

Article

The Integration of Analytic Hierarchy Process and Geographic Information System Methods to Analyze Accessibility in University Campuses: The Case of Osmaniye Korkut Ata University Karacaoğlan Campus, Turkey

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Abstract

University campuses located within cities function as small-scale urban living areas and are expected to be designed to ensure easy and equitable access for all segments of society. In this context, in the first stage of the present study, the criteria identified from the literature on campus-scale accessibility were presented to experts for weighting. The weighted criteria were scored using the AHP method by an expert group across four commonly used pedestrian axes within the campus. In the second stage, a Geographic Information System (GIS)-based composite Accessibility Suitability Index (ASI) was applied across the entire campus pedestrian network. Then, this index was combined with the renormalized AHP weights. The analyses revealed that at Osmaniye Korkut Ata University, Axis 1 fell into the “medium” category, while the other three axes were classified as “low.” Improvement proposals were developed to address the deficiencies identified in the study area. These recommendations are expected to positively influence environmental factors and boost pedestrian use on the Karacaoğlan Campus of Osmaniye Korkut Ata University.

Keywords: accessibility; analytic hierarchy process (AHP); Osmaniye Korkut Ata University

1. Introduction

Accessibility is a multidimensional concept that refers to the ability of individuals—regardless of age, gender, physical ability, or sensory or cognitive differences—to safely, equally, independently, and continuously access and use spaces, services, information, and public areas [1]. In the context of sustainable and compact urban development, accessibility extends beyond the removal of physical barriers to encompass the spatial proximity of urban functions, integrated land use and transportation systems, and a reduction in time, energy, and environmental costs associated with daily activities. Accordingly, accessibility is considered a fundamental indicator of social equity, environmental sustainability, and overall urban quality of life [2]. As a result of uncontrolled growth in cities, inadequate public transportation services, and rapid increase in private car ownership, urban transformation policies that reduce sustainability and livability have led to problems in accessibility in the world and in Turkey [3]. The concept of accessibility has gained importance with the “New Urbanization Movement” that started to emerge in Turkey after 1990 [4]. Beyond this national “New Urbanization Movement”, accessibility is also a core organizing principle in



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many contemporary urban development models—such as compact city, sustainable urbanism, transit-oriented development, and the more recent “15-min city” approaches—which all aim to reduce car dependence, shorten everyday travel distances, and support walkable, human-centered urban environments. In the new urbanization trend, to solve transportation problematics, reducing the use of automobiles, encouraging public transportation, and designing walkable, pedestrian-friendly streets have come to the forefront [4–8].

The concept of accessibility, which is a component of sustainable cities, is the most important way for urbanites to be included in urban life [9–11]. The concept of accessibility is addressed with the right approach in many urban transformation projects and plays an active role in the production of livable public spaces [12]. Accessibility is defined in Law No. 5378 on Persons with Disabilities, which entered into force on 7 July 2005, as “the safe and independent accessibility and usability of buildings, open spaces, transportation and information services, and information and communication technology by people with disabilities” [13].

University campuses located within cities are considered small-scale urban living environments [14]. Depending on the functions they undertake within the urban fabric, these areas are classified into different settlement types, such as self-sufficient, expansionary (colonization), integrated with the dispersed city, and affiliated with the city [15]. These campuses are not only spaces where educational activities take place but also environments that contribute to the social and cultural development of students, academics, and university staff. Students spend a significant portion of their university life within the boundaries of the campus. In this context, campuses function not only as educational facilities but also as living spaces [16]. Therefore, they are expected to be equipped to meet students’ academic, physical, and social needs [17].

Accordingly, the proper planning of open and green spaces within university campuses is of great importance in creating a safe and high-quality living environment for both faculty members and students [18–20]. Furthermore, it is emphasized that education and recreation cannot be considered separately; recreation is seen as an integral part of education and contributes to an individual’s physical, social, and psychological development [21].

The concept of accessibility, which is directly related to the spatial characteristics and qualities of university campuses, plays an important role in meeting the needs of potential users by allowing for comfortable, easy, independent, and equitable use [22–26]. The application areas of accessibility in these campuses cover a scale that needs to be organized in a wide framework such as pedestrian roads, sidewalks, pedestrian crossings, gathering areas, parking lots, waiting areas of educational buildings, and recreation areas [27]. In this context, the continuity of each axis used intensively by pedestrians should be made effective [28–30]. The Higher Education Institution has been giving flag awards since 2018 to show the importance it attaches to this issue. Osmaniye Korkut Ata University, which achieved success by receiving one of these awards in 2022, has failed to ensure the sustainability of this success. Today, it has been determined that pedestrians face various difficulties in terms of accessibility within the campus. For these reasons, Osmaniye Korkut Ata University Karacaoğlan Campus was determined as the study area. This aimed to calculate the accessibility rates of frequently used pedestrian axes in this area. In line with the analysis, we aimed to develop design strategies/predictions that can contribute to the livability and walkability of the campus.

Accordingly, this study has three main aims: (i) to evaluate the accessibility levels of frequently used pedestrian axes within the Osmaniye Korkut Ata University Karacaoğlan Campus using an expert-based Analytic Hierarchy Process (AHP); (ii) to operationalize these criteria in a Geographical Information System (GIS) environment in order to produce a

segment-level Accessibility Suitability Index (ASI) for the campus pedestrian network; and (iii) to translate the combined AHP–GIS findings into design strategies that can improve the livability and walkability of the campus. This paper is structured as follows: Section 2 presents the study area, data sources, and methodological framework; Section 3 reports the AHP-based accessibility assessment of the four axes; Section 4 introduces the GIS-Based Spatial Multi-Criteria Accessibility analysis and the construction of the ASI; Section 5 presents the integrated findings from the AHP and GIS; Section 6 discusses these results in relation to universal design and campus planning research; and Section 7 concludes with key implications and recommendations for campus design and management.

2. Materials and Methods

This study employs a hybrid multi-criteria workflow, integrating expert evaluation with GIS-based network analysis to assess pedestrian accessibility on the Karacaoğlan Campus of Osmaniye Korkut Ata University (Figure 1). First, a campus-scale accessibility framework and a set of criteria were derived from the extant literature and pertinent regulations. These criteria were then weighted using the AHP with input from an expert panel. Secondly, the weighted criteria were employed to evaluate four heavily trafficked pedestrian axes on the campus. Concurrently, a comprehensive GIS database and pedestrian network were developed. From these databases, a series of segment-level indicators were derived, including travel time, proximity to crossings, slope, and green/shade conditions. These indicators were then standardized, amalgamated with the AHP weights, and aggregated into a composite ASI for the entire campus network. Finally, ASI values were summarized for the four axes and interpreted in conjunction with expert scores to identify critical segments and design priorities.

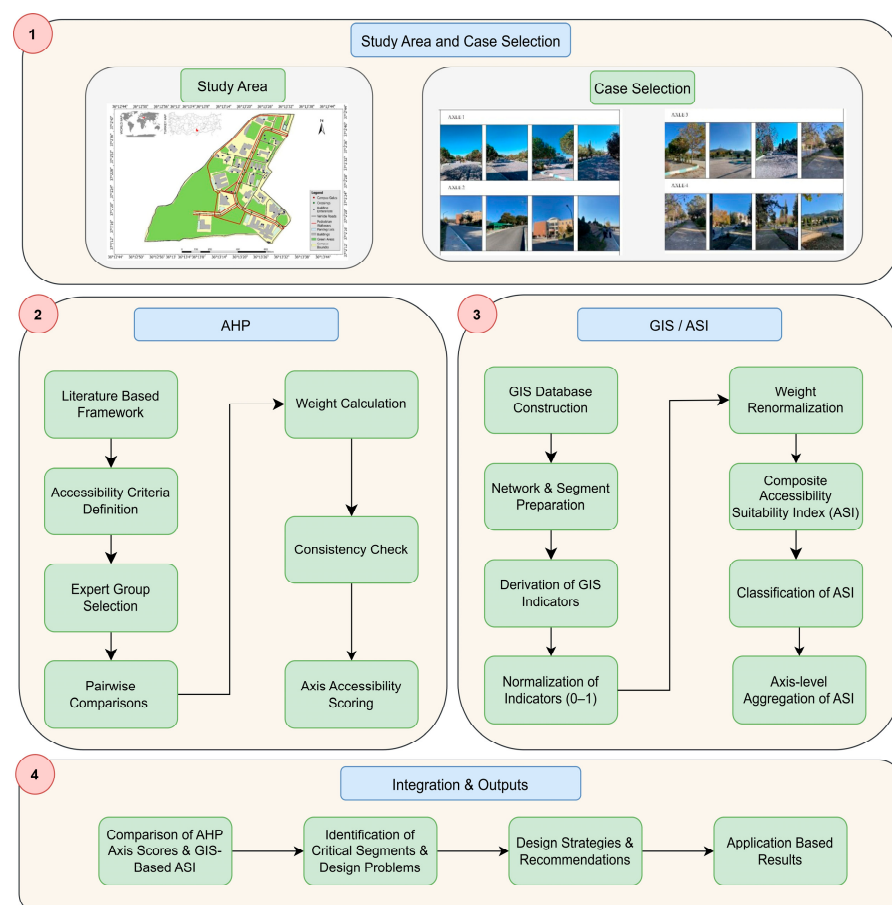


Figure 1. Workflow of AHP–GIS-based accessibility assessment for Karacaoğlan Campus.

The workflow combines expert-based AHP weighting with GIS-based network analysis. Literature-derived accessibility criteria are weighted by experts and applied to four main pedestrian axes, while a parallel GIS workflow computes segment-level indicators and a composite ASI. Axis-level ASI summaries are then compared with expert scores to identify critical segments and propose design interventions.

2.1. Material

The object of the study consists of Osmaniye Korkut Ata University Karacaoğlan Campus, located in Fakiuşağı District in Osmaniye city center (Figure 2). Founded in 1976, Osmaniye Korkut Ata University Karacaoğlan Campus, which was selected as the study area, has a flat ground structure and a population of 12,345 people as of 2021. Osmaniye Korkut Ata University is a living space with 7 faculties (Faculty of Science and Letters, Faculty of Economics and Administrative Sciences, Faculty of Theology, Kadirli Faculty of Social and Human Sciences, Faculty of Architecture, Design and Fine Arts, Faculty of Engineering, Faculty of Health Sciences), 2 institutes (Institute of Science, Institute of Social Sciences), 2 schools (School of Physical Education and Sports, School of Foreign Languages), and 15 July Martyr amphitheatres, libraries, and health centers [31].



Figure 2. The location of Osmaniye Korkut Ata University Karacaoğlan Campus.

2.2. Method

Within the scope of this study, qualitative and quantitative research techniques were used together. In terms of quantitative data, the accessibility of frequently used axes at Osmaniye Korkut Ata University Karacaoğlan Campus was tested using the AHP developed by Thomas Saaty and the GIS method. Direct observations and morphological examinations were carried out in the sample area and photographs were taken. Within the scope of quantitative data collection, the accessibility of frequently used axes in Osmaniye

Korkut Ata University Karacaoğlan Campus was tested with the AHP method developed by Thomas Saaty. Within the scope of the AHP analysis, the criteria weighted by the experts were tested on four main axes with intensive use on the Osmaniye Korkut Ata University Karacaoğlan Campus, aiming to measure and evaluate the accessibility level of each axis.

This study integrates a GIS dataset compiled from campus digitization and open sources. Vector layers include campus boundary, building footprints, building entrances, campus gates, pedestrian walkways, vehicle roads, pedestrian crossings, parking lots, and green areas; a DEM derived from SRTM provides slope. Although SRTM (30 m) is coarse for campus-scale micro-gradients, we retained it as a terrain proxy in the absence of a higher-resolution DEM and a ramp inventory, mitigating coarseness by sampling along pedestrian centerlines and applying short-moving-window smoothing. Accordingly, slope-driven low-accessibility hotspots are interpreted as screening zones for on-site verification rather than precise micro-ramp diagnostics. Slopes are then classified according to universal design thresholds ($\leq 5\%$, $5\text{--}8\%$, $>8\%$) to support interpretable, policy-aligned mapping. All features were topologically cleaned and snapped; linework represents centerlines of walk/road facilities. The spatial reference is WGS84/UTM Zone 37N; analyses were run in ArcGIS Pro 3.5.4.

Using the GIS method to examine problems on these axes in greater detail, we operationalized a compact set of GIS-measurable “GIS analysis criteria”—limited to indicators that can be derived without additional field audits and explained in full in the subsequent GIS sections. Specifically, we computed the following: (i) isochrone proximity (best 2/5/10 min service area band toward gates/entrances); (ii) network connectivity (OD minutes) from segment midpoints to the nearest gate/entrance; (iii) nearest crossing distance to marked pedestrian crossings; (iv) mean slope within a 5 m buffer around each segment; and (v) green/shade ratio within a 15 m buffer (green area overlap divided by buffer area). Indicators were normalized to [0, 1] (cost-type variables inverted using robust percentiles) and then aggregated with the expert AHP weights—renormalized over the implemented subset—to produce a segment-level ASI for the campus. Within this multi-criteria framework, OD travel time is treated as one indicator of network impedance among several spatial dimensions, rather than as the sole outcome of the GIS analysis.

In the spatial composite, five of the expert criteria were therefore operationalized: the existence and adequacy of pedestrian crossings, uninterrupted access to gates and assembly areas, connectivity to alternative routes, slope, and shade/planting. The “continuity” criterion, while conceptually central, is treated as an emergent property of these components and remains in the AHP-based axis assessment rather than being added as a separate GIS layer. This is done in order to avoid double-counting its effects within the composite index.

3. AHP Analysis

In the first stage of the method, evaluation criteria for university campuses and the importance levels of these criteria were determined. The AHP, a multi-criteria decision-making method, was used to determine the importance weights of the criteria. Developed by Professor Thomas L. Saaty, the AHP is a decision-making method used to solve problems involving multiple criteria. This method is used in multi-criteria, multi-objective decision-making when choosing among a large number of alternatives in a situation of certainty or uncertainty [32].

3.1. Determination of AHP Criteria

In the initial phase of the Analytic Hierarchy Process, the evaluation criteria within the scope of accessibility were identified through a comprehensive literature review, particularly drawing on the works of [16,27,33–62]. Building on Brusilovsky’s definition, which frames accessibility as enabling each user to reach information in accordance with their individual needs, knowledge level, and goals, this study conceptualizes accessibility as a multidimensional notion that extends beyond the elimination of physical barriers to include safe, continuous, perceptible, and equitable access to spaces [63]. Accordingly, accessibility is examined through three main subcategories: physical accessibility, cognitive/perceptual accessibility, and environmental–climatic accessibility. Physical accessibility refers to the spatial and structural conditions that enable individuals to use pedestrian routes safely and without interruption. In this context, safety, connection to alternative routes, the existence and adequacy of pedestrian crossings, the continuity of pedestrian paths, the existence and continuity of pavements, pavement width, the existence of ramps, the slope and width of ramps, uninterrupted access to assembly areas and stops, and lighting elements are considered the main components of physical accessibility [64].

Cognitive (perceptual) accessibility is related to individuals’ ability to easily perceive the environment, find their way, and move safely within it. Accordingly, direction and signage elements, the legibility of ground covering materials, and tactile surfaces and warning/guidance tiles for the visually impaired are evaluated as criteria that enhance spatial perception and support cognitive accessibility [65,66].

Environmental and climatic accessibility, on the other hand, refers to the comfortable and sustainable use of pedestrian routes under varying climatic conditions. The shading effect provided by planting and the evaluation of planting in terms of visual quality are considered elements that support the continuity of pedestrian movement—particularly in hot climatic conditions—and indirectly strengthen accessibility [67].

In Turkey, the main legal basis for the specific regulations on accessibility currently in force is Law No. 5378 on Persons with Disabilities. This law mandates that persons with disabilities and older adults must be able to access public buildings, open spaces, transportation systems, and services safely and independently [68].

Within this framework, based on the applicable regulations, the literature, and expert opinions, a total of fifteen accessibility-related evaluation criteria were adopted in this study (Table 1).

Table 1. Accessibility criteria.

Criteria	Score
1. Safety	3-2-1-0
Approaches to ensure safe access for pedestrians should be determined, and areas suitable for 24 h use should be designed [33].	
2. Connectivity to Alternative Routes	3-2-1-0
The ability of pedestrians to reach their destination safely is associated with the connectivity of the physical space [68]. For pedestrians and multiple groups, having continuous (uninterrupted) alternative routes between destinations is important for accessibility [69,70].	
3. Existence and Adequacy of Pedestrian Crossings	3-2-1-0
Pedestrian crossings should be used on roads with heavy vehicle traffic.	

Table 1. Cont.

Criteria	Score
4. Continuity on Pedestrian Roads	3-2-1-0
Pedestrian roads should be accessible from the garden entrance to the unit entrance [22,71].	
5. Existence and Continuity of the Pavement	3-2-1-0
In areas with vehicle entrances and exits, pavements should be designed so that pedestrians can walk safely, and uninterrupted connections to assembly areas and structures should be provided [35].	
6. Width of the pavement	3-2-1-0
Pavement widths should be wide enough for assistive vehicles and wheelchair users to pass. For visually impaired individuals, space-defining, limiting architectural and natural elements should be taken into consideration [22,71].	
7. Existence and Adequacy of Ramps	3-2-1-0
In order to ensure that individuals do not have difficulty in overcoming code differences, these roads should be given slopes that allow them to move comfortably [46].	
8. Slope and Width of Ramps	3-2-1-0
Ramps should be of appropriate slope and width and there should be railings on both sides [72].	
9. Lighting Elements	3-2-1-0
Lighting elements are important for pedestrians to perform their walking activities safely [39–43].	
10. Uninterrupted Access to Assembly Areas and Stops	3-2-1-0
Within the scope of pedestrian access, uninterrupted access to public transportation areas in the region should be provided [73–75].	
11. Shade Effect with Climate/Planting	3-2-1-0
The climate of the region must be taken into consideration within the scope of accessibility for pedestrians. Especially in the summer months, shaded areas should be created to protect pedestrians from the burning effect of the sun, and covered walkways should be created to protect them from the effects of precipitation in the winter months [76–80].	
12. Planting in terms of visual quality	3-2-1-0
Aesthetic elements are also important factors in determining the pedestrian route. Pedestrians prefer to walk routes that appeal to them aesthetically [81–85].	
13. Direction and Signs	3-2-1-0
There are easily perceivable boards that help individuals find the direction they need to follow to reach their intended destination [86].	
14. Ground Covering Material of Pedestrian Roads and Pavements	3-2-1-0
The joints in the material used on the ground should be kept wide enough to not hinder wheelchair or cane users [87,88].	
15. Tactile Surface/Guidance and Warning Tiles for the Visually Impaired	3-2-1-0
Areas within the campus should be designed to be open and accessible to everyone [89,90].	

3.2. Creation of Pairwise Comparison Matrix

After determining the hierarchical structure of the criteria in this study, a non-dimensional pairwise comparison matrix of the criteria was created. In selecting the expert group, priority was given to individuals who frequently visit the campus environment. This criterion is important in that it enables experts, as direct users of the area, to more accurately and comprehensively analyze the problems and needs of the site. The expert group consists of eight architects working in the private sector and public institutions and organizations, as well as five academics from the fields of architecture and landscape architecture and two landscape architects employed at Osmaniye Korkut Ata University. The expert group determined the degree of importance between the criteria based on the 1–9 scale developed by Thomas Saaty and given in Table 2.

Table 2. AHP pairwise comparison scale [32].

Significance Values	Value Definitions
1	Equally significant
3	A little more significant
5	Strongly significant
7	Very strongly significant
9	Extremely significant
2, 4, 6, 8	Intermediate values

In this regard, 15 questions were posed to the experts and they were asked to rank the criteria in terms of their efficacy in creating accessibility on pedestrian routes by scoring their dominant aspects relative to each other. Interviews with experts were conducted face-to-face and online. The final matrix was created by taking the geometric mean of the answers in line with expert opinions.

The matrix is normalized by dividing each value in the final matrix by the sum of its column. The sum of the values in each column of the resulting normalized matrix should be 1. The weight vector w (priority vector) is obtained by taking the arithmetic mean of the values in each row of the normalized matrix [32].

3.3. Calculation of Consistency Ratio

Whether the values in the matrix are consistent or not is checked by determining the consistency ratio. In order to calculate the consistency ratio (CR), the number of criteria is compared with the coefficient λ called the eigenvalue. The formula developed by Saaty is used to calculate the consistency of the comparison matrix. The formula is as follows: $CR = CI/RI$. In the formula, CR is the consistency ratio, CI is the consistency indicator, and R is a

random index. $CI = \frac{(\lambda_{max} - n)}{n - 1}$, $\lambda_{max} = \frac{\sum_{j=1}^n a_{ij} * w_j}{w_i}$. RI value is 1.59 for 15 criteria [91].

As seen in Table 3, since $CR = 0.065 < 0.10$, it was determined that the procedures performed were at an acceptable level.

When the weight scores of accessibility criteria were evaluated in line with expert opinions and the AHP method, the existence and adequacy of ramps in the area were determined as the most important criterion, with 0.087 points. Additionally, as seen in Table 3 the existence and continuity of the pavement was found as the second most important criterion (0.083), and the existence and adequacy of pedestrian crossings and the continuity of pedestrian paths were found as the joint third most important criterion with a value of 0.076.

Table 3. Weight scores and consistency ratio of accessibility criteria according to expert opinions.

Criteria		Eigenvector		Eigenvalue
1	Safety	0.072	7.2%	1.6
2	Connection to Alternative Routes	0.055	5.5%	1.0
3	Existence and Adequacy of Pedestrian Crossings	0.076	7.6%	1.9
4	Continuity in Pedestrian Roads	0.076	7.6%	2.1
5	Existence and Continuity of Pavement	0.083	8.3%	2.3
6	Width of Pavement	0.068	6.8%	1.6
7	Existence and Adequacy of Ramps	0.087	8.7%	2.4
8	Slope and Width of Ramps	0.066	6.6%	1.3
9	Lighting Elements	0.039	3.9%	0.5
10	Uninterrupted Access to Assembly Areas and Stops	0.070	7%	1.6
11	Shade Effect with Climate/Planting	0.065	6.5%	1.4
12	Planting in terms of Visual Quality	0.053	5.3%	0.9
13	Direction and Signs	0.069	6.9%	1.5
14	Ground Covering Material of Pedestrian Roads and Pavements	0.048	4.8%	0.7
15	Tactile Surface/Guidance and Warning Tiles for the Visually Impaired	0.072	7.2%	1.7
		$\lambda_{\max} = 21.8$	CI = 0.103	CR = 0.065

In the second part of the AHP, the 15 criteria determined within the scope of first part were tested on four axes with intensive use in Osmaniye Korkut Ata University Karacaoğlan Campus, aiming to measure and evaluate the accessibility level of each axis. In this study, the route between the two main entrance gates of the university was determined as axis 1, between this axis and the Faculty of Science and Letters as axis 2, between axis 1 and the health center building used by students, academics, and university employees as axis 3, and between axis 1 and the Faculty of Theology as axis 4 (Figure 3).

In this regard, this study aims to re-evaluate these frequently used axes by determining their usability level for pedestrian access.

In order to measure the suitability of the selected axes for pedestrians, the criteria given in Table 2 were evaluated separately by the experts. The experts evaluated the four axes within the scope of the scale (3-2-1-0) given in Table 4, and Table 5 was created by taking the arithmetic mean of the expert evaluations. These values were multiplied by the eigenvector determined in accordance with the AHP and the total scores of the four axes were obtained.

According to the results of the weighting by the experts, the area between the two entrance gates of Osmaniye Korkut Ata University, called axis 1, received the highest score in terms of safety, the existence and continuity of pavement, the width of pavement, climate/planting and shade effect, and visual quality. Axis 1 and axis 2 scored equal points for the criteria of connection to alternative routes, lighting elements, and the continuity of pedestrian roads, while axis 2 (between axis 1 and Faculty of Science and Letters) scored the highest for the criteria of the continuity of pedestrian paths, the existence and adequacy of ramps, the slope and width of ramps, and signboards and directional signs. Axis 2 and axis 3 (between axis 1 and the health center building) scored equal points for the criterion of ground covering material of pedestrian roads and pavements, while the criterion of

the existence and adequacy of pedestrian crossings received the highest value for axis 3. Experts did not give the highest score to axis 4 (between axis 1 and the Faculty of Theology) for any criterion.



Figure 3. Selected axes (Axle 1 blue, Axle 2 yellow, Axle 3 red and Axle 4 green) in study area.

Table 4. Accessibility evaluation of Osmaniye Korkut Ata University Karacaoğlu Campus routes.

Score Class	Suitability Class
3	High
2	Medium
1	Low
0	None

Table 5. Osmaniye Korkut Ata University accessibility scores.

Criteria	Eigenvector	Scores			
		Axis 1	Axis 2	Axis 3	Axis 4
1. Safety	0.072	2.4	1.8	1.33	1.33
		0.17	0.12	0.09	0.09
The maximum value that the safety criterion can take: 0.216					
2. Connection to Alternative Routes	0.055	2.33	2.2	1.66	1.93
		0.12	0.12	0.09	0.10
The maximum value of the criterion for connectivity to alternative routes: 0.15					
3. Existence and Adequacy of Pedestrian Crossings	0.076	1.26	0.93	1.66	1.26

Table 5. Cont.

Criteria	Eigenvector	Scores			
		Axis 1	Axis 2	Axis 3	Axis 4
		0.09	0.07	0.12	0.09
The maximum value of the criterion for the existence and adequacy of pedestrian crossings: 0.22					
4. Continuity in Pedestrian Roads	0.076	2.26	2.33	2	1.86
		0.17	0.17	0.15	0.14
The maximum value of the continuity criterion for pedestrian roads: 0.22					
5. Existence and Continuity of Pavement	0.083	2.4	2.13	2	1.6
		0.19	0.17	0.16	0.13
The maximum value of the criterion for the existence and continuity of the pavement: 0.24					
6. Width of Pavement	0.068	2.26	1.93	2.06	1.8
		0.15	0.13	0.14	0.12
The maximum value that the width of the pavement criterion can take: 0.20					
7. Existence and Adequacy of Ramps	0.087	1.73	1.86	1.53	1.53
		0.15	0.16	0.13	0.13
The maximum value of the criterion for the existence and adequacy of ramps: 0.26					
8. Slope and Width of Ramps	0.066	1.66	1.93	1.53	1.46
		0.10	0.12	0.10	0.09
The maximum value of the slope and width of the ramps: 0.19					
9. Lighting Elements	0.039	2.13	2.26	1.86	1.8
		0.08	0.08	0.07	0.07
The maximum value that the criterion for the existence of lighting elements can take: 0.11					
10. Uninterrupted Access to Assembly Areas and Stops	0.070	1.6	1.93	1.73	1.53
		0.11	0.13	0.12	0.10
The maximum value that the criterion of uninterrupted access to assembly areas and stops can take: 0.21					
11. Shade Effect with Climate/Planting	0.065	2.8	2.26	2.13	2.4
		0.18	0.14	0.13	0.15
The maximum value that the criterion shade effect with climate/infrastructure can take: 0.19					
12. Planting in terms of Visual Quality	0.053	3	2.53	2.4	2.8
		0.15	0.13	0.12	0.14
The maximum value that the planting criterion can take in terms of visual quality: 0.15					
13. Direction and Signs	0.069	1.8	2.13	1.93	2.26
		0.12	0.14	0.13	0.15
The maximum value that the signboards and directional signs criterion can take: 0.20					
14. Ground Covering Material of Pedestrian Roads and Pavements	0.048	1	1.26	1.26	1.2
		0.04	0.06	0.06	0.05
The maximum value of the criterion ground covering material of pedestrian roads and pavements: 0.14					
15. Tactile Surface/Guidance and Warning Tiles for the Visually Impaired	0.072	1.53	1.73	1.66	1.6

Table 5. Cont.

Criteria	Eigenvector	Scores			
		Axis 1	Axis 2	Axis 3	Axis 4
		0.11	0.12	0.11	0.11
The maximum value that the criterion tactile surface/guidance and directional indicators for the visually impaired can take: 0.21.					
TOTAL		2.00	1.93	1.78	1.73

As a result of the evaluations made within the scope of accessibility in Osmaniye Korkut Ata University Karacaoğlan Campus, axis 1 received the highest score with 2.00 and axis 4 received the lowest score. Within the scope of the scale given in Table 6, no axis could be classified as high. Axis 1 was classified as medium (between 2–1) with a score of 2.00, while axes 2 (1.93), 3 (1.78), and 4 (1.73) were classified as low in terms of accessibility.

Table 6. Accessibility evaluation scale.

Score	Evaluation
In the range of 3–2 (not including 2)	High
In the range of 2–1 (not including 1)	Medium
In the range of 1–0	Low

4. GIS-Based Spatial Multi-Criteria Accessibility

A campus geodatabase was compiled comprising campus boundary, building footprints and building entrances, pedestrian walkway centerlines, vehicular roads, pedestrian crossings, parking lots, green areas, and a 30 m SRTM-derived DEM. All layers were digitized or compiled in a common projected coordinate system (WGS84/UTM; 37N zone for Osmaniye), topologically cleaned (snapping, removal of overlaps and dangles where applicable), and stored in a single file geodatabase. Pedestrian walkways were segmented at ~10 m to form the edge set E of a network dataset in ArcGIS Pro 3.5.4. For each edge $e \in E$, geometric length L_e (m) was calculated and converted to walking time

$$T_e = \frac{L_e}{v} \text{ (min)}, v = 72 \text{ m min}^{-1} (\sim 1.2 \text{ m s}^{-1}) \quad (1)$$

which served as the network impedance (“Minutes”) for subsequent analyses.

From the available inventory, AHP criteria that can be observed/reliably proxied in the GIS were transformed into raw spatial indicators $x_i(e)$ for each segment e . Directionality is noted as benefit ($\uparrow$) or cost ($\downarrow$).

(C1) Gate/entrance accessibility ($\uparrow$)

A service area analysis was performed on the network dataset using building entrances and campus gates as facilities. Let τ_e denote the network travel time from the midpoint of e to the nearest facility. This was mapped to a categorical benefit score (isochrone-consistent):

$$x_{iso}(e) = \begin{cases} 1.0, & \tau_e \leq 2 \text{ min} \\ 0.6, & 2 < \tau_e \leq 5 \text{ min} \\ 0.3, & 5 < \tau_e \leq 10 \text{ min} \\ 0.1, & \tau_e > 10 \text{ min} \end{cases} \quad (2)$$

(C2) Crossing accessibility ($\downarrow$ as distance).

Using the Near tool, the Euclidean distance from each segment to the nearest marked (or proxy) crossing point was computed:

$$x_{cross}(e) = \min_{c \in C} d(e, c)(m) \quad (3)$$

(C3) *Connectivity/alternative-route potential* ($\uparrow$)

An OD Cost Matrix on the network dataset estimated shortest-path times from vertices on/near e to key destinations (gates + entrances). Let τ_e be the mean of these times for nodes associated with e ; connectivity was treated as a benefit by inversion:

$$x_{con}(e) = -\tau_e \quad (4)$$

(C4) *Topographic barrier—slope* ($\downarrow$)

The SRTM DEM was projected and clipped to the campus boundary; slope (percent rise) was derived and summarized as the mean within a 5 m buffer around e :

$$x_{slope}(e) = \overline{Slope\%}(buffer_{5m}(e)) \quad (5)$$

(C5) *Green/shade comfort* ($\uparrow$)

The proportion of green area within a 15 m buffer around each segment was calculated as follows:

$$x_{green}(e) = \frac{Area(Green \cap buffer_{15m}(e))}{Area(buffer_{15m}(e))} \in [0, 1] \quad (6)$$

Inventory-dependent criteria without reliable spatial representation at this stage (e.g., lighting density, tactile paving, detailed pavement materials) were retained in expert axis evaluation but excluded from the spatial composite.

Indicators were rescaled to the unit interval to enable aggregation while preserving directionality, using robust bounds (5–95th percentile) to limit outlier influence, for a benefit-type criterion:

$$r_i(e) = \frac{x_i(e) - \underline{x}_i}{\bar{x}_i - \underline{x}_i} \quad (7)$$

and for a cost-type criterion:

$$r_i(e) = \frac{\bar{x}_i - x_i(e)}{\bar{x}_i - \underline{x}_i} \quad (8)$$

where $\underline{x}_i$ and $\bar{x}_i$ denote the chosen lower/upper bounds. Binary continuity already lies in $[0, 1]$. As a policy-aligned alternative, slope can be piece-wise mapped to accessibility thresholds.

4.1. Weighted Aggregation: Accessibility Suitability Index

Let w_i denote the original AHP eigenvector weights for criterion i . Because not all criteria were spatially observable, weights were renormalized over the included subset I :

$$w'_i = \frac{w_i}{\sum_{j \in I} w_j}, \sum_{i \in I} w'_i \quad (9)$$

The composite accessibility score for segment e is given by a weighted linear combination:

$$S(e) = \sum_{i \in I} w'_i r_i(e) \quad (10)$$

For interpretability, S was classified into four ordinal levels: very low ($S < 0.40$), low ($0.40 \leq S < 0.55$), moderate ($0.55 \leq S < 0.70$), and high ($S \geq 0.70$). Here, a criterion

is represented by a proxy rather than audited inventory, an optional confidence factor $c_i \in [0, 1]$ can be reported and applied multiplicatively to produce $S^*(e) = S(e) \sum_{i \in I} w'_i c_i$.

To align with the second part of the method, the four intensively used axes were buffered (10 m) and overlaid with the segment-level ASI. For each axis a , the mean $\bar{S}_a$ and the mean network time to the nearest facility were extracted. Agreement between expert-derived axis rankings and GIS-derived $\{\bar{S}_a\}$ was assessed using Spearman's rank correlation ρ . Discrepancies were interpreted as candidates for targeted design interventions.

All operations were performed in ArcGIS Pro 3.5.4. Key tools included Create Network Dataset, Service Area, OD Cost Matrix, Near, Topology (Must Not Have Dangles), Buffer, Intersect, Spatial Join, Slope, and Zonal Statistics as Table. Parameters were segment length ≈ 10 m; buffers of 5 m (slope) and 15 m (green); service area cut-offs of 2/5/10 min; walking speed $v = 72 \text{ m min}^{-1}$. Detailed criterion-to-layer mappings, normalization bounds, and weight renormalization factors are provided in a Table 7 to ensure full reproducibility.

Table 7. Mapping of expert criteria to GIS indicators and weights used in spatial composite.

AHP	Criterion (Survey)	GIS Indicator and Justification	Direction	Original Weight (w_i)	Renormalized (w'_i)
C10	Uninterrupted access to gates/assembly	Isochrone score to nearest gate/entrance (2/5/10 min classes). Reachability under network constraints.	Benefit	0.07	0.211
C3	Existence and adequacy of crossings	Nearest crossing distance min d(e, c). Shorter distance lowers vehicle conflict.	Cost	0.076	0.229
C2	Connectivity to alternative routes	Mean OD travel time to gates + entrances (inverted). Captures embeddedness and route choice.	Benefit	0.055	0.166
C8	Slope and width of ramps (slope component)	Mean slope % in 5 m buffer. Steeper segments reduce accessibility.	Cost	0.066	0.199
C11	Shade effect with climate/planting	Green ratio in 15 m buffer. Canopy/planting improve thermal comfort/appeal.	Benefit	0.065	0.195

4.2. Mapping AHP Criteria to GIS Indicators and Weight Treatment

In order to integrate expert priorities into a spatially explicit accessibility model, the survey criteria were mapped to observable GIS indicators. However, this was only performed in cases where construct validity and measurement reliability could be assured from the available datasets. These datasets included walkway centerlines, campus gates and building entrances, marked crossings, green areas, parking lots, and an SRTM-derived DEM. Six criteria have been identified as sufficient to satisfy these conditions: isochrone-based access to gates/entrances, proximity to crossings, network connectivity to destinations, slope as a topographic barrier, and green/shade comfort. These constructs have well-established theoretical links to pedestrian accessibility. Specifically, connectivity and isochrones represent reachability under network constraints, slope affects universal design thresholds, and green/shade improves thermal comfort and route appeal. These constructs can be computed with transparent GIS operations.

Criteria contingent upon inventory—for instance, lighting density, tactile paving, pavement material/width, and detailed ramp geometry—were excluded from the spatial composite due to the unavailability of audited field inventories. The exclusive reliance on well-measured constructs is instrumental in averting the introduction of uncontrolled error or proxy bias. These excluded criteria remain integral to the expert axis evaluation reported elsewhere in the manuscript and can be incorporated into the spatial composite in future work when audited layers become available. Table 7 reports the criterion-to-indicator

mapping, normalization rules, and both the original survey weights and the renormalized subset weights applied in the spatial model.

The spatial composite intentionally includes only those survey constructs that can be measured validly and reliably from the available GIS layers—walkway centerlines, gates/entrances, marked crossings, green areas, parking lots, and an SRTM-derived DEM—at the segment scale of the pedestrian network. Accordingly, six criteria were operationalized: (i) isochrone-based access to gates/entrances, representing practical reachability under network constraints (2/5/10 min bands); (ii) proximity to crossings, a segment-level proxy for exposure to vehicular conflict; (iii) connectivity to destinations, via inverted mean OD travel time that reflects embeddedness and route choice; (iv) slope, as a topographic barrier pertinent to universal design thresholds; and (v) green/shade, the share of adjacent green area as a reproducible proxy for thermal comfort and walk appeal. Each indicator is transparent to compute, policy-interpretable, and non-redundant (e.g., connectivity captures network structure while isochrones capture facility proximity), thereby minimizing construct overlap and MAUP effects.

Conversely, criteria that depend on audited inventories—lighting density (C9), tactile surfaces (C15), pavement material/width (C14, C6), ramp geometry beyond slope (C7, C8-width), direction/signage (C13), and a robust safety construct (C1; beyond crude parking-interface proxies)—were excluded from the spatial composite to avoid proxy bias and threats to construct validity. All indicators are normalized with robust min–max (p5–p95) and aggregated using the renormalized AHP weights reported in Table 5; sensitivity checks are recommended to verify that low/very low ASI classifications and axis rank orders are stable against reasonable weight uncertainty. When audited layers become available, the framework is extensible: new indicators can be incorporated with the same normalization and aggregation scheme, and weights can be re-normalized to preserve expert priorities.

5. Results

As a result of the AHP weightings and expert evaluations, in the accessibility analysis conducted at Osmaniye Korkut Ata University Karacaoğlan Campus, axis 1 received the highest score with 2.00, while axis 4 obtained the lowest score. Within the scale presented in Table 7, none of the axes could be classified as high. Axis 1 was evaluated as medium (within the 2–1 range) with a score of 2.00, whereas axes 2 (1.93), 3 (1.78), and 4 (1.73) were classified as low in terms of accessibility. The GIS model is capable of calculating the ASI for all pedestrian segments across the campus. However, for the purpose of comparison with the expert-based AHP assessment, four predefined axes have been retained as aggregate reporting units. Specifically, the ASI at the segment level within each axis is summarized using the length-weighted average 10th-percentile ASI (to reflect the worst conditions) and the proportion of segments classified as low/very low ($S < 0.55$). This approach preserves the fine spatial variation necessary for intervention targeting while providing axis-level statistics directly comparable to expert assessments. When this is applied, axis 1 has the highest length-weighted average ASI and the lowest low/very low segment ratio, while axis 4 has the lowest average and the highest deficiency ratio. This is generally consistent with the expert ranking reported above.

This section presents the network-based ASI that was computed for pedestrian segments across the Karacaoğlan Campus. The ASI values were derived by aggregating five spatial indicators: isochrone-based access to gates/entrances, proximity to crossings, connectivity (OD travel time), slope, and adjacent green/shade. These values were normalized to [0, 1] and combined using the renormalized AHP weights established in the Methods Section. The segment-level ASI was classified into four interpretive levels; the scale ranges

from very low ($S < 0.40$), low ($0.40 \leq S < 0.55$), and moderate ($0.55 \leq S < 0.70$) to high ($S \geq 0.70$) (Figure 4). To facilitate a comparison with expert judgments, the mean ASI was also summarized for the four axes that had previously been defined and intensively used. This dual reporting method enables the examination of spatial patterns of accessibility at a fine scale while assessing consistency with expert-derived axis scores. The direct causal relationship between the criteria and travel time is not modeled; rather, each spatial indicator contributes independently to the composite ASI according to its weight. Consequently, segments with low accessibility emerge where several disadvantages co-occur, such as longer travel times, greater crossing distances, steeper slopes, and limited shade.



Figure 4. ASI for campus pedestrian segments. Segment scores (0–1) are classified as very low, low, moderate, and high. Symbols indicate campus gates (red), marked crossings (yellow), and building entrances (blue). Base layers include buildings, parking lots, vehicle roads, green areas, and campus boundary; analysis units are network segments, not polygons.

The initial phase of the study involved the derivation of five segment-level accessibility indicators from the GIS dataset that was compiled for the Karacaoğlan Campus. The computation of isochrone proximity was derived from network service area polygons (2/5/10 min bands, travel toward facilities), with each walkway segment receiving the optimal band it intersected. The second issue that was examined pertained to network connectivity. This was measured in terms of the minimum OD travel time (in minutes) from each segment midpoint to the nearest campus gate or building entrance on the pedestrian network. The third method of analysis involved the use of crossing proximity, which entailed the implementation of the Near analysis to record the distance from each segment to the closest marked pedestrian crossing. The calculation of slope exposure entailed the determination of the mean percent slope from SRTM-derived terrain within a 5 m

buffer around each segment. The concept of micro-climatic comfort (green/shade) was operationalized through the calculation of the ratio of green area overlap within a 15 m buffer to the buffer area. This ratio captured tree belts, planted strips, and pocket greens along the designated path.

Given the heterogeneity of the indicators, a common 0–1 scale was employed for normalization prior to aggregation. Cost-type variables (OD minutes, crossing distance, mean slope) were transformed into benefits using robust percentile mapping (values $\leq P5 \rightarrow 1$, $\geq P95 \rightarrow 0$, linear in between). Benefit-type variables (isochrone band score and green ratio) were scaled in the standard direction ($P5 \rightarrow 0$, $P95 \rightarrow 1$). The normalized indicators were then combined into the ASI using the AHP-derived weights.

This analysis provides a visual representation of the ASI at the scale of the pedestrian segment. Warm colors (red–orange) indicate segments with compounded deficits—typically where walkway continuity is interrupted, slopes exceed universal design thresholds, crossings are distant, and facilities are not reachable within the 2/5/10 min isochrones. It has been determined that cooler colors (yellow–green) correspond to segments that are continuous, gently sloped, shaded/green-adjacent, and well connected to building entrances and campus gates. The map emphasizes the presence of contiguous “corridors” of moderate–high ASI, which function as conduits for pedestrian mobility. These corridors are interspersed with localized very low/low pockets, frequently situated in proximity to long peripheral links, steep approaches, or vehicular conflict points. At the scale of the axis, the spatial pattern generally corroborates the expert ranking (axis 1 performing best), while segments with a poor ASI flag targeted design actions such as adding or relocating crossings, repairing discontinuities, moderating slopes or ramps, and enhancing shade and wayfinding.

6. Discussion

As a result of the AHP analysis conducted within the scope of this study, the most important criteria according to expert weightings were determined to be the existence and adequacy of ramps, the existence and adequacy of pedestrian crossings, and the continuity of pedestrian roads. The prominence of these criteria among the key measures is also consistent with findings in the literature [86–93].

For the existence and adequacy of ramps, one of the criteria assigned high weights by the experts, the expected score at OKU Karacaoğlan Campus was determined as 0.26. However, it was observed that the four axes evaluated in this study are insufficient in this regard. The interruption of ramp continuity specifically observed on axis 4 during the fieldwork supports the expert opinions, and this situation is considered a significant deficiency in terms of accessibility for people with disabilities (Figure 5). In the context of universal design, longitudinal slopes up to 5% ($\approx 1:20$) are generally regarded as barrier-free walking surfaces, while slopes in the 5–8% range correspond to typical ramp gradients that are acceptable only for relatively short runs with intermediate landings; slopes steeper than 8% usually exceed recommended ramp standards for wheelchair users. GIS findings confirmed the expert assessment by using the slope indicator as a spatial proxy in conditions where ramp adequacy could not be directly measured: in particular, clusters with slopes above 8% along axis 4 overlap with low/very low-ASI segments and thus function as substandard “implicit ramps” in terms of user experience. In these sections, network travel time to gates/entrances increases and the distance to marked pedestrian crossings grows, meaning that accessibility is cumulatively weakened. Gradual/dual-arm ramps, new/improved pedestrian crossings, and shading/planting interventions should therefore be prioritized on axis 4.

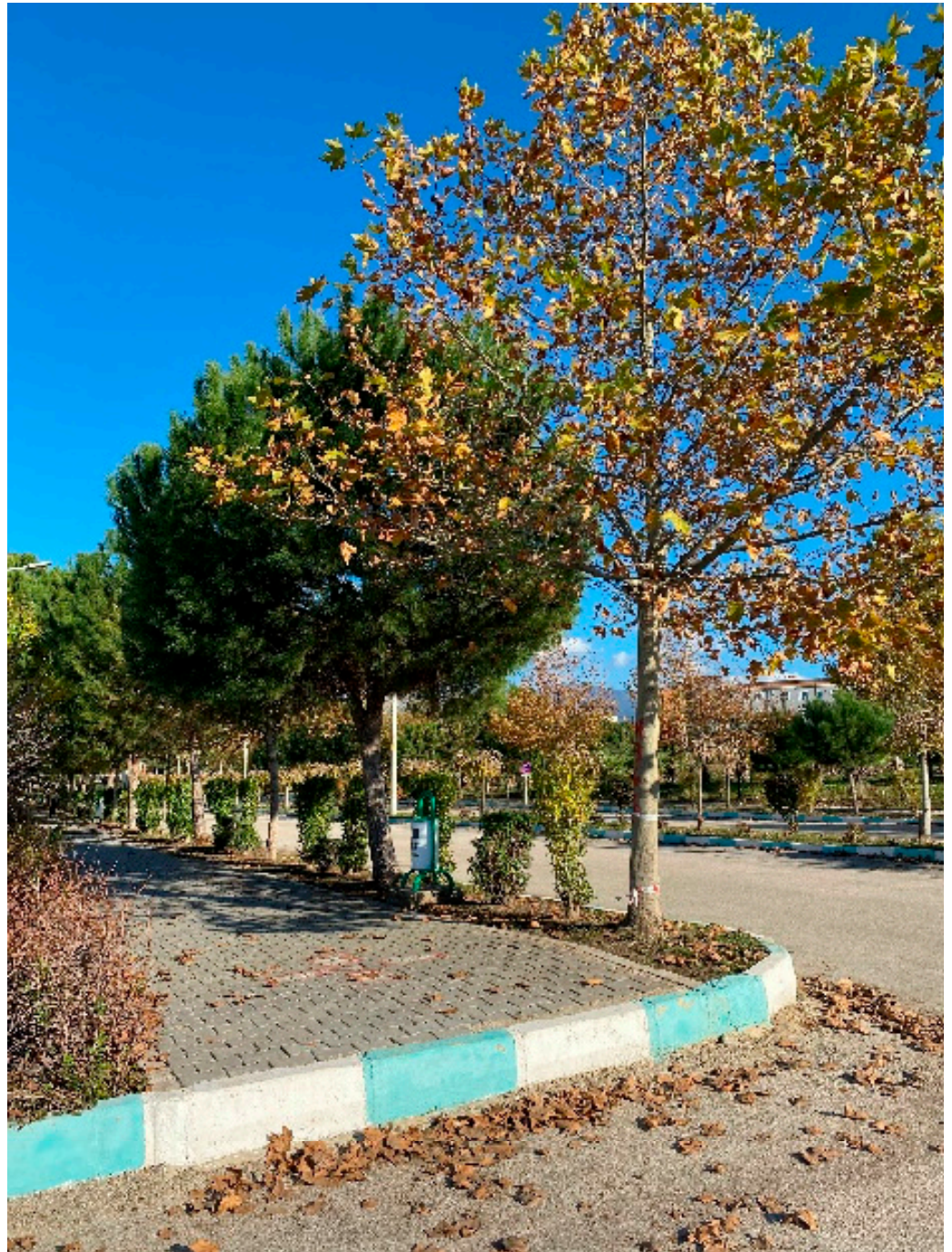


Figure 5. Lack of ramp on axis no. 4 (the image belongs to the authors).

In the AHP analysis, “existence and adequacy of pedestrian crossings”, which received a score of 0.076 and was considered among the important criteria, was defined as a secondary criterion under the heading of the continuity of pedestrian roads. While an average score of 0.22 was expected for the existence and adequacy of pedestrian crossings across all axes, axis 1 scored 0.09, axis 2 scored 0.07, axis 3 scored 0.012, and axis 4 scored 0.09. According to these results, this criterion was found to be insufficient across all axes. Observations indicated that, particularly in certain sections of axes 1, 2, and 4, pedestrians encountered vehicles due to the absence of pedestrian crossings. This situation endangers pedestrian safety and provides a basis for the negative assessments reported in the expert opinions.

The criterion of continuity on pedestrian roads received the lowest score of 0.14 on axis 4 according to expert evaluations for Osmaniye Korkut Ata University. In contrast, the other axes generally yielded average results. GIS findings quantitatively confirmed the expert assessment. Distance values to the nearest pedestrian crossing, calculated through proximity analysis, formed high-value clusters especially on axes 1, 2, and 4; these sections overlapped with low/very low-ASI classes. This pattern highlights the pedestrian safety gap along long uninterrupted vehicle road frontages and in front of parking lots. The findings suggest prioritizing new/improved marked pedestrian crossings, sidewalk widening, and pedestrian refuge islands based on pedestrian desire lines and OD flows.

In the importance ranking, safety and tactile/guidance and warning surfaces for the visually impaired (tactile surface/guidance and warning tiles for the visually impaired) were ranked fourth in importance with a score of 0.072. Previous studies have also emphasized that safety is one of the most critical components for a walkable campus environment [94]. According to expert opinions regarding OKU Karacaoğlan Campus, this criterion received its highest value on axis 1 with a score of 0.17. The location of axis 1 between two security gates was the most significant factor contributing to this high score. The lowest score, 0.09, was shared by axes 3 and 4. In these two axes, insufficient nighttime lighting and the use of the area by local residents to access walking paths, and social facilities are among the main reasons for the low score. Additionally, the lack of different activities at various times of the day results in fewer people using these intermediate axes, negatively affecting the perception of safety. GIS findings confirmed the perception of safety through spatial proxies. On axes 3 and 4, OD times to gates/entrances are noticeably longer, the proportion of segments outside the 5 min isochrone is high, and distance to marked pedestrian crossings increases; as a result, ASI classes mostly fall into the low/very low category. On axis 1, proximity to two security gates and the density of entrance frontages reduce OD times, consistently supporting the high safety score from the expert evaluation. Since an inventory of lighting and tactile surfaces was not available, direct measurement could not be performed; however, when these layers are added, the safety subdimension is expected to be reflected in the model more accurately.

The maximum value that the tactile surface criterion for the visually impaired can receive was determined as 0.21. However, the four axes in the designated area of the OKU campus scored 0.11, 0.12, 0.11, and 0.11, respectively. The moderately important criteria are as follows: uninterrupted access to assembly areas and stops, direction and signs, width of pavement (Figure 6), slope and width of ramps (Figure 7), and shade effect with climate/planting. The weights of these criteria range between 0.065 and 0.070. Among these criteria, under the climate/planting category, the OKU Campus achieved its highest possible value on axis 1, while the other axes showed above-average values. The criterion “planting in terms of visual quality” was weighted at 0.053, indicating that the campus achieved its maximum possible value in terms of visual quality, especially on axis 1. Although the other criteria fall into the low-importance category, they also received low scores across the OKU Karacaoğlan Campus. Deficiencies identified under the direction, signs, and markers criterion can cause confusion at many points within the campus (Figure 8).



Figure 6. Pavement widths on axis 2 (the image belongs to the authors).



Figure 7. The slope of the ramps (axis 1–axis 2) (the image belongs to the authors).

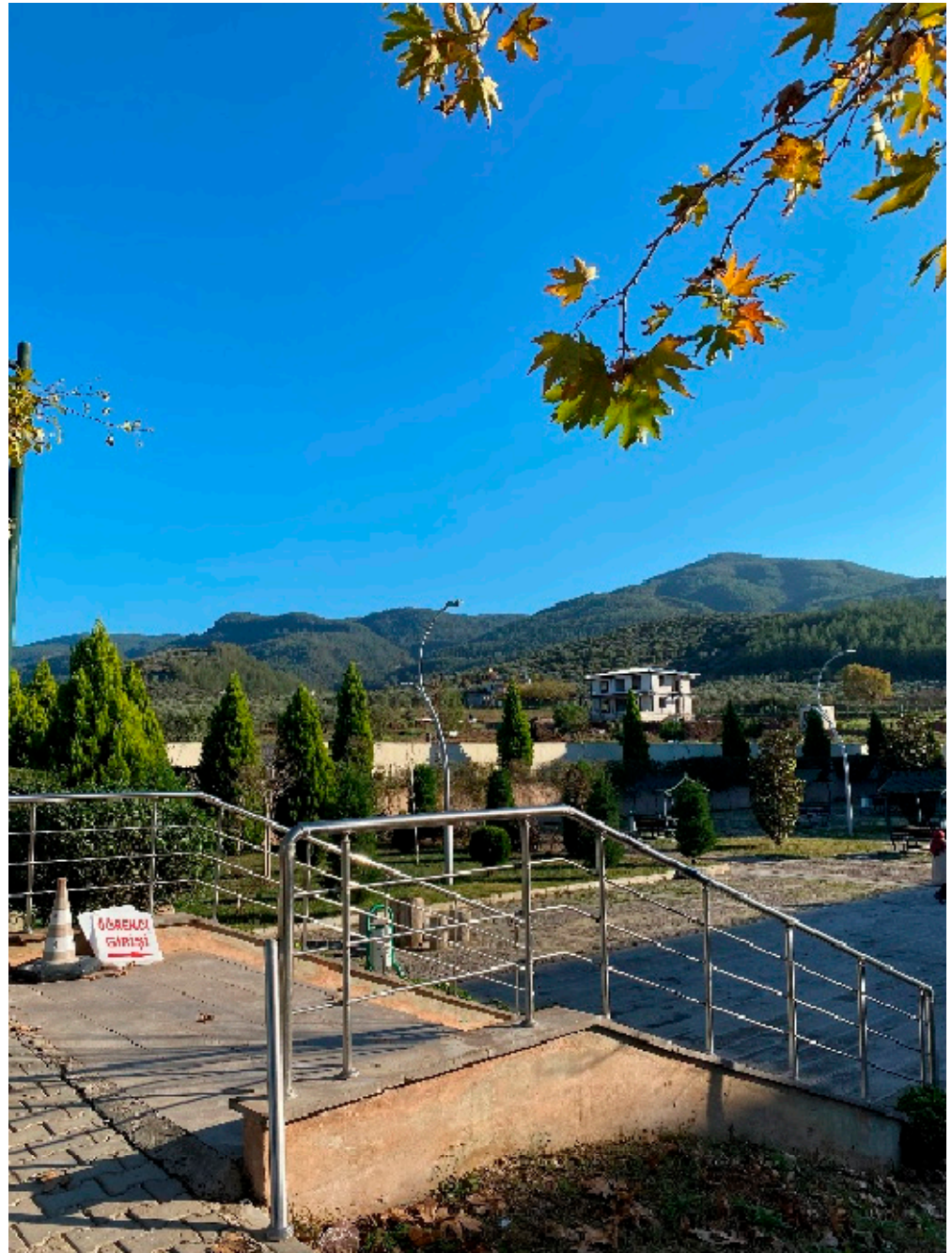


Figure 8. Signboards and directional signs in front of the Faculty of Theology (the image belongs to the authors).

7. Conclusions

In recent years, pedestrian-oriented transportation network arrangements have gained significant attention on university campuses. To underscore its commitment to this issue, the Council of Higher Education (YÖK) in Turkey began awarding accessibility flags in 2018. Osmaniye Korkut Ata University, which received one of these awards in 2022, was selected as the case study area for this study due to its inadequacies in maintaining the sustainability of this achievement. Within the scope of this study, the criteria reflecting the requirements of the concept of accessibility were identified through a campus-scale literature review and were weighted based on expert opinions.

According to the results of the weighting, the most important criteria for ensuring accessibility along pedestrian routes on university campuses were identified as follows: the

presence and continuity of sidewalks, the existence and adequacy of pedestrian crossings, and the continuity of pedestrian pathways.

These criteria, whose levels of importance were determined by experts, were used to assess the spatial accessibility of four pedestrian axes within the Karacaoğlan Campus of Osmaniye Korkut Ata University which were found to be actively and intensively used during the academic term. Expert evaluations categorized axis 1 as medium in terms of accessibility, while the other three axes were classified as low. It was concluded that, except for the criteria related to climate/vegetation providing shading effects and visual quality, all other criteria in the study area require improvement.

Specifically, within the scope of this study, the criteria of safety and connections to alternative routes were evaluated for intermediate axes, while the continuity of pedestrian paths, the presence and continuity of sidewalks, and the existence and adequacy of ramps were assessed for axis 4. Additionally, across the entire campus, the following criteria were identified as requiring revision: the presence of directional signs and markers, the existence and continuity of pedestrian crossings, sidewalk width, the improvement in lighting elements, the slope and width of ramps, uninterrupted access to assembly points, tactile ground surface indicators and guidance paths for the visually impaired, and the pavement material of sidewalks and pedestrian paths.

Concurrent with the expert-based AHP assessment, our GIS workflow operationalized the measurable subset of accessibility criteria at the segment level across the entire campus network, thereby producing a composite ASI from five indicators (isochrone proximity to gates/entrances, OD travel time, nearest crossing distance, mean slope, and green/shade ratio) combined with renormalized AHP weights. The aggregation of the ASI back to the four predefined axes substantiated the expert ranking while unveiling fine-scale deficit pockets that are obscured by axis averages. The prevailing challenges that are conducive to design are characterized by extended frontages devoid of notable crossings, pronounced inclines that surpass universal design benchmarks on axis 4, inadequate shading along peripheral links, and protracted journey times in instances where access points are deficient. Consequently, priority interventions must encompass the addition or relocation of marked crossings aligned with desire lines, ramp re-alignment, or switchbacks with landings ($\leq 5\text{--}8\%$ effective slope), secondary access points or connectors to reduce network times, and tree belts or pergolas to enhance the micro-climate. Lighting, tactile surfaces, and pavement quality must be inventoried and improved in the near future.

The method employed in this study is applicable not only to university campuses but to all areas in terms of accessibility assessment, serving as a framework for both public and private institutions managing such processes. Analyzing the results of applying the method to the Karacaoğlan Campus reveals that the model is capable of identifying the accessibility levels of axes 1, 2, 3, and 4, while also providing guidance on how these can be enhanced through design principles. Furthermore, the model used within the scope of accessibility can serve as an evaluation tool to assess the level of pedestrian accessibility in existing spaces, planned areas, or urban environments. In this context, it can act as a guide for urban administrators, city planners, municipalities, and designers [95]. In addition, the segment-level ASI and the underlying GIS-derived indicators (such as slope and effective track width) can be simplified into user-friendly accessibility maps or digital campus guides, enabling students, staff, and visitors—especially those with reduced mobility—to identify the most suitable and comfortable routes for their daily movements. Moreover, the AHP weightings and expert evaluations applied in this study are suitable for use in YÖK's accessibility flag awards granted to universities [27].

In addition, this method can be used periodically to measure accessibility, thus contributing to the ongoing maintenance of campuses through regular evaluations by users.

Awareness of this issue can also be raised through educational programs offered at universities. Accessibility maps, commonly used in international campuses for people with disabilities, could be disseminated in both digital and printed formats. In conclusion, the recommendations developed within the scope of this study are expected to contribute to the improvement in environmental factors on campus and to promote increased pedestrian use. In addition to the AHP-based framework employed in this study, the proposed GIS workflow is compatible with other multi-criteria decision-making methods, including TOPSIS, VIKOR, PROMETHEE, ELECTRE, fuzzy AHP, and the Analytic Network Process (ANP). Future research endeavors could integrate these alternative methods with the same spatial indicators to compare weighting schemes and rank orders. This would allow for the testing of the robustness and sensitivity of campus accessibility assessments under different MCDM approaches.

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