the magic tool for the Gated Communities to make this dream come true. Designing Gated Communities with effective and efficient pedestrian circulatory networks is highly important to improve the resident’s walking behavior, social and human health, well-being, and to attract newer homebuyers [31]. The main principles to improve the Gated Communities walkability are to establish effective and efficient pedestrian circulatory networks, direct the buildings toward the streets and open spaces, buildings to meet the human scale with masses and urban principles, clearness and continuity of side-ways, walkways and sidewalks, provide complete streets, amenities and facilities to support community activities and social interactions, parking lots must be behind the structures or underground, and provide cycling lanes [12]. Gated communities with limited walkability are fostered by land use and urban design patterns. Walkable Gated Communities are characterized by enclosure, imageability, human scale, complexity, and transparency [31]. One of the walkability therapeutic advantages is the health benefits and well-being of physical exercise. The street network design is an important element in creating walkable Gated Communities [33]. The street is divided into four distinct zones, which are the front zone,

throughway zone, furnish zone, and edge zone (Figure 7) [34]. These zones are critical to provide clear streets that promote walkability. The following table describes and clarifies each zone in detail (Table 4).



Source: Authors after the following [34]

Figure 7. A Schematic Sketch showing the Street Zones (P.116)

Table 4. The Street Four Distinct Zones Description

Zones	Description
Front Zone	The front zone is the space of the zones comprising the Street side. The front zone is the space between the building facades and pedestrian travel way. It can provide a buffer distance from vertical surfaces and allows entry-exit buildings or people to window shop without interfering with moving pedestrians. The front zone also provides width for the overhanging such as canopy, bay windows and store signage. When the appropriate width is provided the front zone may accommodate various activities associated with adjacent uses such as merchant displays or seating.
Throughway Zone	The thruway must provide a minimum horizontal and vertical clear area for the pedestrians’ travel in compliance with accessible route requirements.
Furnish Zone	The furnish zone is a multipurpose zone. It serves as a buffer between vehicular area and pedestrian travel way of the thoroughfare within the curbs. It provides space for street trees and planting strips, street furniture, utility poles, sidewalk cafes, sign poles, signal and fire hydrants, bicycle racks and bus shelters.
Edge Zone	The edge zone is also known as the “curb zone”. It is the transition area between the furnishings zone and the thoroughfare-traveled way of the Street side. It provides space for vehicle in the parking lane, and for the diagonally parked vehicle.

Source: Authors after the following [34]

Table 5. Walkable Street Elements and Characters

Element	Characters
Sidewalk Design	The sidewalk should be wide enough to provide the four distinct zones: The edge zone that separates the roadway from the sidewalk, the furnish zone that provides space for street furnishing and landscape, the throughway zone that provides a minimum four-foot width for accessibility, and the front zone providing a "shy distance" between the throughway zone and building façade line.
Access to Desired Uses	Successful pedestrian-oriented Gated Community must have a mix of complementary uses within a convenient walking distance and to be well-connected with a comfortable pedestrian circulatory network.
Access for Persons with Disabilities	Considerations must be made to ensure that persons with disabilities are provided with equal access to the amenities and facilities.
Ease of Crossing Street	Wide streets can be intimidating and more dangerous for pedestrians to cross. There are methods for providing a safer transition, shortening the crossing distances, and building a stronger visual connection for the pedestrian crossing.
Manageable Walking Distances	A typical comfortable walking distances from an origin to a destination is about 5 to 10 minutes walking distance. The walking distances though are dictated by natural and man-made barriers, and street patterns. Provisions should be made to provide passage through or across these barriers.
Scale	Pedestrian infrastructure such as signs, landscaping, paving, and building design details that must provide visual interest and human scale.
Security	Pedestrian safety is greatly influenced by the scale, amount, intensity, security cameras, and quality of lighting. The store fronts, office windows, and home windows provide the feeling of "eyes on the street."
Visual Interest and Community Identity	Successful design must enhance the intimacy of the pedestrian environment including open spaces such as courtyards, plazas, and squares. Also, the building facades give a shape to the street.
Climate	The gated community location and orientation, street trees, and architectural elements can make the pedestrian areas more inviting , such as providing shade and protection from the sun exposure and seasonal rains and winds.
Noise and Air Quality	The buffers between the roadways and sidewalks help protect the pedestrians from the auto-environment.
Efficient Parking	The sensitive planning and design of parking facilities will minimize the negative impacts of parking on the pedestrian sidewalks and walkways. While still provides good vehicular access to the gated community.

Source: Authors after the following [34]

The Gated Community must include suitable softscape and hardscape matching with the site climate, and street furniture made of local materials. The street urban design is known as the main motivator for people to walk that affect the gated community's urban walkability rate. Walkable environments are economically efficient, provide healthy social lifestyle, better quality of life, healthy environment, accessible, and humanized. The following table describes the walkable street characters in detail (Table 5).

6. GCWDEM Model for Measuring Gated Communities Efficiency toward Walkability

Gated Community Walkability Design Efficiency Model (GCWDEM) is a sustainable urban design model specialized for the Gated Communities. To be more

walkable, healthy, and characterized with efficient and effective circulatory network for its residents. Gated Community Walkability Design Efficiency Model (GCWDEM) is divided into four main principles (Figure 8) [37]. Each principle consists of specific sustainable urban design patterns that are different from the other principles [38]. Applying these four principles will result in successful sustainable healthy walkable environment. That will positively affect the Gated Communities walking behavior and overall walkability. Urban Healthy Community is defined as an environment that calls for walkability and sustainability. The Gated Communities urban design must consist of these four main principles, which are pedestrian network (walkways and sidewalks), cycling, transit, and motorist toolbox to be healthy and sustainable [37]. The following table explains each principle with its design patterns (Table 6).

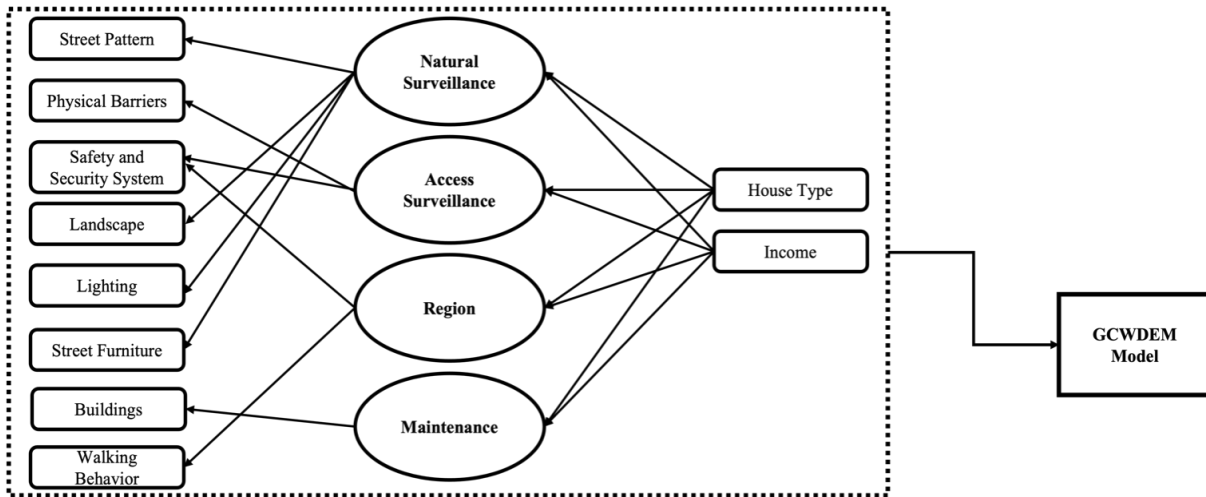


Figure 8. Source: Authors after the following [36], GCWDEM Model

Table 6. GCWDEM Model for Sustainable Urban Design Patterns

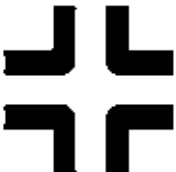
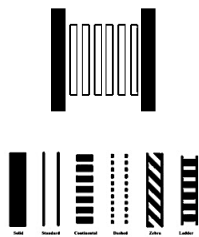
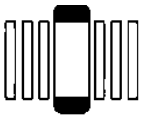

Principle	Sustainable Urban Design Pattern	Description
Pedestrian Network (Walkways and Sidewalks)	1. Sidewalk	 <p>Sidewalks must be continuing, provide clear path, wide enough to allow two people using wheelchairs to pass one another, and to allocate space for building entrances and commercial activity. These clear paths, trees, utilities, and street furniture must be used to serve as a buffer between the clear path, buildings, and moving motor vehicle.</p>
	2. Pedestrian crossings	 <p>Walkable urban environment is supported by safe and frequent pedestrian crossing. These pedestrian crossings must be located at all intersections and mid-block points, to be used where the pedestrian traffic is anticipated, desire lines are observed, support-marked crossings with signals, raised signage, refuge islands, narrow and corner radii. The motor vehicle must be slow when approaching pedestrian crossings.</p>
	3. Pedestrian Islands	 <p>Pedestrian islands reduce the crossing distance. It provides waiting areas for people who can't cross the pedestrian interval streets full width in the time.</p>
	4. Sidewalk Extensions	 <p>Sidewalk extensions are part of the sidewalks that usually at the point of intersection. It is visually and physically narrowing the roadway and shortening crossing distances, increases the curb space for the waiting people to cross, and makes them more visible to the drivers, and calm traffic speeds. Large sidewalk extensions can accommodate street furniture, benches, transit stops, rainwater storage, landscape, and trees.</p>

Table 6 Continued

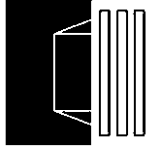




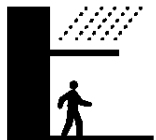


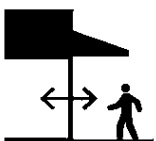

Pedestrian Network (Walkways and Sidewalks)	5.	Pedestrian Ramps		These ramps must be installed at every crosswalk and changed in level with non-slip materials and a maximum slope of 1:10. To be aligned perpendicular with the crosswalk, because they are critical for people pushing strollers, carts or using wheelchairs.
	6.	Signage		Provide consistent pedestrian signage in a clear visual font that can be easily read. Providing information to allow users to navigate the streets.
	7.	Streetlight		Well-lit sidewalks, walkways, spaces, and streets are critical to the pedestrian safety, helpful in creating lively, spaces at night. The lighting must be placed along all streets, to ensure appropriate illumination levels and to avoid dark spots. It should never obstruct the walking paths.
	8.	Seating		Seating should have comfortable backs, offer a mix of unshaded and shaded seats matching the local climate, and allow legroom that does not block the pedestrians clear path. To provide frequent opportunities for people to pause and rest with a variety of seating arrangements to invite chatting and social activity between the users.
	9.	Water Fountains		Provide water fountains to offer sustainable alternatives, to support wildlife. By using creative designs, and to ensure that they are maintained to clean and safety standards. Also, they give a sense to the place, and the water sound provides a healing effect for the pedestrians.
	10.	Weather Protection		Canopies into building facades to add shelter for the people to offer protection from the weather during rain, water, or extreme heat. It gives a character to the street.
	11.	Curbs		Curbs create a structural edge between the sidewalk and the adjacent cycle or travel lanes. It stops the vehicle from entering or blocking pedestrian areas. Its maximum height is 15 cm. They should incorporate the ramps at pedestrian crossings to facilitate safe accessibility.
	12.	Waste Receptacles		Place waste receptacles near shops, corners, crossings, and park lots, and adjacent to clear path. To provide conveniently available receptacles for waste to help maintain a clean and attractive walkable environment. They should be sized in accordance with the expected use, local collection, and maintenance plans.
	13.	Active Building Edges		Building frontage design plays an important role in shaping the pedestrian experience overall. Since the ground floor design influences the street character and pedestrian engagement level. The frequent entrances, appropriate transparency levels, visual variation, and textures shape an enticing street environment.
	14.	Landscape		Adding landscape as much as possible to create a pleasant and attractive walkable environment, to contribute neighborhood character, and to encourage active transportation choices. The landscape improves the microclimatic conditions, air quality, filter water, and increases the gated community biodiversity by offering numerous physical and mental health benefits.

Table 6 Continued


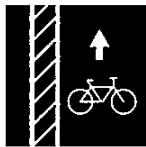
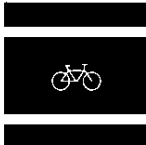
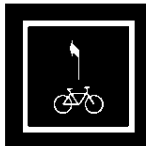





Cycling	1.	Cycle Facilities		Cycle facilities are spaces specifically designed for the cycle's movement. These dedicated facilities are portions of the road that are assigned for the cyclist's use. They are generally known as bike lanes or cycle lanes.
	2.	Cycle Marked Buffers		Cycle marked buffers are painted spaces parallel to the cycle lanes used to separate them from adjacent motor vehicle. They increase the comfort and safety for the cyclists. These buffers must be 1 m wide. They can also be used next to the parking lanes to prevent the cyclists from being hit by the car doors opening.
	3.	Cycle Boxes		Cycle boxes provide designated areas ahead of stop lines for motor vehicle at the signalized intersections. They help cyclists make turns across the traffic without being hit, and should be at least 3 m deep, to allow the cyclists to maneuver into them and face forward.
	4.	Turn line Cycle Boxes		Turn line boxes are painted as waiting spaces that allow the cyclists to safely make a turn to the other direction. They are designed for the cyclist to turn out of the travel path. They are usually in line with the parking lane, buffer, or the front opposing traffic lane.
	5.	Corner Refuge Islands		Corner refuge islands are made of concrete barriers placed at the intersection corners with a curved space for the cycles between the sidewalk and road. They also provide protected waiting area for cyclists and facilitate turns. The corner refuge islands with small turn radii help to increase the motor vehicle speeds and increase the cyclist visibility.
	6.	Signage		Signage are important elements that identify the cycle lanes, and reach the wanted destinations. These include signs with directions and markings on the road.
	7.	Cycle Share Stations		Cycle share stations are special cycle racks that act as places to pick up or drop off cycle share bicycles. The cycle share stations can be an integral part of the walkable environment streets by allowing spontaneous trips, serving as traffic calming measures, and providing protection from motor vehicle. They must be clearly visible to the pedestrians.
	8.	Cycle Racks		Cycle racks are inexpensive street elements that allow cyclists to securely park their cycles. They are useful when placed near major areas or in commercial areas. They must be placed at least 0.75 m apart. They create opportunities functionality, and the rack safety should not be compromised for the visual appeal.
	9.	Cycle Corals		Cycle corral is a row of cycle racks placed on the street that occupies space in the parking lane. Parking spaces can be used efficiently as cycle parking, which helps to free up space on the sidewalks. These cycle racks should be protected from parked cars.

Table 6 Continued


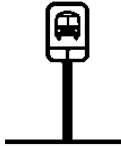
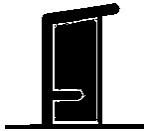
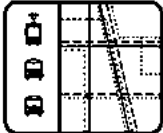














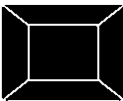


Transit	1. Transit Lanes		On-street transit lanes help to improve the travel time, performance, and relieve transit congestion by allocating a space for transit vehicle. The transit lanes are demarcated by pavement markings and signs. The sidewalk should be colored to reinforce the lane designation, and to improve the motorist compliance with the lane restriction.
	2. Transit Stops		Clearly marked transit stop areas are used to indicate where a given transit line stops for passengers. They include signs, route names and numbers, signage destination information, schedules, and maps. The transit stops must provide seating for the passengers and maintain clear path for the pedestrians. They should allow the bus to load onto and from the sidewalk or a refuge island to the transit lane without pulling out of traffic.
	3. Transit Shelters		Transit shelters must provide and offer seating for passengers, and space for people with strollers and in wheelchairs. Also, to allow space and clear path and offer overhead protection and vertical partitions to offer shelter from weather. These vertical partitions must be transparent to provide safety and visibility for waiting passengers.
	4. Signage		Routes and schedules must be displayed on maps posted at all the bus stops and stations to show information such as the destinations and travel times. Use readable text size and visual symbols at the stops, by mobile applications or text-based systems.
	5. Real-Time Arrival Information		Real-time arrival information increases legibility, reduces the travel time, facilitates trip planning, and improves users' satisfaction. It helps to clarify the services and destinations. It can be displayed on full-color, LED signs, by phone, SMS, or online.
	6. Transit Signals		Active transit signal improves the transit efficiency. It may be applied on the frequent corridors.
	7. Accessible Boarding Area		Every transit stop must have a boarding area that allows people to use wheelchairs and push strollers to access the transit vehicle easily.
	8. Seating		Seating can be provided within the transit shelters or as stand-alone elements in the sidewalk amenity zone. They must be organized to provide clear pedestrian paths and boarding zones.
	9. Ticket Vending Machines		Ticket vending machines are important for the passengers buy their tickets before the vehicle arrives. To help speed up the boarding process and improve the overall efficiency. These machines must be combined with clear information about the purchase process, and maintain a clear path for passing pedestrians.
	10. Cycle Parking		Cycles must be used in conjunction with transit service to provide dedicated and secure cycle parking racks next to all transit stops for the transit users who use bikes.
	11. Waste Bins		Transit stations and stops attract a high number of people who are sometimes eating, drinking, reading, or doing other activities while waiting. Waste bins are important to dispose of their waste to reduce overall maintenance requirements and keep spaces clean and tidy.

Table 6 Continued

Motorist Toolbox	1. Travel Lanes		Travel lanes are often shared with other street users. Mixed-traffic lanes should not be wider than 3 m.
	2. Traffic Signals		Traffic control signals are critical tools. It can be used to reduce the speed while improving traffic flow. These can be used to manage the traffic flow at the intersections and mid-block crossings.
	3. Signage		Signage indicates regular information such as speed limit, turn restrictions, or allowable access. Also, it provides information about upcoming destinations and street names.
	4. Surface and Pavement Markings		Surface markings are used to provide information on the required driving speed limit. These markings indicate lane divisions, speed limits, and provide lanes directional arrows.
	5. Lighting		Lighting is important to ensure a safe environment for the pedestrians. The streetlighting are typically provided on a pole or post at the edge of the curb, which are grid-powered connected underground.
	6. On-street Parking		On-street parking spaces are designated for motor vehicle parking. Mostly at the curbside spaces or separated by cycle lanes or service lanes.
	7. Bollards		Bollards are used to restrict the access to certain areas by providing a physical barrier. They can be designed in conjunction with planters, lighting, seating, and other street furniture. They must be installed in every pedestrian access to block golf cars to pass from it and the cars to park in it.
	8. Traffic Calming Strategy		Traffic speeds must be reduced by using different traffic calming techniques that alter physically the road. These techniques are to change the street geometry and implement road bumps and speed tables.
	9. Electric Vehicle Charging Stations		On-street electric charging stations must be next to parking spaces. To provide a boost for golf cars, scooters, and electric cars. These parking spaces should be reserved only for electric vehicle and to be marked accordingly.
	10. Road Safety Cameras		Cameras can be mounted beside or over a roadbed to assist in detecting violations. To provide more safety and security for the community.

Source: Authors after the following [37]

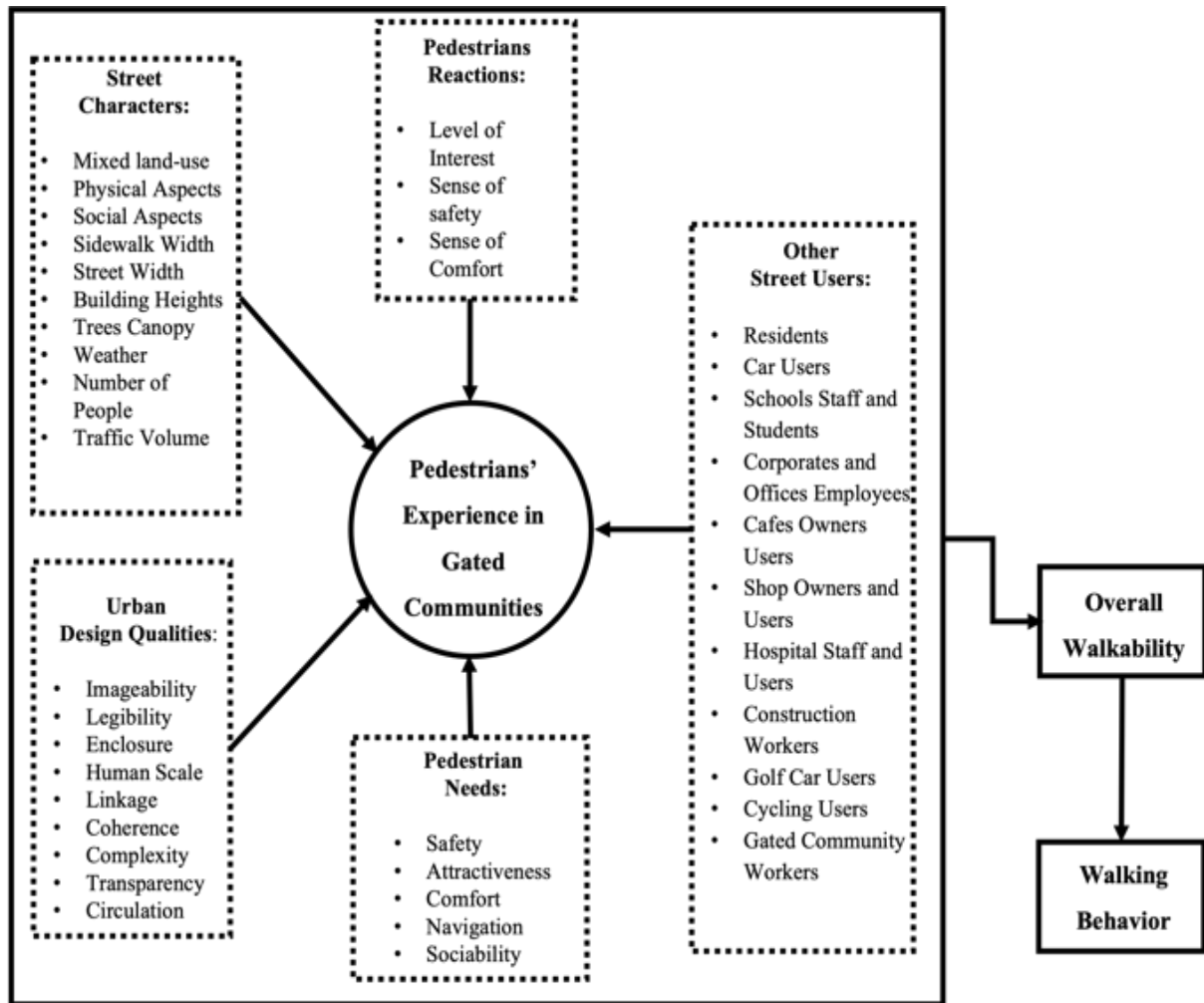


Figure 9. Source: Authors after the following [32], The Conceptual Walkability Framework in Gated Communities

7. Framework of Gated Community Walkability Design Efficiency Model (GCWDEM)

Gated Communities sustainable urban design patterns have been defined to guide and assist in the design process, and the main purpose is to explain the strong bond between the built environment urban design patterns and walkability. The above table shows the specialized sustainable urban design patterns for the Gated Communities to an Urban Healthy Community and more walkable (Table 6). Those Gated Communities sustainable urban design patterns are very flexible to be implanted in the Gated Communities design process as a proactive approach, or to be applied on existing Gated Communities as a reactive approach. The following figure shows the conceptual framework for walkability in the Gated Communities (Figure 9) [32].



Source: Authors

Figure 10. Beverly Hills Compound

8. Practical Case Study Beverly Hills Sheikh Zayed, Cairo, Egypt

The efficiency of GCWDEM model is to be concluded by applying it on Beverly Hills Compound.

8.1. Reasons for choosing Beverly Hills as a Case Study

- It is one of the first Gated Communities in Egypt started in 2000.
- One of the first ever largest scale residential compounds in Greater Cairo.
- It is considered as one of the major and important Gated Communities in Egypt
- Provides all the luxury services, different users, and various amenities and facilities
- It implements the concept of golf courses
- It provides residential areas starting from one room studio to huge palaces.

8.2. Location

- Beverly Hills is located on the outskirts of Cairo. Just 5 minutes from Cairo-Alex toll station up to smart village, and east of Juhayna square at Waslet Dahshur road near to Mall of Arabia, and next to 6th of October toll station (Figure 11).
- Beverly Hills is located 200 m above sea level, and provides a climate that is cooler 4 - 5 degrees than Cairo.
- The total area of Beverly Hills compound is approximately about 2500 acres.



Source: Authors

Figure 11. Beverly Hills Masterplan

8.3. Site Accessibility

- Beverly Hills is accessible either from 26 July Axis or from Cairo-Alex Desert Road (Figure12).



Source: Authors

Figure 12. Beverly Hills Accessibility

8.4. Beverly Hills Space Typology

There are several types of places in Beverly Hills that can be identified as potential spaces to be converted into sustainable walkable environments in Beverly Hills, which are:

- Walkways (5 - 2.5 m wide)
- Vehicular Streets (22 -9.5 m wide)
- Sidewalks (8- 2 m wide)

8.5. Beverly Hills Space Character



Source: Authors

Figure 13. Beverly Hills Accessibility

The hardscape used materials are asphalt, interlocking pavers, no tree canopies found, no weather protections found, seats are very rare to find, and water fountains with poor quality. The space lacks sidewalks maintenance, street seats, tree canopies, streetlighting, and pedestrians' signage. The sidewalks are wrecked and unshaded through daytime and aren't well-lit at nighttime. Moreover, the pedestrian accesses are used for the golf cars to pass

through it, and to park cars (Figure 13&14).

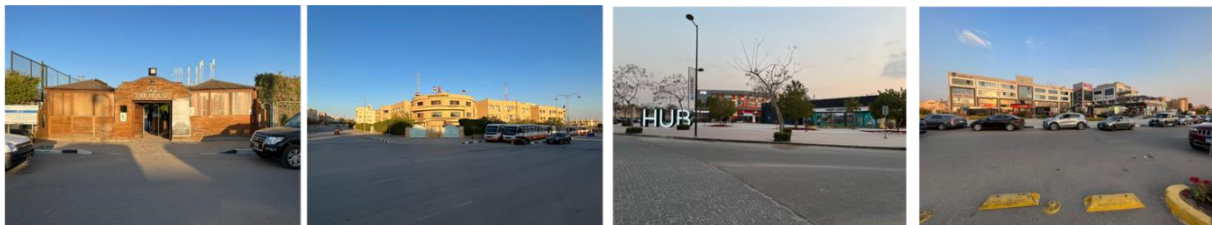
8.6. Beverly Hills Users Characteristics

The most engaged demographics in Beverly Hills outdoor recreation and leisure activities are children and teens, followed by adults, and they are mainly present during evening time (Figure 15).



Source: Authors

Figure 14. Beverly Hills Main Nodes



Beverly Hills Club House

Beverly Hills School

Westown Hub

West Square

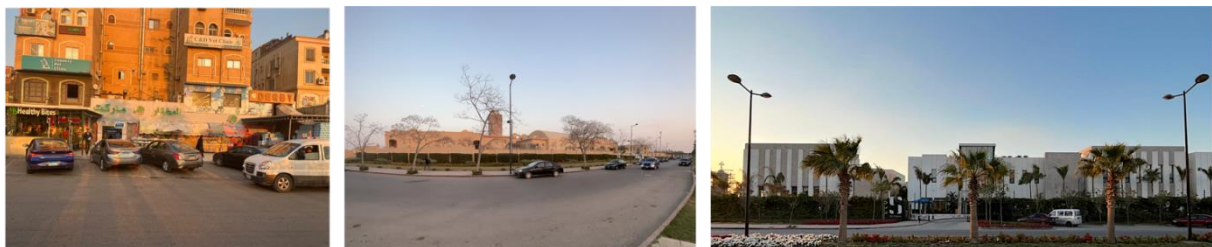


The Mosque

Sodic Medical District

The Church

The Polygon



El Mokhtar Market

The British International School, Cairo (BISC)

Club S



Walk of Cairo

El Nada Hospital and Clinics

The Strip

Source: Authors

Figure 15. Beverly Hills Landmarks



Source: Authors

Figure 16. Some of the Mentioned Problems that affects the Walkability Rate

9. Results and Discussion

Beverly Hills walkability score on Walkscore is only 28 out of 100, because most of the errands requires a car [39]. This means that it is a car-dependent Gated Community (Figure 17). The missing urban design patterns had noticed a strong negative influence and badly affected the walking behavior and the walkability rate (Figure 18). It resulted in a lack of integration between the sustainable urban design patterns. The absence of these urban design patterns lowered the positive impacts of walkability on the physical health and well-being, mental health, emotional health, social health, and quality of life. The missing urban design patterns could be easily implanted to enhance the walkability and quality of life. Referring to the case study the missing urban design patterns are twenty-four patterns. The available urban design patterns need to be enhanced, improved, regularly maintenance, and to increase its quantity. To be more efficient and effective, and to result in increasing the walkability rate. Referring to the case study the available urban design patterns are only twenty. The residents' common recommendations are streetlight, seats, kids' area, dogs' area, and more trees and plantings (Figure19 &20). The following table compromises the analysis for Beverly Hills (Table 7).

Walbaility Rate

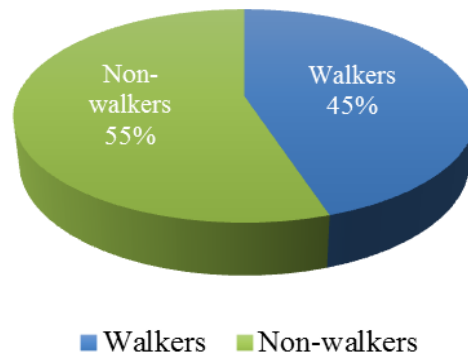


Figure 17. Source: Authors Walkability Rate

Sustainable Urban Design Patterns Availability

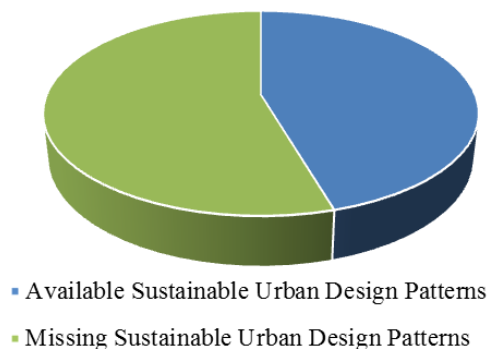


Figure 18. Source: Authors Urban Design Patterns Analysis

Table 7. The Analysis of Beverly Hills Urban Design Pattern

Principle	Sustainable Urban Design Pattern	Availability and Condition
Pedestrian Network (Walkways and Sidewalks)	1. Sidewalks	Available but need more maintenance since its sidewalk condition is poor: Part of the sidewalk is wrecked; bricks are out of place; people step in sand and metal protrusions on the pavement, unshaded at daytime, and weakly lit at night.
	2. Pedestrian crossings	Missing: No zebra crossing lines or pedestrian signs available.
	3. Pedestrian Islands	Available but need more maintenance since its pavement condition is poor: the grass is out of place and the blocks are wrecked, so the people step in sand.
	4. Sidewalk Extensions	Available but need more maintenance since its pavement condition is poor, unshaded at daytime, and weakly lit at night.
	5. Pedestrian Ramps	Missing: no pedestrian ramps are available for wheelchair users and stroller users.
	6. Signage	Missing: no signs indicating the names and directions of streets & even the directions to landmarks such as the mosque, and no crossing signs for pedestrians.
	7. Streetlight	Available but with a very poor quality: dim streetlight, some places aren't lit, the sidewalks are well-lit at night.
	8. Seating	Available but are very rare to find, and its condition and quality is very poor, and isn't shaded and not available everywhere.
	9. Water Fountains	Available but with a very poor quality, the water is green, and most of them aren't working.
	10. Weather Protection	Missing: lack of canopy during rain, wind, or sun.
	11. Curbs	Available but its pavement quality is poor and broken
	12. Waste Receptacles	Available but are too rare to find. They aren't available everywhere, only at certain places.
	13. Active Building Edges	Available but need to be enhanced by providing seating and weather protection
	14. Landscape	Available on both sides and in the median island but not available everywhere, does not provide a buffer for the pedestrians, too small to provide canopy and almost dead and unattractive. It needs more maintenance and to be increased.
Cycling	1. Cycle Facilities	Missing: lack of spaces that are specifically designed for the movement of cycles.
	2. Cycle Marked Buffers	Missing: lack of painted spaces parallel to cycle lanes that separate them from adjacent motor vehicle traffic.
	3. Cycle Boxes	Missing: the lack of designated areas ahead of stop lines for the motor vehicle at signalized intersections that allow the cyclists to get ahead of motor vehicle.
	4. Turn line Cycle Boxes	Missing: lack of painted waiting spaces that allow cyclists to safely make a turn across oncoming traffic.
	5. Corner Refuge Islands	Missing: the lack of concrete barriers at the intersection corners that provide a curved space for cycles between the sidewalk and the road.
	6. Signage	Missing: lack of signage elements that identify cycle routes to reach major destinations or connecting cycle facilities.
	7. Cycle Share Stations	Missing: lack of places that acts to pick up or drop off cycle, and to share bicycles.
	8. Cycle Racks	Missing: there aren't street elements that allow cyclists to securely park their cycles.
	9. Cycle Corals	Missing: lack of a row of cycle racks placed in all the streets that occupies space in the parking lane.

Table 7 Continued

Transit	1.	Transit Lanes	Missing: lack of transit lanes that will improve the travel time and performance.
	2.	Transit Stops	The available bus stops but there is no sign that indicates that this a bus stop, and its quality is poor.
	3.	Transit Shelters	Available but its quality is poor and need to be enhanced.
	4.	Signage	Missing: there isn't a sign to easy understand and use the bus. The lack of routes and schedules displays, lack of showing the bus information such as destinations, travel times, frequency, and transfer points.
	5.	Real-Time Arrival Information	Missing: there isn't real time arrival information available.
	6.	Transit Signals	Missing: lack of active transit signal priority that improves the transit efficiency.
	7.	Accessible Boarding Area	Missing: lack of area that allows people using wheelchairs access the transit vehicle.
	8.	Seating	Available but is broken and quality is poor. It needs more maintenance and enhancement.
	9.	Ticket Vending Machines	Missing: the lack of ticket vending machines to help the passengers purchase their tickets before the bus arrives, to speed up the boarding process and improve overall efficiency.
	10.	Cycle Parking	Missing: lack of dedicated and secure cycle parking racks next to all transit stops.
	11.	Waste Bins	Available but broken and its quality is poor
Motorist Toolbox	1.	Travel Lanes	Available but the surface material needs more enhancement and maintenance.
	2.	Traffic Signals	Missing: signals at intersections and mid-block crossings to manage the traffic flow.
	3.	Signage	Missing no signs indicates the names and directions of streets & even the directions to landmarks.
	4.	Surface and Pavement Markings	Available pavement marking but its quality is poor, rarely obvious for the users, not available in all streets, and the surface material need more maintenance.
	5.	Lighting	Available but very dim streetlights.
	6.	On-street Parking	Available but isn't well marked for users.
	7.	Bollards	Available but its quality is poor and not well and efficiently used. Not available at all the pedestrian access, and the golf cars pass through it and some users use it as a parking lot.
	8.	Traffic Calming Strategy	Available but the road bumps and speed tables are not available in every street.
	9.	Electric Vehicle Charging Stations	Missing: unavailable and this provides a huge problem for the golf cars and scooter users.
	10.	Road Safety Cameras	Available but few and not in all the streets.

Source: Authors

As mentioned above, there are some important factors that play an important role in the pedestrians’ choice whether to walk or not to walk. The following table analyzes the factors that influence the pedestrian’s choice to walk (Table 8).

Table 8. The Measurement Scale (the factors that influence the residents choice to walk)

Component	Patterns
Respondent Profile	• Gender
	• Age
	• Residence Place
	• Pedestrian walkways condition
	• Mixed Land use activity
Psychological Factors	• Time
	• Distance
	• Weather
	• Health
	• Reactional
	• Social
	• Motivation
	• Socio-economic
Perception to Physical Factors	• Urban Design Qualities
	• Comfort Factor
	• Accessibility and Linkage Factors
	• Safety Factor
	• Enjoyment Factor

Source: Authors after the following [2]

Based on the former analysis, the factors that highly

affects Beverly Hills walking behavior and walkability rate, are mainly resulted from the urban design patterns availability, efficiency, and effectivity. From the GCWDEM model, measurement scale factors, site analysis, and field survey it was easy to conclude the walkability rate of Beverly hills as shown in Figure (18). That was directly influenced by the urban design pattern availability, quality, efficiency, effectiveness, and pattern union and integration. For instance, from the field survey several interviewers stated that they don’t walk a lot as a daily habit because the sidewalks are unshaded, there is no place to rest while walking, and at night the sidewalks aren’t lit well. They only walk few times a week because they have dogs, and some walks few times a month. The resident’s satisfaction levels and recommendations about the basic quality standards of living in Beverly Hills are shown below in (Figure 19 & 20).

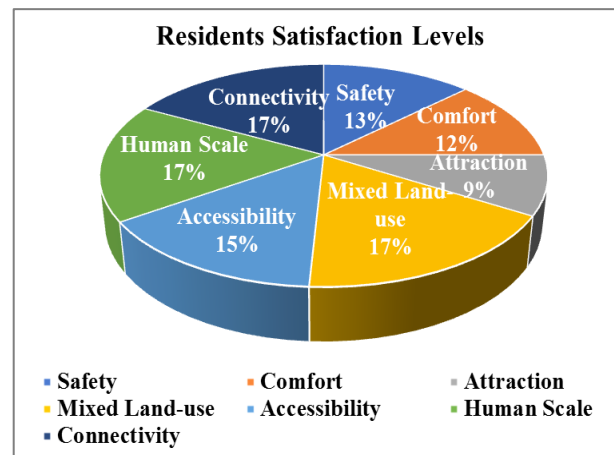


Figure 19. Source: Authors after the following [32]

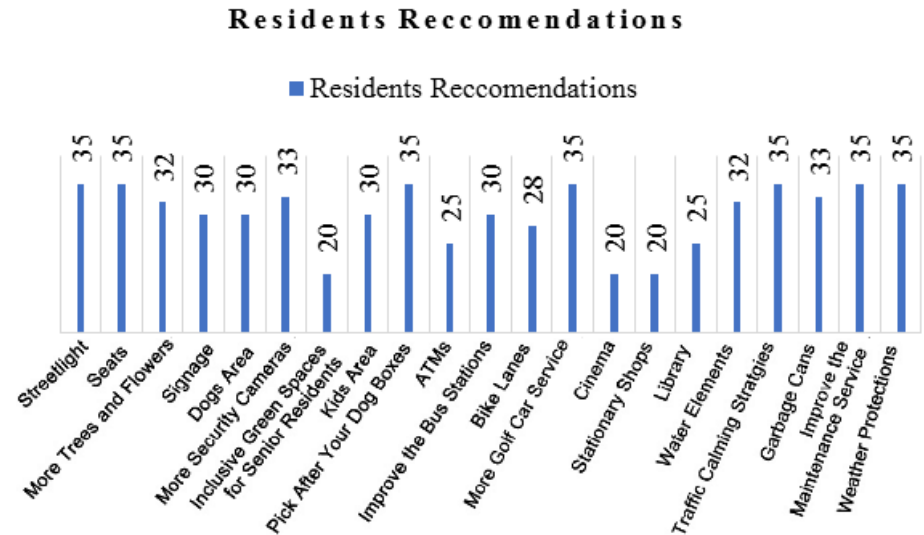
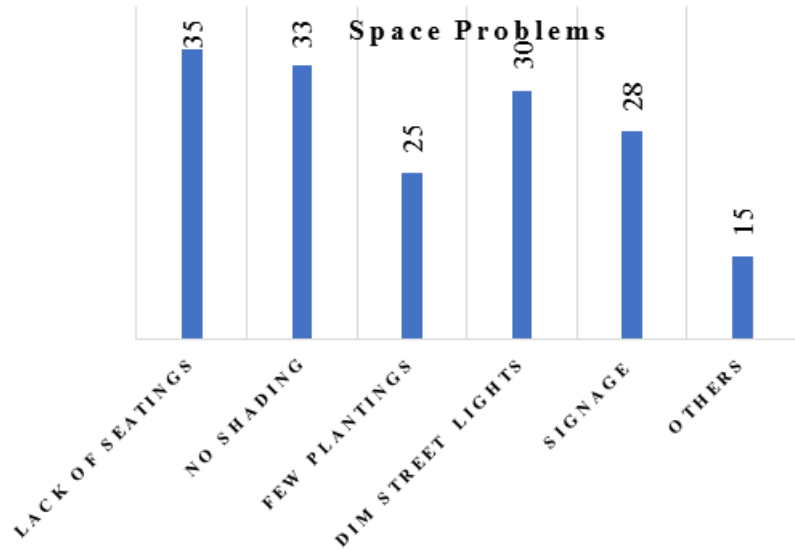
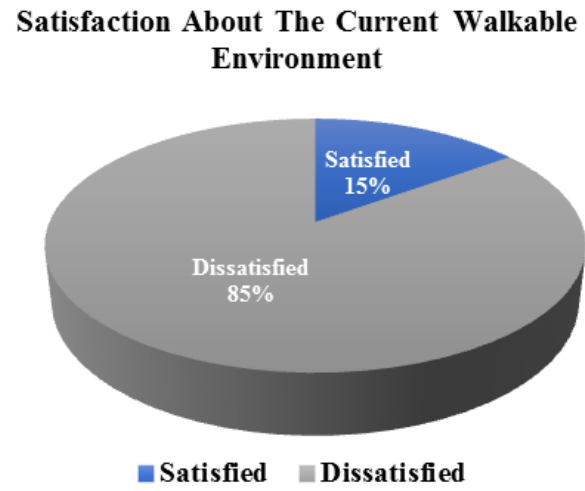
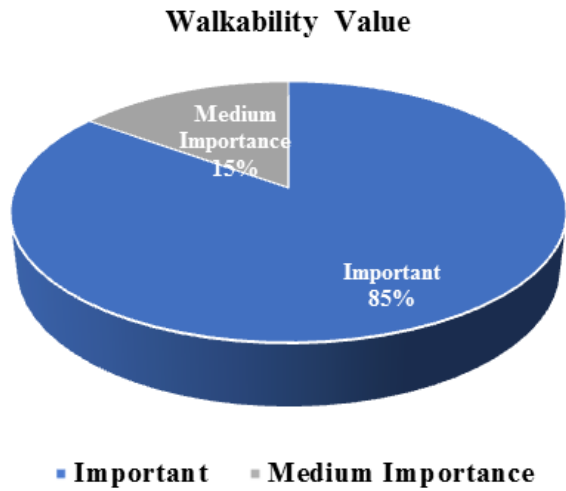


Figure 20. Source: Authors, Beverly Hills Residents' Evaluation of Current Space and Their Recommendations.

enhance and improve the Gated Communities efficiency, walkability rate, and quality of life. By providing efficient and effective pedestrian circulatory network, walkable environment, healthy and sustainable neighborhoods. So, this takes us back to the main research question that is “Can GCWDEM model help the Gated Communities to be more walkable?” This paper introduced an innovated sustainable urban design model to approach more Walkable sustainable Healthy Gated Communities, and to enhance the Gated Communities urban design efficiency. The model was applied on a case study within the Egyptian urban context to analyze its results and possibilities. GCWDEM model will help in enhancing the existing Gated Communities walkability rate and quality of life, and to be integrated within the design process of new Sustainable Healthy Gated Communities. All in all, the more sustainable urban design patterns used in the Gated Community design process, the more it will be sustainable and healthy, and welcoming walkability. This will positively impact the resident’s social health, human health and well-being, mental health, quality of life, and physical activity since the pedestrian quality is highly correlated with walkability rate and walking behavior. It will attract more homebuyers since everyone’s dream is to live in walkable sustainable healthy neighborhoods, and of course to have a better quality of life.

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