Measuring Walkability for More Liveable and Sustainable Cities: The Case of Mersin City Centre

Muge Akkar Ercan[1], **Zuleyha Sara Belge**[2]

[1]*Middle East Technical University, Turkey*
[2]*Mersin University, Turkey*

Abstract

Walkability is of rising importance in planning and design circles. In Turkey and the world, it is increasingly recognized as an urban strategy to create healthy societies within sustainable and 'liveable' cities. Despite this interest, the extent to which Turkish cities are walkable remains questionable. Defining the performative features of walkability, this research offers a micro-scale walkability assessment model with eight qualitative and quantitative factors of urban design. Describing the model with its factors, this article first presents a research methodology, then explores the walkability level of the historic city centre of Mersin, specifically Ataturk and Uray Streets (AUS). Finally, it discusses the major planning and design strategies that can improve walkability and liveability level of the historic city centre of Mersin, and underlines the contributions the model can make to current planning practice with reference to inclusive, human-centred and flexible design approaches. The research concludes that a sensitive qualitative and quantitative assessment of walkability is necessary to identify the walkability level of urban space. Additionally, it suggests that a comprehensive, integrated, and multi-dimensional planning and design approach regarding micro-scale, meso-scale and macro-scale is required to develop holistic and integrated urban design strategies to achieve walkable, liveable and sustainable cities.

Introduction

Walkability is of rising importance in planning and design circles. In Turkey and the world, it is increasingly recognized as an urban strategy to create healthy societies within sustainable and 'liveable' cities (Gehl and Gemzøe, 1996; Living Streets, 2003; 2006; TfL, 2004; 2005). Walking is not only a mode of transport, but also a means of benefiting individuals, communities and the environment. Walkable cities increase basic mobility of urbanites, improve their physical health and emotional well-being, and operate as restorative, relaxing or recreational environments (Forsyth, 2015). Walkable, attractive and safe public spaces often strengthen social life and social cohesion within the community, and contribute to community liveability (Forsyth, 2015; Leyden, 2003). By making commercial areas more attractive for consumers and investors, walkable environments increase commercial and business capacities of enterprises, foster new business and employment opportunities, increase property values, thereby contributing to economic vitality and regeneration of declining urban environments (Sohn et al., 2012; VTPI, 2014).

Walkability is also the foundation for sustainable cities. As a 'green' mode of travel, it has low environmental impact; reducing congestion and conserving energy without air and noise pollution (Forthsyth and Southworth, 2008). In compact or polycentric urban forms, walkable environments reduce the distances between home, work, shopping, recreational and public transit stops, and hence restrict urban sprawl (Hildebrand, 1999; Jabareen, 2006; VTPI, 2015). By decreasing car dependency, walkable cities help reduce energy consumption and greenhouse gas emissions, fostering more efficient use of public resources, lowering the costs of infrastructure and services, thereby formulating more economical urban ways of life (VTPI, 2015). Also, walking is a socially equitable mode of transport that is available to the majority of the population, across classes, including children and seniors (Forthsyth and Southworth, 2008).

The New Urban Agenda supports walkable and cyclable cities to improve health and well-being of societies (UNCHSD, 2016). In the early-2000s, walkable streets became an issue in the agenda of local authorities in Turkey to increase the mobility of people with disabilities in urban spaces. With the onset of the Healthy Nutrition and Active Life Program launched in 2013, it has been recognized as a way of combating obesity and promoting a healthy lifestyle. Despite these promising advances, similar to many countries, urban sprawl, the inefficient and insufficient provision of public transport infrastructure and services, as well as rising private car ownership have hindered the development of walkable cities in Turkey. Focusing on the question of the extent to which Turkish cities are walkable, this research examines the walkability level of the historic city centre of Mersin, specifically Ataturk and Uray Streets (AUS). It first proposes a micro-scale assessment model and describes the factors to measure the walkability level of urban space, then explains the research methodology, and summarizes the research findings. Finally, it discusses the major planning and design strategies which can improve the walkability and liveability level of the historic city centre; underlining the contributions of the model to the current planning practice with reference to an inclusive, human-centred and flexible design approach.

How to measure walkability in urban space

The literature on walkability and pedestrian-friendly environments is so vast that there are at least fourteen literature surveys on the built environment and travel (including pedestrian travel), another fourteen literature surveys on the built environment and physical activity (including walkability and biking), and three reviews of the many reviews (Ewing et al., 2016). According to a

<table>
<tr><th>FACTORS</th><th colspan="2">QUALITY INDICATORS AND PARAMETERS</th></tr>
<tr><td>A. Attractivenes and convenience</td><td colspan="2">A1. Clean and well-maintained walking paths
A2. Presence of interesting urban scenes and destinations (historic streetscape, public artworks, good-looking and well-maintained shopfronts, etc.)
A3. Aesthetic quality of streets
A4. A variety and diversity of activities and events in urban space</td></tr>
<tr><td rowspan="2">B. Safety</td><td>B.1 Actual safety</td><td>B2. Perceptual safety</td></tr>
<tr><td>B1a. Street width and enclosure
B1b. Design and management measures/ features to improve pedestrian safety in traffic
B1c. Design and management measures to reduce traffic congestion, noise and crime
B1d. Traffic calming measures</td><td>B2a. A clear demarcation between public and private space
B2b. Urban design measures to provide ‘eyes on the street’
B2c. Common use facilities and activities to add more ‘eyes on the street’</td></tr>
<tr><td>C. Integration o pedestrian network with other transportatio modes</td><td colspan="2">C1. An integrated and holistic transportation planning strategy
C2. The presence of internally well-connected pedestrian network
C3. Integration of the pedestrian network with other public transit modes (tram, bus, metro, etc.), train station, intercity bus terminal, parking and service zones within a walking distance</td></tr>
<tr><td>D. Quality of street pattern</td><td colspan="2">D1. Street pattern type
D2. Length of streets and/or blocks
D3. Number of intersections per unit area
D4. Number of dead-end streets per unit area
D5. Design features of building blocks</td></tr>
<tr><td>E. Connectivity of network</td><td colspan="2">E1. The presence of continuous road network, sidewalks and pedestrian paths
E2. The intensity of connectivity within an urban network system (Connectivity index)</td></tr>
<tr><td>F. Connection t open space systems</td><td colspan="2">F1. Strong connections of natural spaces, meeting and gathering places with unique features and visual interests through continuous sidewalks and pedestrian pathways freed from physical obstacles and clutters
F2. High level of pavement quality for the accessibility of pedestrians and disadvantaged groups (related to factor G)</td></tr>
<tr><td>G. Quality of sidewalks an pedestrian paths</td><td colspan="2">G1. Sidewalk width
G2. Continuous sidewalks and paths without pits, bumps or other irregularities
G3. Clear walking zones on sidewalks
G4. Quality of pavement for the comfort and safety of pedestrians with varied ages and physical abilities
G5. Raised or textured pavement at crosswalks
G6. Public amenities and service areas
G7. Street furniture
G8. Street and traffic signposts
G9. Street lighting
G10. Street trees, flower pots and other landscape elements</td></tr>
<tr><td>H. Accessibility</td><td colspan="2">H1. Accessibility of pedestrians to public service areas (schools, health, religious and administrative buildings/sites) and the major public spaces within a walking distance
H2. Unimpeded pedestrian movement to public service areas and the major public spaces (related to factor G)
H3. Orientations (‘permanency’ and ‘legibility’)</td></tr>
</table>

Table 1: Factors of walkability, their quality indicators and parameters

meta-analysis, there are 200 individual studies of the built environment and travel; but only six of them include variables that have some relationship to streetscape and urban design (Ewing and Cervero, 2010). Walkability is a multi-dimensional and measurable notion with a series of factors. This research, proposing eight qualitative and quantitative factors of urban design, provides a micro-scale assessment model to measure the walkability level of urban space and to guide streetscape projects seeking to create walkable environments (Table 1). This set of factors, along with the corresponding spatial parameters and indicators, has been produced through a literature review on the issue of walkability. That is, it has been identified through the *a priori* framework that relates to or denotes reasoning or knowledge which proceeds from theoretical deduction rather than from observation or experience.

One of these factors is 'attractiveness and convenience' of the pedestrian network. Well-maintained and clean walking paths with interesting urban scenes and destinations, the aesthetic quality of streets, as well as variety and diversity of activities/events improve the attractiveness and convenience of walkable environments (Appleyard, 1981; Jacobs, 1995; Krambeck and Shah, 2006).

Another walkability measure is the 'safety' of streets, comprising two dimensions: 'actual' and 'perceived'. 'Actual safety' of pedestrians can be achieved through the physical properties of urban space, including street widths and enclosure, design and management measures that improve safety of pedestrians, disadvantaged groups and cyclists, and reduce traffic congestion, noise and crime (Southworth, 2005; Forsyth, 2015). Traffic calming measures, such as separating pedestrian and vehicular traffic, creating safe pedestrian crossings, slowing down traffic through chokers, speed bumps, narrow streets, and traffic diverters are the prominent measures that improve actual safety. The extent to which pedestrians feel safe in a space is related to 'perceived safety'. Evans (2009) and Wheeler (2001) define it as the protection of pedestrians from the feeling of crime or the danger of vehicular traffic. Urban environments with a high crime rate, traffic congestion and noise are generally perceived as insecure and less walkable by pedestrians (Appleyard, 1981; Evans, 2009; Wheeler, 2001). Improving the actual safety of streets positively affects the perceived safety, and encourages people to walk more (Southworth, 2005). Jacobs (1961) defines three main qualities necessary for perceptual safety: a clear demarcation between public and private space, buildings oriented towards the street to provide 'eyes on the street' (natural surveillance), and common use facilities to add more 'eyes on the streets'. She (1961) argues that the declining vitality of public spaces reduces the possibilities for natural surveillance, while increasing the possibilities for crime occurrence. Walkability, in this sense, improves the level of perceived safety.

'Integration of pedestrian network with other transportation modes' is another measure to create walkable environments. The presence of an integrated and holistic transportation planning strategy with a focus on pedestrians, an internally well-connected pedestrian network and its integration with other public transit modes (tram, bus, metro, etc.), train station, intercity bus terminal, parking and service zones within a walking distance are all critical to create walkable cities (Southworth, 2005).

'Quality of street pattern' directly affects the walkability level of urban space (Southworth and Owens, 1993). Street patterns are assessed through the physical configuration of street network (grid, curvilinear, etc.), the length of streets and/or blocks, the number of intersections and dead-end streets per unit area, and design features of block patterns. Grid or modified-grid patterns are highly walkable, as they ensure high level of accessibility between destinations and easy approachability to public services by providing shortest trip distances, numerous intersections and alternative travel trip routes between destinations (Southworth and Owens, 1993). Curvilinear street patterns provide much safer environments than grid-street patterns by mitigating the nuisance and dangers of through traffic (Carmona et al., 2010). Also, they protect and promote privacy of community by enclosing views, reducing visual permeability and discouraging non-residents from entering into the area (Carmona et al., 2010). However, they are less walkable, as they contain a small number of intersections per unit area, and provide longer trip distances and less alternative travel trip routes (Southworth and Owens, 1993; Southworth, 2005).

Many tools for measuring the quality of the walking environment have emerged in the past few years. Active Living Research website maintained by R.W. Johnson suggests sixteen walking audit instruments that also include the length of streets and/or blocks, the height of buildings, the number of intersections and dead-end streets per unit, and design features of block patterns (Ewing & Clemente, 2013). These qualities help us to define two important sub-factors to define the walkability level: 'enclosure' and 'human-scale':

> (...) In an urban setting, enclosure is formed by lining the street or plaza with unbroken building fronts of roughly equal height. The buildings become the 'walls' of the outdoor room, the street and sidewalks become the 'floor', and if the buildings are roughly equal height, the sky projects as an invisible ceiling. Buildings lined up that way are often referred to as 'street walls' (Ewing & Clemente, 2013).
>
> Alexander et al. (1977, pp. 489–491) state that the total width of the street, building-to-building, should not exceed the building heights in order to maintain a comfortable feeling of enclosure. Allan Jacobs (1993) is more lenient in this regard, suggesting that the proportion of building heights to street width should be at least 1:2. Other designers have recommended proportions as high as 3:2 and as low as 1:6 for a sense of enclosure (Ewing & Handy, 2009: 74)

Several authors suggest that both the height and width of buildings define the notion of human scale (Ewing and Handy, 2009). In other words, to attain a feeling of 'human scale', building widths should be in proportion with building heights (Ewing and Handy, 2009). These are the perceptual qualities of the urban environment that may influence walking behaviours or user preferences. According to the research of Ewing et al. (2005b, 2006), the number of long sightlines and building height on the same side of the street detract from the perception of human scale, while the presence of first-floor windows, small planters and street furniture increase the perception of human scale (Ewing and Handy, 2009).

'Connectivity of street network' shows how far the street network eases the movement of pedestrians, cyclists, and vehicles. It is measured by: a) the presence of continuous road networks, sidewalks and pedestrian paths, and b) the level of connectedness within an urban network system (Southworth, 2005; VTPI, 2010). There are several

FACTORS		Codes of quality indicators	Direct observation	Morphological Analyses	Questionnaires
A. Attractiveness and convenience		A1	■	• Street pattern analysis • Mapping symbolic, historic buildings/sites, public artworks, meeting and gathering places • Land-use maps of Z1, Z2, Z3, Z4 and their surroundings • Land-use maps of each distinct zone for ground and upper floors	■
		A2	■		■ Mentalmaps
		A3	■		■ Mental maps
		A4	■		x
B. Safety	*B1. Actual safety*	*B1a*	■	• Figure-ground maps • Mapping street width	■
		B1b	■	Mapping traffic calming measures, traffic lights, pedestrian crossings, sidewalk widths and car-parking spaces	■
	B2. Perceived safety	*B2a*	■	Mapping landscape elements, pavement materials and changes in pavement levels in public and private spaces	x
		B2b	■	• Land-use maps for each distinct zone • Mapping street lighting	■
		B2c	■		■
		B2d	■	Average daily number of pedestrians and vehicles in each distinct zone	■
C. Integration of pedestrian network with other transportation modes		C1✧	x	x	x
		C2	x	Mapping pedestrian network (sidewalks and pedestrian path)	x
		C3	x	Accessibility analysis (mapping and analysing whether train stations, public transit stops/stations, car-parks are accessible within a 800-meter walking distance)	x
D. Quality of street pattern		D1	■	• Figure-ground maps • Mapping street/building block lengths • Number of intersections per hectare • Number of dead-end streets per hectare • Mapping building heights	■
		D2	■		x
		D3	■		x
		D4	■		x
E. Connec tivity networ k		E1	■	Mapping streets and sidewalks to see the continuity of street network, sidewalks and pedestrian paths	x
		E2	■	Calculation of Connectivity Index (CI)	x
F. Connection to open space systems		F1	■	• Spatial analysis of the relation between open public spaces and street and pedestrian networks • Spatial analysis on the continuity of sidewalks and pedestrian networks	x
		F2	■	Spatial analysis of the quality of pedestrian and sidewalk network (related to the parameter G)	■
G. Quality of sidewalks and pedestrian paths		G1	■	• Mapping sidewalk width • Mapping vehicular road width	x
		G2	■	• Spatial analysis of the continuity of pedestrian and sidewalk network	■
		G3	■	• Spatial analysis of sidewalks (including walking zone) in terms of obstacles and other irregularities	■
		G4	■	Spatial analysis of pavement quality	■
		G5	■	Spatial analysis of pavement quality (raised or textured pavement at crosswalks)	■
		G6	■	Spatial analysis of sidewalk or pedestrian network in terms of public amenities and service areas	■
		G7	■	Spatial analysis of street furniture and locations on the sidewalks	■
		G8	■	Spatial analysis of street and traffic signposts	■
		G9	■	Spatial analysis of street lighting	■
		G10	■	Spatial analysis of street trees, flower pots and other landscape elements	■
C. Accessi bility		H1	■	Accessibility of pedestrians to service areas (education, health, religious, administrative buildings/sites) and the major public spaces within a walking distance	x
		H2	■	Spatial analyses on the parameter G	■
		H3	■	Mental maps	■

■ The research tool is used for the assessment of the parameter.

- The research tool is not used for the assessment of the parameter.

✧ Different from other parameters, data regarding C1 was collected through archival documents and interviews. To study C1 (i.e., an integrated and holistic transportation planning strategy), this research used Mersin Transportation Strategy– Final report (2010) and results of interviews that were conducted with the expert academics on urban transportation in the Department of City and Regional Planning of Mersin University.

Table 2: Research tools for the data collection regarding the factors of walkability, their quality indicators and parameters

methods to measure the level of connectedness within an urban network system, one of which is 'connectivity index (CI)'. The score of CI is calculated by dividing the number of roadway links to the number of roadway nodes (Litman, 2016). The higher the CI score, the smaller the size of building blocks, and the greater the internal connectivity (Southworth, 2005). The CI of traditional grid patterns is 1.65, indicating a high level of connectivity, while CI of curvilinear street patterns are much lower than that of grid or modified-grid patterns (Southworth, 2005; Zhang, 2013). The minimum CI for a walkable community is 1.4 (Litman, 2016). Highly-interconnected and continuous street patterns enable destinations to connect quickly and directly each other, distribute the traffic equally in many roads rather than a single arterial, increase legibility, and they ultimately have high potentials to create more pedestrian-friendly streets (Southworth and Owens, 1993; Forsyth, 2015).

Another quality of walkability is 'connection to open space systems'. Natural spaces, meeting and gathering places should be strongly connected to each other through continuous sidewalks and pathways with a good quality pavement for accessibility of pedestrians and disadvantaged groups (Southworth, 2005). Accessing such public spaces, open places with unique features, meeting and gathering places by walking contribute to social life, and help generate liveable and walkable urban spaces (Montgomery, 1998).
'Quality of sidewalks and pedestrian paths' improves the comfort of pedestrians. It is affected by a number of variables, such as sidewalk width, continuous sidewalks and paths providing a smooth surface without irregularities, clear walking zones on sidewalks, the quality of pavement for the comfort of pedestrians with varied ages and physical abilities, raised or textured pavement at crosswalks, the locations of public amenities and service areas (e.g., public toilettes, breastfeeding facilities), street furniture, street and traffic signs, trees, and flower pots, and quality of street lighting (Southworth, 2005, Duany et al., 2010; Pedestrian and Streetscape Guide, 2003).

Finally, 'accessibility to public service areas and gathering spaces' can be measured first by the accessibility of pedestrians to education, health, religious and administrative buildings, and the major public spaces that should be within a 10-20 minute-walking distance (i.e., maximum 800 meters) (Lotfi and Koohsari, 2009). Unimpeded pedestrian movement to such service areas and public spaces, and orientation are other sub-measures of accessibility (Jacobs, 1995, Southworth, 2005). Orientation enables pedestrians to realise public space network and to recognise the most important landmarks in public spaces in order to avoid from the fear of being lost. 'Permeability' and 'legibility' play crucial roles in terms of orientation of people in urban space. Permeability is the extent to which an environment allows a visual and physical choice of routes both through and within it; and 'legibility' means the extent to or the ease with which the cityscape can be 'read' and its layout can be understood (Carmona et al., 2010). The visual assessment literature, which attempts to measure how individuals perceive their environments, and better understand the features that individuals value in them, adds other potentially important qualities. It goes beyond the boundaries of urban design to the fields of architecture, landscape architecture, park planning, environmental psychology, etc., as perceptual qualities of the environment figure prominently in these fields as well (Ewing et al., 2006: 224). In this research, we suggest the use of mental or cognitive maps to have a better understanding on the users' perception of space legibility. Because Lynch (1960) suggests the use of mental maps (cognitive maps) to study legibility of urban space based on paths, edges, districts, nodes and landmarks. He (1960) claims that a clear mental map gives people an important sense of emotional security, it is the framework for communication and conceptual organization, and heightens the depth and intensity of everyday human experience. A street network made up of short and direct route choices generates a permeable and legible urban pattern for pedestrians (Forsyth, 2015).

Methodology

This research, providing a micro-scale walkability assessment model, and employing descriptive and exploratory case study method, examines the walkability level of the main commercial streets of Mersin, i.e. Ataturk and Uray Streets (AUS). It studies the spatial development of the city and the city centre over the last 85 years to reveal the morphological changes, the current problems, and the potentials at the levels of city and city centre regarding walkability. The spatial analyses on the land-use functions, building density, design and architectural features, landmarks, intersections, boundaries, and traffic management policies in AUS revealed four specific zones with different characters, represented as Z1, Z2, Z3 and Z4 (Figure 2). The walkability level of each zone was studied individually regarding walkability factors to reveal the positive and negative aspects of the space effecting its walkability level (Table 2).

The case study relies on multiple sources of qualitative and quantitative evidence, involving a mixture of primary and secondary data. Table 2 presents the sources of evidence for investigation in connection with the walkability factors, quality indicators and parameters. Archival documents (reports, books, master and doctoral theses, academic articles, newspaper cuttings, maps, plans, photos, etc.) constitute the first source of evidence. The second source of evidence is direct observation. The site was visited several times during December 2011, March 2012 and March 2015 on both week and weekend days between the hours of 7.00-9.00, 9.00-12.00, 12.00-13.30, 13.30-17.00, 17.00-19.00, 19.00-22.00 to observe the user profile, their frequencies, the current spatial organization and features of these streets, and their management and operation (Table 3).

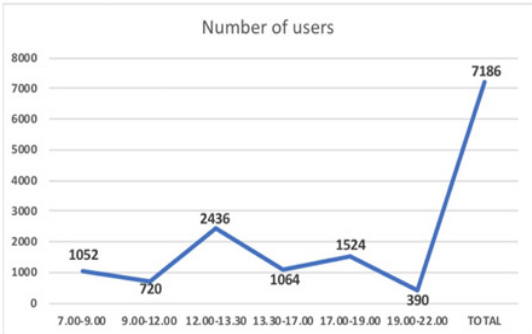

Table 3: Number of visitors of AUS according to different time intervals in a day

Detailed notes about the factors positively and negatively affecting the walkability level of each zone were recorded in a research diary to attain primary data. Photos were taken to provide evidence for direct observations. Third, a survey of 72 questionnaires was conducted in December of 2011 on both week and weekend days between the hours of 10:00–12:00 and 13:00–17:00 with user groups from different age, gender, education and occupation groups to reach varying perceptions and opinions (Table 4).

Survey questions cover the user evaluation regarding the factors of attractiveness and convenience, safety, quality of street pattern, quality of sidewalks and pedestrian paths, and accessibility. Last, spatial analyses were mapped to show the factors effecting the walkability level of the site. Four types of questions were used in the survey. Demographic questions were asked to identify the user profile of the streets in terms of gender, age, educational status, occupation, place of living, visiting frequency and visiting part of these streets to assure that a variety of participants was included in the survey research. Closed-ended, open-ended and multiple-choice questions were used to understand the user perceptions regarding the walkability aspects of these streets. The answers of the closed-ended questions were examined in SPSS software; descriptive statistical analyses through frequency tables were prepared to reveal the factors affecting the walkability level of AUS. Likert scale was used to make comparison between four zones. The answers of the survey questions were scored from 1 to 4. In Likert scale, 1 represented ‘unfavourable zone" for survey respondents; 4 represents "the most favourable zone"; and 0 referred to ‘not applicable’, as the respondents could not evaluate the factor for some zones (Tables 5, 6). Between 1 and 4, 2 and 3 were given for the zones which had a ratio from lower to higher. If the same ratios were found for a factor, both were given the same point score. Content analysis was employed for the analysis of the open-ended questions. Further, mental maps, drawn by the survey respondents, were used to understand how far AUS and their surroundings are legible for the users and which aspects of the public space are memorable for them (Figure 1). These mental maps were very useful to show memorable buildings and places in AUS according to the users’ perception (See Figure 9). Last, four zones were compared between each other regarding each walkability factor to reveal their walkability level under three categories: "high level of walkability" scored as +1, "moderate level of walkability" scored as 0, and "low level of walkability" scored as -1 (Table 9). This qualitative categorisation and quantitative scoring enables us to compare multiple zones between each other in qualitative and quantitative terms to attain an ultimate assessment of walkability level of urban space.

Metrics	Frequency	Valid percent (%)
Gender		
•Men	43	59.7
•Women	29	40.3
Age		
•16-34	32	44
•35-59	31	43
•60+	9	13
Education		
•İlliterate	1	1.4
•Primary school	6	8.3
•Secondary school	3	4.2
•High school	16	22.2
•University& higher education	46	63.9
Occupation		
•Shopkeepers	21	29
•Officers	11	15
•Street vendors	6	9
•Pedestrians	34	47
Pedestrian types		
•Pedestrians	60	83.4
•Pedestrians with disabilities	12	16.6
Place of living		
•Northern Mersin	5	6.9
•Southern Mersin	0	0
•Eastern Mersin	5	6.9
•Western Mersin	46	64
•Outside of Mersin	5	6.9
•Centre of Mersin	11	15.3
Visiting frequency		
•Every day	16	22.2
•Every weekend	0	0
•Every day from Monday to Friday	15	20.8
•3-4 times a week	2	2.8
•Once or twice a week	9	12.5
•Once or twice a month	30	42.7
Utilization of Ataturk and Uray Streets by pedestrians		
•Zone 1	15	20.8
•Zone 2	12	16.7
•Zone 3	24	33.3
•Zone 4	21	29.2
Mode of transition to arrive at Ataturk and Uray Streets		
•Private car	30	41.7
•Walking	15	20.8
•Bus/Minibus	26	36.1
•Train	1	1.4

Table 4: Demographic composition of the current users of AUS.

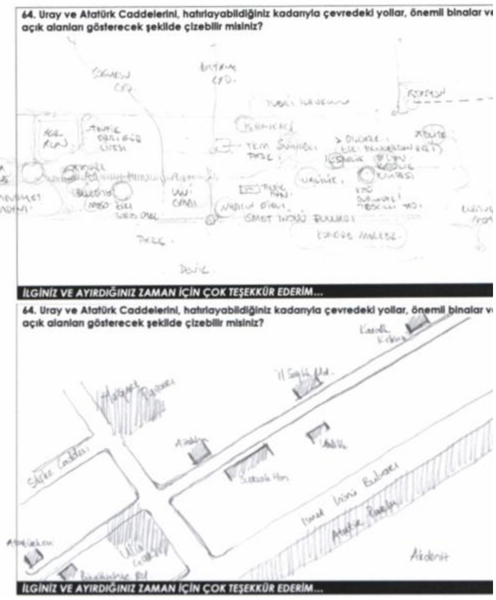

Figure 1: Two mental map examples of survey participants showing that Ataturk and Uray Streets are highly legible for users (Authors, 2012)

Mersin and the Historic City Centre

Mersin is a cosmopolitan city located in the south of Turkey. It became an important Eastern Mediterranean port city in the 19th century. Starting from the 1930s, the city developed linearly along the coast, and grew in a compact form towards the north, north-east and north-west directions until the mid-1980s. Thereafter, urban sprawl has become the dominant tendency shaping the urban macroform. The city centre developed around AUS since the 19th century, parallel to the coast, and later it sprawled along the main roads to the north and north-east directions (Figure 2). Both streets, connected to each other linearly with squares and parks, are surrounded by Kurtuluş Square, Istiklal Street and the Central Station to the north and north-east; Ismet Inonu Boulevard, Ataturk Park, Mersin international port and the old marine to the south and south-east; and Sakarya Street, Cumhuriyet Square and Çamlıbel neighbourhood to the south-west (Figure 3). To the north and north-east of these streets, the city centre extends with commercial, administrative, cultural and residential functions.

AUS contain four distinct zones: Zone 1 (Z1) extends from the roundabout of Uray Street and 5210th Street to Kurtuluş Square; Zone 2 (Z2) stretches from Akdeniz District Governorship to the intersection of Uray and Kuva-i Milliye Streets; Zone 3 (Z3) is a square (old Custom Square) enclosed by Ulu Mosque and Ulu Market; and finally, Zone 4 (Z4) extends from 4706th Street to Cumhuriyet Square (Figure 2).

Figure 2. **The location of the historic city centre and AUS in Mersin (above) and four distinct zones of AUS (below) (Authors, 2019)**

AUS significantly contribute to the urban identity with their cultural and historic buildings/sites, meeting and socializing places, and the most well-known symbols and landmarks of Mersin. Following the reclamation of the coast and the construction of ten-storey buildings along Ismet Inonu Boulevard, both streets have become disintegrated from the seaside. The heavy vehicular traffic, congestion and noise pollution on those streets have been obstructing the pedestrian mobility and use, thereby impoverishing their liveability and sustainability.

Assessment of Walkability Level of AUS

Attractiveness and convenience

AUS offer rich visual experiences for walkers. Z1, Z2 and Z3 generate pedestrian movements owing to the variety and diversity of activities in urban space (e.g., government agencies, commercial, office, education and cultural uses, transportation hubs and stops). Being a pedestrianized street and containing the historic buildings, squares, and parks, Z4 is the liveliest part of this area. It is only accessible by cars during the early morning hours or very late evening times for service-related purposes. Survey results show that especially Z4 is attractive and comfortable for walkers. The presence of interesting urban scenes and destinations such as historic landmarks, well-kept shop windows, traditional shopping malls, food and beverage shops, banks on the ground floors of buildings make AUS attractive for pedestrians (Figure 3). According to the questionnaire results and mental map analyses, Z3 and Z4 are the most preferable parts of walkers due to its memorable symbolic places, and 'diversity' and 'variety' of activities and events. Overall, the findings show that Z4 is the most walkable zone due to better cleaning, maintenance and repair of the sidewalks and its appealing and safe look for walkers, followed by Z3, whereas Z1 and Z2 are the least walkable sites (Table 9).

Actual and Perceived Safety

As a pedestrianized street with a high-quality street lighting and a rich variety of activities adding more eyes on the street, Z4 is the safest zone for walkers among four zones. It is followed by Z3, Z2 and Z1, respectively. The majority of survey respondents (90% for Z1; 68% for Z2) complained about narrow sidewalks, and obstructions (pits, bumps or other irregularities) along the sidewalks in Z1 and Z2. Heavy vehicular traffic in these zones, cars parking illegally on sidewalks and next to on-street car-parking lots, pedestrians crossing the street wherever they want threaten the actual safety of pedestrians. Most of the survey participants agreed that the vehicular traffic is the prominent safety problem for pedestrians to move within Z1 and Z2. There needs a holistic traffic calming strategy and a design guideline to address the needs of both pedestrians and vehicular drivers for the city centre. Such

Figure 3. **The important landmarks and gathering places on AUS (Authors, 2012)**

a design and management strategy should consider the location and design rules of traffic lights and crossings, ramps for improving the accessibility of disadvantaged groups, speed bumps, on-street car-parking lots, delineated car-parks nearby AUS, and street lighting, but also the management, control and use codes for both pedestrians and vehicular drivers.

Regarding the perceived safety, survey respondents generally find Z3 and Z4 very safe. However, they raise their concerns about the safety in Z1 and Z2. Narrow sidewalks, fast-driven cars, unsafe street crossings, illegal car-parking, inadequate street lighting, night clubs, bars, restaurants and entertainment places working late at night, empty premises and deserted parts (e.g. Z1) at night are the prominent factors reducing the feeling of safety in the city centre and AUS. Likewise, they showed the vehicular traffic as the main source of noise pollution (Tables 5, 6).

AUS are visited daily by 7,186 pedestrians on average (Table 3). According to Gehl (2010), activities, such as frequenting street cafés and outside dining, make public space convivial and animated. Similar to many Mediterranean cities, in spite of the hot and humid climate, there exists a lively street life in the historic city centre of Mersin. With a rich variety of urban activities, active street frontage, and continuous building frontage forming a street wall, the public life in AUS are kept dynamic and lively all day long. However, they become deserted, especially after 22.00. In AUS, there are no residential uses, or other facilities, such as hotels, to ensure the presence of a night population that could provide ‘eyes on the street’. According to the majority of survey respondents, both streets would potentially be perceived as much safer, if there existed some living population. All in all, the research findings reveal that Z4 is the safest zone in terms of actual and perceptual safety, followed by Z3, whereas Z1 and Z2 are the least secure zones in all senses.

Integration of pedestrian network with other transportation modes

The pedestrian network in the historic city centre is highly connected with different transportation modes. Within the study area, there are six bus stops: one is located in front of the Central Station, three bus stops on Ismet Inonu Boulevard, one on the junction of Ataturk and Sakarya Streets, and the last one on Silifke Street (Figure 8). Between 6:00 and 22:00, the city centre is highly accessible from different parts of Mersin by public transit modes. A bus or a minibus arrives to the city centre every 6 minutes from the east of Mersin, and every 1.5 minutes from the north and the west of the city (1). Almost every day, around 21,420 people travel to the city centre by public transit; being considered as adequate by the Mersin Metropolitan Municipality (MMM) (MBB, 2010). Direct observations and spatial analyses revealed that bus and minibus stops are all accessible by walking. However, special attention to the design of the sidewalks, crosswalks, car-parking areas, and public transit stops is needed to address the accessibility needs of disadvantaged groups. In summer, people tend to access to the city centre by car due to hot weather (1). There are four car-parking sites in Z1, and one in Z4, all of which are accessible to AUS by walking (Figure 8). Only the use of these car-parking sites needs to be encouraged.

Urban Transportation Strategy 2025 which has been in power since 2010 envisages an integrated and holistic urban transportation system for Mersin (MBB, 2010). In recent years, MMM purchased 60 new buses to improve the mobility of the disadvantage groups within the city centre. Nevertheless, the major policies that encourage the use of public transit to access to the city centre, such as the construction of multi-modal transfer centres, the light railway lines and their stops, the new car-parks in the city

QUESTIONS	Z1	Z2	Z3	Z4
A. ATTRACTIVENESS AND CONVENIENCE				
A1. Walking paths are clean and well-maintained.	2	2	3	1
A2. The variety and diversity of activities and uses is attractive and interesting for all.	4	2	1	3
A3. This part of the street is good-looking and interesting.	1	3	2	4
	7	**7**	**6**	**8**
B. SAFETY				
B.1. Actual safety				
B1a. Which parts of AUS are wide enough for vehicular traffic?	1	2	0	0
B1b. Which part/s of AUS can you walk easier and more comfortable?	1	2	3	4
B1b. Which parts of AUS obstruct comfortable pedestrian mobility?	2	3	3	4
B1b. Cars should drive slower on AUS?	1	2	3	4
B1b. As a pedestrian, I have difficulty to cross Z1 and Z2.	2	1	0	0
B1b. There is no sufficient pedestrian crossing on Z1 and Z2.	2	1	0	0
B1b. The street crossings along Z1 and Z2 are placed properly.	2	1	0	0
B1b. The street crossings along Z1 and Z2 are easily accessible for pedestrians.	2	1	0	0
B1b. The street crossings along Z1 and Z2 are safe for disadvantaged groups (elderly people, disabled groups, children and parents with young children).	2	1	0	0
B1b. Traffic lights on Z1 and Z2 are designed and placed according to the needs of disadvantaged groups.	1	2	0	0
B1b. Sidewalks and pedestrian paths are safe for disadvantaged groups.	1	2	2	2
B1b. Vehicles parking along AUS obstruct pedestrian mobility.	1	3	2	4
	18	**21**	**13**	**18**
B2. Perceptual safety				
B2b. AUS will be much safer, if there exists more residential use.	3	2	4	3
B2c. Stores/shops open till late hours at night make these streets much safer.	2	1	3	4
B2d. Both AUS are safe at night.	3	1	3	2
B2d. Which part of AUS is noisy?	1	2	3	4
B2d. Which part of AUS' noise is more resulted from the vehicular traffic?	2	3	1	4
	11	**9**	**14**	**17**
D. QUALITY OF STREET PATTERN				
D1. AUS are easily accessible from other destinations by walking.	3	2	4	1
	3	**2**	**4**	**1**
G. QUALITY OF SIDEWALKS AND PEDESTRIAN PATHS				
G1. Sidewalks and pedestrian paths of AUS are easily walkable and comfortable.	2	1	4	3
G1. There is no pits, bumps or other irregularities for pedestrians along sidewalks and pedestrian paths.	1	2	3	4
G1. Canopies of shopfronts protect pedestrians from hot and wet weather conditions.	1	2	4	3
G1. Raised or textured pavement at crosswalks, sidewalks and pedestrian paths are designed for easy and comfortable mobility of disadvantaged groups.	1	3	3	2
G1. Street furniture (bins, benches, light posts, bollards, etc.) on the street hinder the mobility of pedestrians.	1	2	3	4
G2. The sidewalks/pedestrian paths are wide enough for comfortable and easy movement of pedestrians.	1	2	3	4
G3. The pavement slabs on sidewalks and pedestrian paths are well-laid out and do not hinder pedestrian movement.	2	2	3	1
G3. Level variations along the sidewalks pavement (ramps, etc.) are adequately safe for pedestrians.	1	2	4	3
G3. Pavement slabs along the sidewalks/pedestrian paths are not deformed or broken.	2	2	1	3
G4. Street furniture (bins, benches, bollards, etc.) provided along the street is sufficient.	2	3	1	4
G4. There are enough rest places along these streets.	1	2	3	4
G5. Street and traffic signs on the streets are sufficient.	3	1	3	2
G6. They are well-lit streets at night.	2	1	2	2
G7. The trees on the streets hinder the comfortable and easy movement of pedestrians.	3	3	2	1
G7. Flower pots and other landscape elements hinder the comfortable and easy movement of pedestrians.	4	3	2	1
	27	**31**	**41**	**41**
H. ACCESSIBILITY				
H2. Cars parking on-street parking lots along the streets hinder the comfortable and easy movement of pedestrians.	1	3	4	3
H3. Vehicular traffic on AUS is a problem for pedestrians to access to different parts of the street.	1	3	2	4
H3. Vehicular traffic on the parallel streets is a problem for pedestrians to access to different parts of the street.	2	3	1	4
	4	**9**	**7**	**11**
TOTAL	**70**	**79**	**85**	**96**

Table 5: Scores of survey questions on the walkability quality of four distinct zones of AUS (Z1, Z2, Z3 and Z4) (1 = unfavourable zone; 4 = the most favourable zone; 0 = not applicable.

centre and the pedestrian walkway and bicycle route networks, have yet to be completed.

Quality of Street Pattern

The walkability level of AUS is assessed according to the physical configuration of street network. As Southworth and Owens (1993) suggest that grid and modified grid street patterns are highly walkable, we visualised the street network of AUS through its figure-ground map (Figure 4). The figure-ground map of AUS indicates that the street pattern of the historic centre presents the characteristics of a 'modified-grid plan' (Figure 4). Having alternative route options, this type of street pattern provides pedestrians with a coherent and legible street network, ultimately ensuring a walkable and liveable environment. The streets around AUS reach directly to AUS by providing a high level of accessibility between destinations and easy approachability to public services. They also provide pedestrians with the shortest trip distances, numerous intersections and alternative travel trip routes between destinations.

The length of building block on AUS ranges between 18 meters and 100 meters for Z3 and Z4 and between 28 meters and 165 meters for Z1 and Z2. The average building block lengths of Z1, Z2, Z3 and Z4 are 80, 47, 47, and 40 meters, respectively (Table 7). Ideally, with longer average length of building block, Z1 provides a continuous and longer walking path, by creating a good level of enclosure, compared to Z2, Z3 and Z4 (Tables 7 and 8). However, in the case of AUS, Z2, Z3 and Z4 are highly walkable zones despite shorter average lengths of building block, compared to that of Z1. Because Z3 and Z4 are pedestrianised zones, and pedestrians have a high possibility to walk without a vehicular traffic intrusion.

results and above-mentioned explanations show that, regarding street pattern quality, Z3 and Z4 are highly walkable, followed by Z2. The least walkable zone is Z1.

Connectivity of network

With the modified-grid street pattern, AUS provide alternative, direct and short travel trip routes for pedestrians, disadvantaged groups and bike users. The Connectivity index (CI) score of AUS and that of AUS and its surrounding small streets are 1.38 and 1.49, respectively. Being very close to the CI score of walkable spaces (i.e., 1.4), as suggested by Litman (2016), these figures indicate a high level of connectivity. A high level of connectivity for the pedestrian network is ensured by the pedestrianized walkway in Z3 and Z4, and this walkway is connected to the sidewalks in Z1 and Z2. Direct observations and the spatial analysis reveal that the most walkable area is Z3 and Z4, whereas Z1 and Z2 contain obstacles which impede the continuous movement of pedestrians, such as narrow sidewalks. Thus, regarding connectivity of network, Z3 and Z4 are highly walkable, while Z1 and Z2 are moderate level walkable zones.

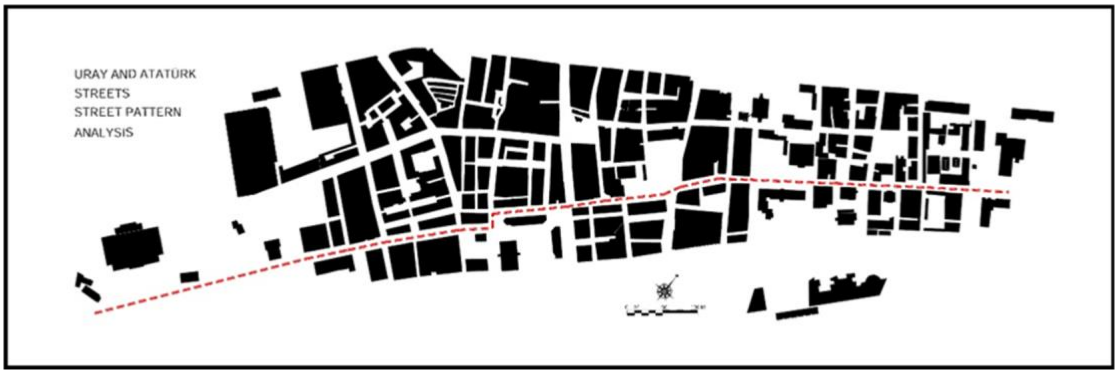

Figure 4: Figure-ground map of AUS and its surrounding in Mersin (Authors, 2012

Regarding the number of intersections per hectare, ideally the lower the number of intersections per hectare is, the higher the level of walkability is. Despite the high number of intersection per hectare, Z3 and Z4 (5.2) are more walkable than Z1 and Z2 (3.25), because Z3 and Z4 are pedestrianised zones.

Regarding the building height, the average numbers of storey in Z1 and Z2 are 3 and 2.4, respectively (Table 8). Considering that each storey is 3.5 meter high, the average height of each zone is Z1 (10.5 meters), Z2 (8.4 meters), Z3 (16.1 meters) and Z4 (15.4 meters). In Z1, the buildings of government agencies are higher than four storeys, whereas Z2 contains mostly single-, two- or three-storey buildings. With the buildings ranging from two to seven-storeys, Z4 and Z3 are much denser than Z1 and Z2. Thus, regarding the building height and building density, Z4 and Z3 are much denser than Z1 and Z2. The average street widths for Z1 and Z2 are 10 meters and 10.5 meters respectively. For Z4 and Z3, they are 15 meters. In terms of building height to building width ratio, Z4 is 1.02; Z3 is 1.07, Z2 is 0.8, and Z1 is 1.05. Regarding a sense of enclosure, these zones provide a comfortable feeling of enclosure, whereas Z2 offers the lowest level of a comfortable feeling of enclosure. We can come to a similar conclusion in terms of the human-scale perception. In sum, direct observations, morphological analyses, survey

Connection to open space systems

The distance from the west end (Z4) to the east end (Z1), which is a 1.5 kilometre long, in general is not seen as a walkable distance, if we consider 800 meters for a walkable distance. But, still, apart from very hot days, it is a rather walkable distance for a healthy individual. Along AUS, the distance from the public transit stops to the landmarks, symbolic buildings and sites, such as the Central Station, Inonu Park, Yoğurt Bazaar, Ulu Market, Cumhuriyet Square, is within an 800-meter walking

	YES (%)	NO (%)	NO IDEA (%)
B. **SAFETY**			
B2d. Cumhuriyet Square is safe at night.	49	40	11
B2d. Ulu Mosque and Ulu Mall Square are safe at night.	26	52	28
G. QUALITY OF SIDEWALKS AND PEDESTRIAN PATHS			
G6. Cumhuriyet Square is well-lit at night.	77	14	9
G6. Ulu Mosque and Ulu Market area are well-lit at night.	40	36	14

Table 6: Survey results on the walkability quality of Cumhuriyet Square and Ulu Mosque and Ulu Market area (around old Customs Square)

distance. The Culture and Convention Centre, and Ataturk Park are important meeting and activity places generating significant walking movement between AUS and the seaside. The four zones are connected to Ataturk Park and the seaside via six main streets, and some narrow lanes (Figure 5). Using these connections, pedestrians conveniently can access to Ataturk Park within a walking distance ranging between 200 meters and 350 meters, and to the seaside within a walking distance ranging between 400 meters and 500 meters. According to the direct observations, morphological analyses and questionnaires, all zones exhibit the highest quality in terms of the connection to the open space systems. In particular, the systematic observations and the spatial analyses on these streets show that the sidewalks on these streets are rarely disconnected and intermittent. On the streets linked to the sea, street vendors and street cafés, in particular, are significant features keeping these places alive and vivid. Nevertheless, a particular care and maintenance is needed for the sidewalks and pedestrian paths, specifically for the sidewalk ramps and the quality of sidewalk pavement on AUS and on the streets connected to Ataturk Park and the seaside, to create a smooth and clear surface for disadvantaged groups.

Quality of Sidewalks and Pedestrian Paths

As a 15-meter wide pedestrianized street, Z4 provides the most comfortable walking conditions among the four zones. However, the sidewalk widths of Z1 and Z2 are not adequate for comfortable and safe pedestrian movements, being poor in terms of street furniture, street and traffic sign posts, street lighting, public amenities and service areas. In AUS, there are neither benches, nor public toilettes and breastfeeding facilities, apart from those in Ulu Mosque. Z1 and Z2 are particularly poor in terms of clear walking zone on sidewalks (Figure 5). Displays of shops, tables and chairs of restaurants and cafés should be reduced in the walking zone to create better pedestrian

Building block length								
Zones / Number of Building Block	**Z1**		**Z2**		**Z3**		**Z4**	
	North	**South**	**North**	**South**	**North**	**South**	**North**	**South**
1	165	152	32	72	27	100	39	33
2	63	40	67	63	18		54	60
3	28	34	30	30	44		35	37
4	124	57	67	35			46	26
5		54	38	31			19	58
6							40	37
Total building block length (meter)	**380**	**337**	**234**	**231**	**89**	**100**	**233**	**251**
Average building block length for each side of the street* (meter)	**95**	**67**	**47**	**46**	**30**	**100**	**39**	**42**
Average**	**~80**		**~47**		**~47**		**~40**	

** Average building block length = Total building block length / building block numbers (eg.: 380/4=95 for Z1 northern side)*
*** Average building block length for each zone (northern and southern sides together) = [Average building block length (north) + Average building block length (south)]/2*

Table 7: Building block lengths in AUS and average block building lengths in each zone

Building heights (storey)				
Zones / Number of storey	**Z1**	**Z2**	**Z3**	**Z4**
1 storey	2	5	-	-
2 storeys	6	4	2	4
3 storeys	6	5	-	-
4 storeys	2	2	2	3
5 storeys	1	1	1	4
6 storeys	2	-	1	4
7 storeys	-	-	2	1
Total Building Number	19	17	8	16
Average number of storey*	**3**	**2.4**	**4.6**	**4.4**

** Average number of storey = [(1 x number of building)+(2 x number of building) + (3 x number of building) + ...(n x number of building] / Total number of building*

Table 8: Building heights in AUS and average building heights in each zone

movement particularly in Z2. Regarding the pavement quality, ramps, street lighting, location of landscape elements, survey respondents are mostly happy about Z3 and Z4, but unsatisfied with Z1 and Z2. The pavement quality of Z3 and Z4 is adequate, whereas repair works for some parts of street floor along Z1 and Z2 are necessary (Figure 6).

According to Gehl (2010), planting trees along sidewalks close to each other enable streets to be visually perceived much narrower; and this can be used to slow down vehicular traffic, to increase pedestrians' safety, and to contribute to the aesthetic quality of the public space. According to survey respondents (56% for Z3, 72% for Z4), trees do not hinder pedestrian movement, while this ratio is 39% for Z1 and Z2. To ensure continuous pedestrian movement, trees should be placed in the curb zone and the distance between two trees should range from 4.5 meters to 7.5 meters (Jacobs, 1995). In AUS, trees are generally placed 3.5 meters away from buildings (Figure 5). Although the majority of survey respondents claim that trees in Z1 and Z2 restrict pedestrian movement, they should be kept on these streets. They provide not only shade for walkers and cool down the street, but also significantly make the public space aesthetically pleasing (Figure 5). Yet, the base, covering and grates of trees should be designed stable enough for the safe and easy movements of pedestrians and disadvantaged groups. All

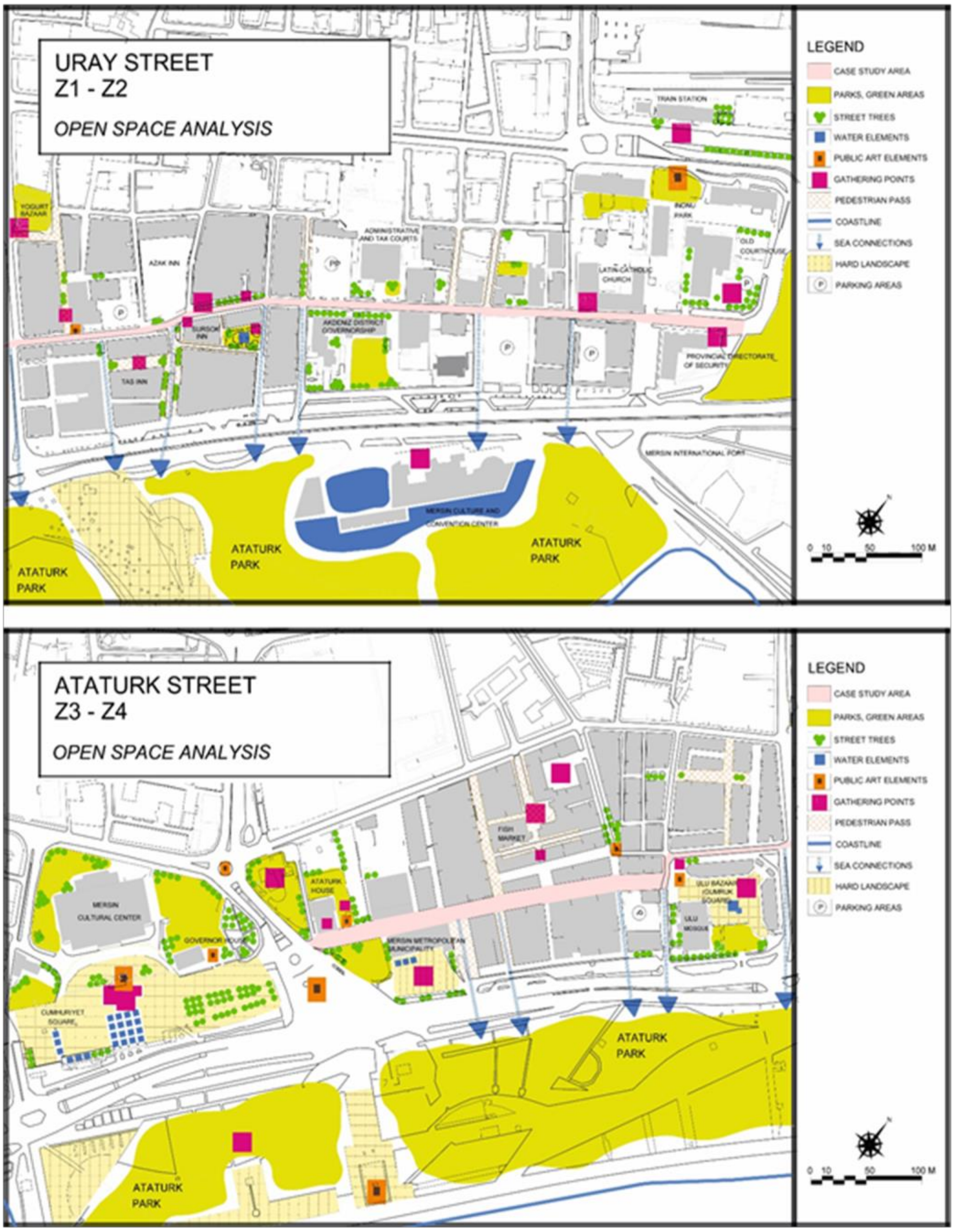

Figure 5: Spatial analysis on the connection to open space systems in AUS (Authors, 2015)

in all, Z4 is the most walkable part of the study area regarding its pavement quality, street sign boards and street lights, while Z3 is a moderate walkable zone. Z1 and Z2 are the least walkable parts in terms of the quality of sidewalks and pedestrian paths.

Accessibility

In AUS, public service areas and the major public spaces are accessible for pedestrians. Pedestrians have an easy access to the shops along Z3 and Z4, while they have difficulty in accessing to the sidewalks and stores in Z1 and Z2. In terms of quality of sidewalks and pedestrian paths, Z4 and Z3 are highly walkable zone, Z3 is a moderate walkable zone, and Z1 and Z2 are the low walkable zones.

Figure 6: The spatial analysis on the quality of sidewalks and pedestrian paths of AUS (Authors, 2012)

Figure 7: Problems related to the quality of pavement on AUS (Authors, 2012 right, left), 2015 (middle))

Regarding pedestrians' accessibility to public transit amenities within walking distance, orientation and unimpeded movement to public spaces and amenities, direct observations and spatial analyses reveal that the most walkable zone is Z3, followed by Z4 (Figure 7). Direct observations show that vehicles, which access to Z4 and park on the walkway after 18.00, obstruct the safe and continuous mobility of pedestrians. Cumhuriyet Square is used as a parking space for special events and activities that take place in the Cultural Centre. Direct observations revealed that pedestrian movements are significantly obstructed when the square is used as a car-parking site. Irregular and illegal on-street parking generally cause traffic congestions. Measures should be taken towards encouraging the use of public transit modes to access to the events and activities in the city centre to provide safer

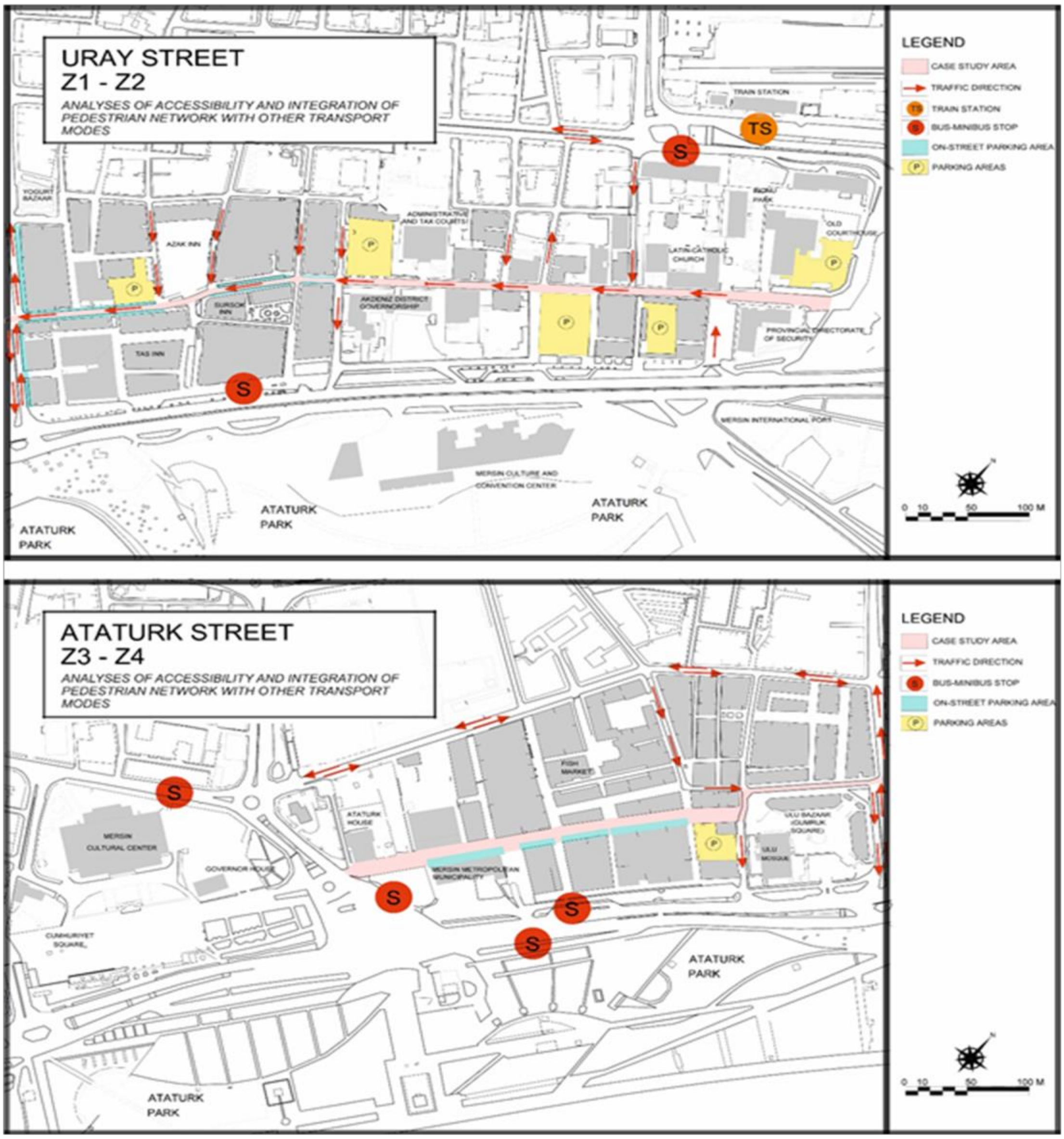

Figure 8: The analyses of accessibility and integration of pedestrian network with other transport modes on AUS (Authors, 2012)

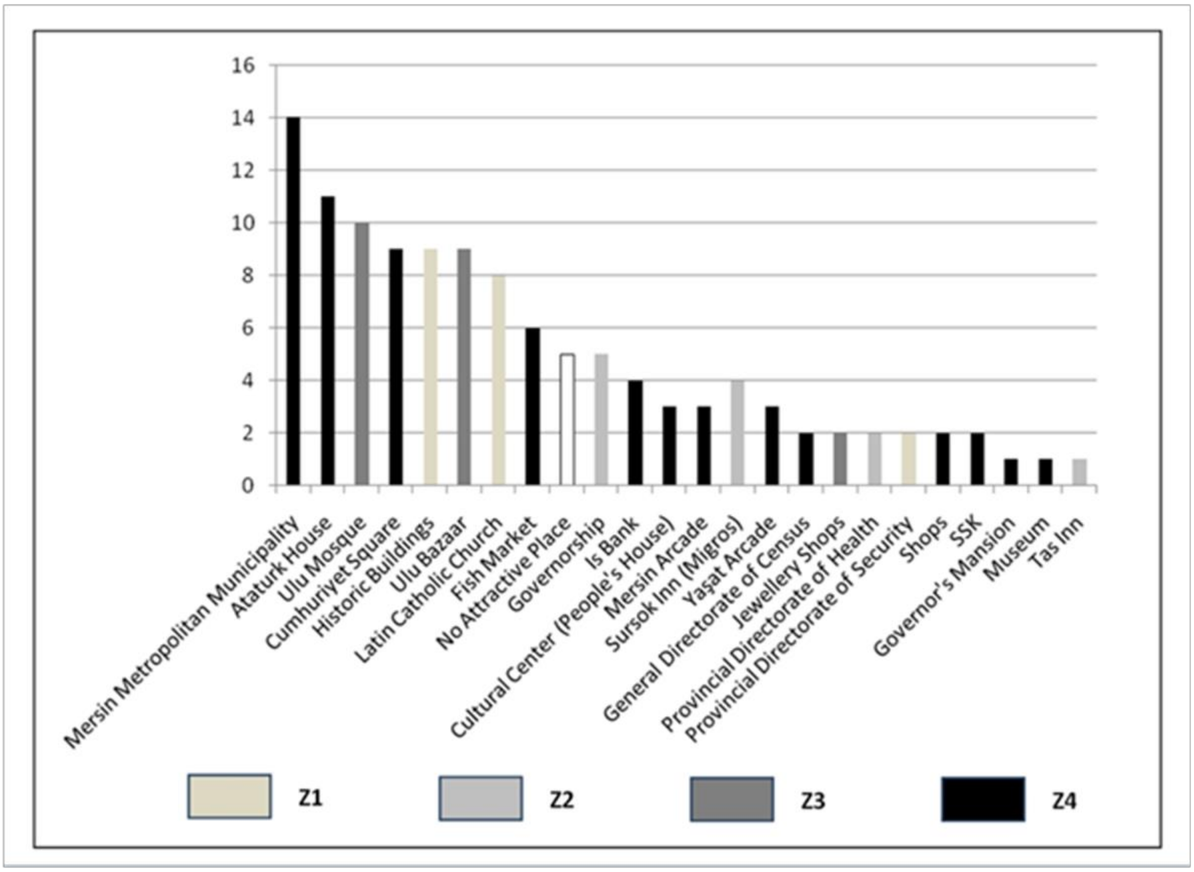

Figure 9: Memorable buildings and places in four zones based on the analysis of mental maps of the survey (Authors, 2012)

public spaces for pedestrians. In this sense, the management and control measures become important to improve the pedestrian accessibility in the city centre, thereby enhancing the walkability, liveability and sustainability of historic city centre. Much stricter and more frequent controls of public spaces are necessary to hinder irregular and illegal on-street car-parking by charging high traffic fines, redirecting them to alternative car-parking sites.

Orientation is examined under the sub-criteria of 'permeability' and 'legibility'. Landmarks and symbolic buildings in AUS are important in memorable and legible urban space (Figure 8). Mental maps of survey participants show that survey participants were able to clearly indicate the landmarks, symbolic buildings, paths and edges of AUS on the mental maps. This shows that AUS are highly legible, providing visually strong images that make the place memorable for its users. Because of most memorable landmarks which are located in Z4 and Z3, they are highly walkable zones. But, at the same time, containing short and

WALKABILITY PARAMETERS / DISTINCT ZONES	Z1	Z2	Z3	Z4
Attractiveness and convenience	-1	-1	0	+1
Safety	-1	-1	0	+1
Integration of pedestrian network with other transportation modes	+1	+1	+1	+1
Quality of street pattern	-1	0	+1	+1
Connectivity of network	0	0	+1	+1
Connection to open space systems	+1	+1	+1	+1
Quality of sidewalks and pedestrian paths	-1	-1	0	+1
Accessibility	-1	-1	0	+1
TOTAL	-3	-2	+4	+9

Qualitative categorisation of walkability capacity

+1	HIGH LEVEL OF WALKABILITY	0	MODERATE LEVEL OF WALKABILITY	-1	LOW LEVEL OF WALKABILITY

Table 9: Comparative evaluation of four zones of AUS regarding the walkability factors

direct route choices, modified-grid street pattern also generate permeable urban pattern for pedestrians, as can be noted through the mental maps of the survey participants. All in all, in terms of accessibility, Z4 is the most walkable part of the study area, followed by Z3; and Z1 and Z2 are the low walkable parts.

Conclusion

This article, using the micro-scale walkability model with eight qualitative and quantitative urban design measures, has explored and depicted the walkability level of four distinct zones of AUS in Mersin. Table 9 shows the walkability scores of four zones. This research revealed that Z4 is the most walkable and liveable part of AUS, followed by Z3, whereas Z1 and Z2 are the least walkable zones.

Historic buildings, public artworks, land-use functions, activity nodes and streetscape elements (building facades, trees, street furniture, etc.) significantly contribute to the walkability of AUS by making these public spaces interesting and enjoyable for pedestrians. Beside the visual and functional richness, the maintenance, repair and cleaning of streets need to be provided equally and sufficiently to each zone to improve walkability level of these streets. The investment in heritage conservation – whether through preservation, rehabilitation, restoration or adaptive re-use- will improve the walkability, thereby accelerating the regeneration and liveability of the historic city centre. Beside administrative, office, commercial and cultural uses, the development of high-quality tourism, entertainment and residential functions can be encouraged within the scope of 24-hour city (centre) strategy, which may also improve economic vitality and perceptual safety of this part of the city. In this sense, improving public space quality is critical. Likewise, there needs an urban design project and guidelines that will consider the eight design measures of walkability in comprehensive and integrated ways. Constructing pedestrian crossings on Z1 and Z2, identifying the number of parking areas and clearly showing parking lots on the designated parking lanes along Uray Street, introducing traffic lights, speed bumps and parking charges in the historic city centre are possible solutions for a balanced use of public space by car users and pedestrians. A high level of actual and perceived safety of AUS can be achieved by using the same types of street lighting, locating these street lambs among the same distances and ensuring that all work. To improve the accessibility and quality of sidewalks and pathways, there needs to take the following actions: improving quality of pavement, clearly delineating frontage zone, walking zone and furnishing zone on the sidewalks through pavement materials and simple design interventions, introducing disabled ramps, removing obstacles on the sidewalks, relocating street furniture, traffic signs, street lighting and other landscape elements in furnishing zone, improving aesthetics of streetscape. Public amenities and service areas (e.g. public toilettes and breastfeeding facilities), benches and canopies should be provided to ease the life of a variety of user groups on the public spaces and to protect them from hot and sunny weather conditions of Mersin. Some of these streetscape elements (e.g. canopies) can be also used to create a visual continuity through building facades.

Further, there needs a comprehensive, integrated and sustainable transport strategy that will connect the city-level transportation system with that of historic city, improve the use of public transit, and reduce the car usage in the historic city centre to achieve a liveable and sustainable city centre. This strategy also should envisage the diversification of public transit modes (i.e., metro, tram, bus and minibus), the development of an integrated transport system through the multi-modal transfer centres, the construction of metro or tram lines along the urban corridors with high density and mix uses in order to encourage the easy access of the public to the city centre via public transit modes. Besides, it needs to include the development of pedestrian walkway and bicycle route network in the city centre and within the city. Also, a variety of policies are required to reduce the car usage within the city centre, such as reorganising vehicular traffic circulation system according to one-way or two-way implementations, rising car-parking charges, increasing traffic controls in the city centre, and introducing traffic fines with high charges for illegal car-parking. It is necessary to improve the service and comfort quality of public transit modes for Mersin to encourage public transit usage, by increasing frequencies, installing air-conditioners in them.

The analysis of the Mersin case reveals that walkability is multi-dimensional, and that it is qualitatively and quantitatively measurable. A sensitive qualitative and quantitative assessment of walkability is necessary to identify the walkability level of urban space. Likewise, a comprehensive, integrated and multi-dimensional planning and design approach regarding the micro-scale (i.e., street level), meso-scale (neighbourhood level) and macro-scale (i.e., city level) is required to develop holistic and integrated urban design strategies and actions to achieve walkable, liveable and sustainable urban environments in Mersin, and other Turkish cities. Instead of a top-down and centralist approach, there needs a dynamic, flexible, human-centred and inclusive planning and design approach to address the complex problems and needs of today and future cities (de Roo and Silva, 2010; Lehnerer, 2009; Batty and Marshall, 2012). In this sense, the walkability model of this research can contribute to the decision-making process, as it provides a practical means for policy-makers, scholars and practitioners to assess and score the walkability level of space, and to identify the strengths and weaknesses of urban areas. An inclusive and human-centred approach becomes operational with this model through the inclusion of the user opinions in the walkability assessment. As shown in the case of AUS, the model has the potential to provide input for the upper-scale plans and guide urban design projects by providing the main walkability principles and design strategies. In this way, instead of following a rigid and hierarchical relationship between upper- and lower-scale plans, it is possible to establish a much more flexible approach which can provide mutual feedback and inputs between upper- and lower-scale plans.

Notes

1 This research does not include the public transportation services to the city and the user choice on public and private transport modes to access to the city centre of Mersin, due to the limited statistical data available in the archive of MMM. The statistical figures were attained

through the interviews with the urban transportation experts at the Department of City and Regional Planning in Mersin University in March 2015.

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