

Organizing Transportation Using Pedestrian Zone Approach and Investigating its Effects on Urban Traffic in Kermanshah

Mohammad Ali Azam, Seyed Mohammad Seyed Hosseini, Hasan Javanshir

1-Ph.D Student, Department of Civil Engineering- Construction Management, South Tehran Branch, Azad University

2-Professor, Department of Civil Engineering, South Tehran Branch, Azad University*

3-Assisstant Professor, Department of Civil Engineering, South Tehran Branch, Azad university

Abstract- The goal of the present study was to organize transportation using a pedestrian-zone construction approach and investigate its effects on urban traffic in the city of Kermanshah, Iran. First, the weights of criteria and indicators derived from the study's theoretical framework were determined to measure the potentiality of passageways for pedestrian movement using the hierarchical analysis process and the Delphi method. Then, each of the passageways in the area under study (studied population) was quantitatively and qualitatively evaluated based on commercial, educational, treatment-health, recreational and leisure, and urban public facility [land] uses, the separation of sidewalks from the driving area, traffic density, the useful sidewalk width, and the width of sidewalk passage. Also, other factors such as access control, vision lines, hiding places, passageway lighting, the presence of police and police cars, network connectivity gradient, signs, sidewalk pavement, sidewalk obstruction, interfering terrains in height, parking lots, and public transportation stations were investigated. Concerning the criterion of land use, Beheshti Street and Modarres Street received higher scores than other passageways due to enjoying educational and treatment uses, and commercial and tourism uses, respectively. Concerning the criterion of traffic safety, Beheshti Street was assigned the highest score, while Modarres Street was assigned the lowest score. Concerning the criterion of security, both streets (i.e., Beheshti and Modarres Streets) held higher scores compared to other streets with a narrow margin. Modarres Street also obtained the highest score due to having a better situation in terms of interfering terrains of height, and the presence of strong signs such as the congregational mosque, and the traditional marketplace. The proposed fourth option, i.e., traffic organization, was found to be a more inclusive option by relying on full traffic elimination and permanent allocation of the path to a pedestrian zone.

Keywords- pedestrian zone, urban traffic, transportation organization, Kermanshah

Introduction

Regionalization and function-division and urban use policies in the modern urban development era eliminated urban dynamicity and urban life, resulting in the creation of cities divided by homogenous regions, social class categorization from each other, and the elimination of diverse activities. The outcome of this eliminated the liveliness and vitality of central sections of cities. In many cities of the world, this process caused a countless number of problems, wasted natural resources, and facilities, reduced central urban activities, especially traditional centers, increased the number of urban incidents, resulted in human isolation, and generally, diseases caused by automation. Following the failure of modern urban development and the significance of human development and the environment debates, many criticisms were raised by urban scholars of modern urban development [1].

Today, pedestrian zones are not only among the most important public urban domains (as William Wright defined sidewalks to be a kind of public space based on studies on Manhattan streets); but they are also considered essential for continuing urban life [2]. When cities become dependent on rejuvenating pedestrian zones to improve environmental quality, reduce fossil fuels, improve humans' mental and physical health, increase reciprocal relations between citizens, improve the social-cultural and physical quality of urban life, and humanize urban environments, it thus seems inevitable to adopt a pedestrian approach and to facilitate pedestrian movement [3].

The lack of walkable open spaces, and also the undesirable quality of available spaces of this kind in current cities have undermined social interactions among citizens. In this connection, the lack of desirable urban spaces in which social relations are supported by citizens has sparked a kind of individualism and isolationism. This greatly

contributes to the formation of a sense of non-attachment among citizens to urban spaces, and consequently, their residence there [4].

According to the Master Plan of Kermanshah City ratified in 2003, the central section of the city includes four regions of physical divisions proposed by the plan. The central section of the city is generally assigned to various land uses. In this plan, by maintaining the proposed network of the master plan, the residential section was determined based on density (low, medium, and high) scale.

The modern and historical identity of the city of Kermanshah is tied with Azadi Square; for this, organizing the square can help organize the city. Azadi Square serves as the strongest point of urban reference at the city's scales. Incompatible land uses around this square are replaceable capacities and function as an interchange design across the city. Due to the incidence of numerous traffic problems and the creation of a traffic node, Azadi Square of Kermanshah City has failed to function as a traffic node and to withstand daily traffic load; for this, urban management has, for years, failed to provide a solution to it [5]. Considering the commercial and residential fabric around the square, the people of the city need to make their daily provisions in the central city. Twenty-two taxi and bus lines transfer people from different points of the city, with the peak hours witnessing 5400 pedestrians commuting streets at city entries [6]. A study of the existing situation of Azadi Square suggests that superficial and temporary solutions won't help remove the problems in the long run, as measures need to be taken to modify network and land use patterns [7]. The outcome is that Azadi Square is a place for the movement and displacement, and also, return of people; this key point is reasonable of squares in the plans to be proposed [8]. In most cities, daily activities take shape in central parts, and allocating urban centers to pedestrians not only helps organize and decentralize traffic but also preserves the valuable historical fabric and redefines them as contexts for social interactions. The present study aimed to investigate sample cases in pedestrian zones to organize urban centers using the walkability approach, and to offer a strategy in this regard [9]. As stated, this study aimed to organize transportation using a pedestrian-zone construction approach and to investigate its effects on urban traffic in Kermanshah City.

Different Walkability Theories

Today, considering the dominance of vehicles on human life and the appearance of adverse environmental, economic and social outcomes of this

phenomenon on human life, it is vital to encourage fewer personal cars, strengthen citizens' social interactions, and reduce the adverse effects of fossil fuels on human natural resources; hence, the goal of increasing walkability in cities can be fulfilled. Here, the goals of this study are to pay attention to humans as the most important agents for the formation of cities and living there and to deal with some of the most important human needs, including movement, health, and the strengthening of social lives in cities. For this, modern cities are founded on the growing need for walkability [10].

New Urbanism is one of the most important civil engineering approaches in recent decades which was introduced in the U.S. following the growing significance of urban issues and the cultural weakness of modern cities, caused by vehicles. Modern engineers believed that dependence on personal cars should be eliminated, and the urban environment should conform to the urban life scale, and not to autos. Pedestrian passageways in new urbanism are not only places for pedestrian traffic; rather, they serve as social places for the public where they gather to speak and see each other. Also, pedestrian zones in new urbanism are scientific and practical solutions for many of the acute urban problems, which can deal with the destruction of economic and physical situations, declining quality of life, pollution, density, and the migration of the middle class from the central parts of cities [11].

Another theory is the idea of a healthy city; the idea of a healthy city enlivens peoples' sense of attachment to the city and neighborhood. People have a specifically seasonal and emotional relation to their local hometowns. A city is not just a geographical place or a set of buildings, shops, and streets. A healthy city is one whose quality is constantly improving and provides new opportunities for its citizens. Also, sustainable development creates a balance between development and the environment. In 1980, the subject "sustainable development" was for the first time introduced in a report by the International Union for Conservation of Nature and Natural Resources (IUCN). Sustainability includes sustainable natural resources, social sustainability, and economic sustainability. In essence, sustainable development does not alone concentrate on environmental issues; rather, it also focuses on social and economic aspects. Sustainable development is where society, the economy, and the environment meet [12].

The other theory is the pedestrian expansion movement. This movement has become a global movement and brought about numerous accomplishments for Europe, the Americas, Australia,

Canada, etc. Also, various models and methods have been introduced for creating pedestrian streets, and no-traffic regions, making urban centers pedestrian, creating new pedestrian spaces, reducing pressure from residential compounds, and turning streets and squares into artistic and recreational centers, to name a few. The final goal of this movement was to “contain vehicles” and “relax traffic” to restore the lost natural rights of people and to revive the social, cultural, and aesthetic function of urban spaces [13]. The last theory is a human-oriented city. Consistent with the growing need for vehicles in modern cities, and the need for expanding passageways, highways,

and driving roads, human-centered cities are increasingly becoming a new phenomenon. The reduced share of pedestrians from the urban transporting system, especially in large cities, led urban authorities to address the issue of expanding citizens’ gathering places and their participation in collective lives. This is the human-oriented movement in urban transportation development that seeks a better living conditions for human beings in an increasingly urbanized world. Some of the most important experiences behind creating pedestrian zones in both domestic and foreign case studies are summararily given below.

Table 1: Summary of foreign experiences

City/Country	Situation	Characteristics
Essen/Germany	Limbaker and Ketwiger Streets	Commercial pedestrian axes that gradually become a central pedestrian zone Ghost town in Limnaker due to the lack of land uses and entertaining activities The presence of highly diverse activities and functions in Ketwiger The gradual implementation of axes based on pre-determined planning and designs The creation of a high number of parking lots and public transportation stations
Copenhagen/Denmark	Strøget	The six-fold increase in pedestrian urban spaces over the last 40 years Executing a ten-stage master plan for expanding walkability and increasing life quality Creating a pedestrian zone and paths of pedestrian priority where cars can travel there at low-speed limits Creating cycling lines Design based on human scales The gradual reduction of traffic and parking lot
Rotterdam/The Netherlands	Lijnbaan	Recreational and entertainment spaces Uniform street pavement along the pedestrian zone The presence of urban furniture in proportionate to the environment Supporting the features of neighborhood units and the presence of trade centers
Bogata/U.S. A.	Boston	Improving accessibility and pedestrian movement Constructing a safe pedestrian zone and conducting safety studies for pedestrians Constructing and rejuvenating public spaces and social services
Lima/U.S. A.	Washington	Improving pedestrian zones and reducing dependency on vehicles Improving the environment Social mobility and collective participation

City/Country	Situation	Characteristics
Bangkok/Thailand	Rattanakosin	Prioritizing pedestrians Expanding pedestrian zones for convenience, comfort, and safety of pedestrians

Table 2: Summary of domestic experiences

City/Country	Situation	Characteristics
Mashhad/Iran	Jannat St.	Diverse land use Suitable width Removing driving traffic Access to suitable driving roads parallel Jannat Street Suitable pavement Harmonious and balanced skyline Suitable lighting
Tabriz/Iran	Tarbyat St.	Removing driving traffic The presence of suitable surrounding driving axes Urban furniture in proportion to the environment Suitable lighting Suitable pavement Designing spiral green space Observing human proportions Predicting multi-story parking lots
Tehran/Iran	Sepahsalar St.	Historical background The presence of historical apartments on the street Suitable commercial land use Suitable pavement Removing driving paths Removing motorcycle paths

According to the literature, a majority of scholars divided urban public spaces into the following six groups:

- Sustainability and environmental considerations

Spatial and visual perception

- Social interaction approach
- Walkability expansion

- Security and human-oriented approach in urban space, and
- Environmental-behavioral considerations [8].

In this connection, although scholars may have looked into the subject from different angles, they are classified into one group based on their main line of thought.

Table 3: Categorizing scholars' views concerning public spaces and pedestrian passageways

Row	Scholar	Year	Approach	Theory
1	Jane Jacobs	(1916-2006)	Strengthening social interactions	The presence of attractive and diverse land uses on the body of streets The continuous use of sidewalks The constant presence of observer's eyes on the streets Protecting street security
2	Francis Tibbalds	(1941-1992)	Creating security and human-oriented approach in urban spaces	The non-separation of pedestrian and driving zones with an emphasis on prioritizing pedestrians Emphasis on the diversification of functions and activities
3	Gordon Cullen	(1914-1994)	Emphasis on spatial and visual perception	Attention to consecutive visions and the mental image of pedestrians in urban spaces Emphasis on the continuity and connectivity of the pedestrian network in the city Emphasis on the presence of daily activities on the street leads to the presence of citizens in urban green spaces, followed by vitality.
4	Speir Regen	(1933)	Emphasis on movement in urban space and expanding walkability	The concomitant presence of pedestrian and driving zones on the street with an emphasis on traffic and pedestrian safety Reducing traffic density, lowering traffic speed limits, and creating safe pedestrian zones for traffic safety
5	Lewis Mumford	(1895-1990)	Creating security and human-oriented approach in urban space	Pedestrian zones with mixed land use Emphasis on creating open private spaces in neighborhoods City serves as an embodiment of culture and a defense of humans against cars
6	Camillo Sitte	(1845-1900)	Emphasis on visual and spatial perception	Visual continuity of pedestrian movement Creating a sense of confidence in the urban environment
7	Amos Rapoport	(1929)	Emphasis on environmental-behavioral effects	Movement in the environment as the most important factor in the knowledge of the environment and mental image specific points, access, and land use are the three major factors affecting direction lines The concentration of activities is an effective factor in directions
8	Rob Krier	(1938)	Emphasis on spatial and visual perception	Renewed attention to the human and social concept of streets The concomitant presence of driving and pedestrian lines on the street Commercial use is the most important land use concerning pedestrians

9	Serge Chermayeff	(1900-1996)	Emphasis on environmental and sustainability considerations	Attention to environmental issues; personal cars as the causes of human life collapse Providing public free transportation Proposing to use rental bikes for dense urban spaces
10	Michael E. Arth	(1947)	Emphasis on movement in urban space and expanding walkability	Concentrating on reducing or removing cars in public urban spaces Pedestrian villages in a car-free area Removing frontal driving streets and replacing them with a tree-planted passageway path Alternative travel with low effects such as cycling and biking

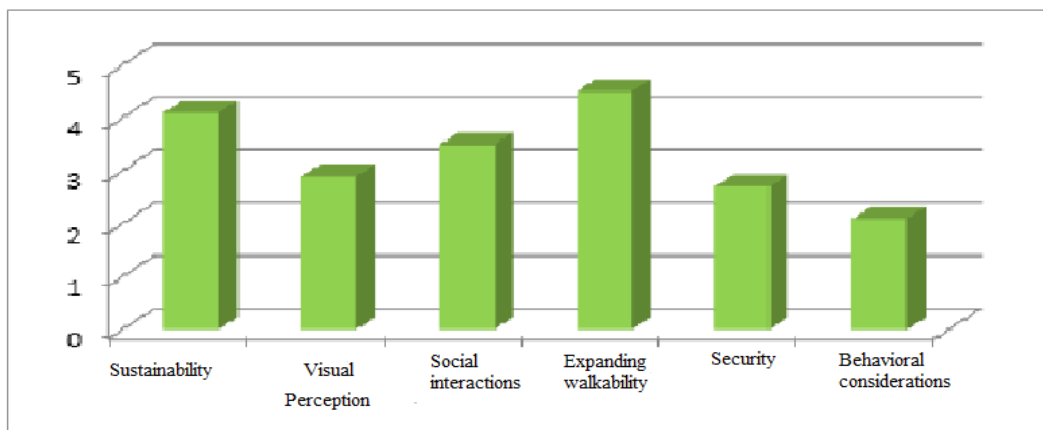


Figure 1: Major theories by public space theorists

Study Method

This study was an applied study that used a descriptive-analytical method. A theoretical framework was formed in this study, and criteria and indicators affecting the measurement of the potentiality of passageways for pedestrian movement were determined. Then, a case-background study method was used to investigate the area under study; meanwhile, criteria and indicators derived from the theoretical study framework were evaluated to find passageways with pedestrian zone potentials.

In sum, the relationship between criteria and sub-criteria was investigated using the study tool, as shown in Figure 2. The present study

used the Delphi method to determine criteria and sub-criteria. Also, for the Delphi method, several postgraduate students majoring in Transportation Planning at Azad University, South Tehran Branch, were selected as the expert group. After taking the views of the experts, criteria and sub-criteria as the most important indicators affecting the potentiality of passageways for pedestrian movement were identified, and the main criteria were as follows:

1. Land use, 2. traffic safety, 3. security, and 4. attraction and comfort

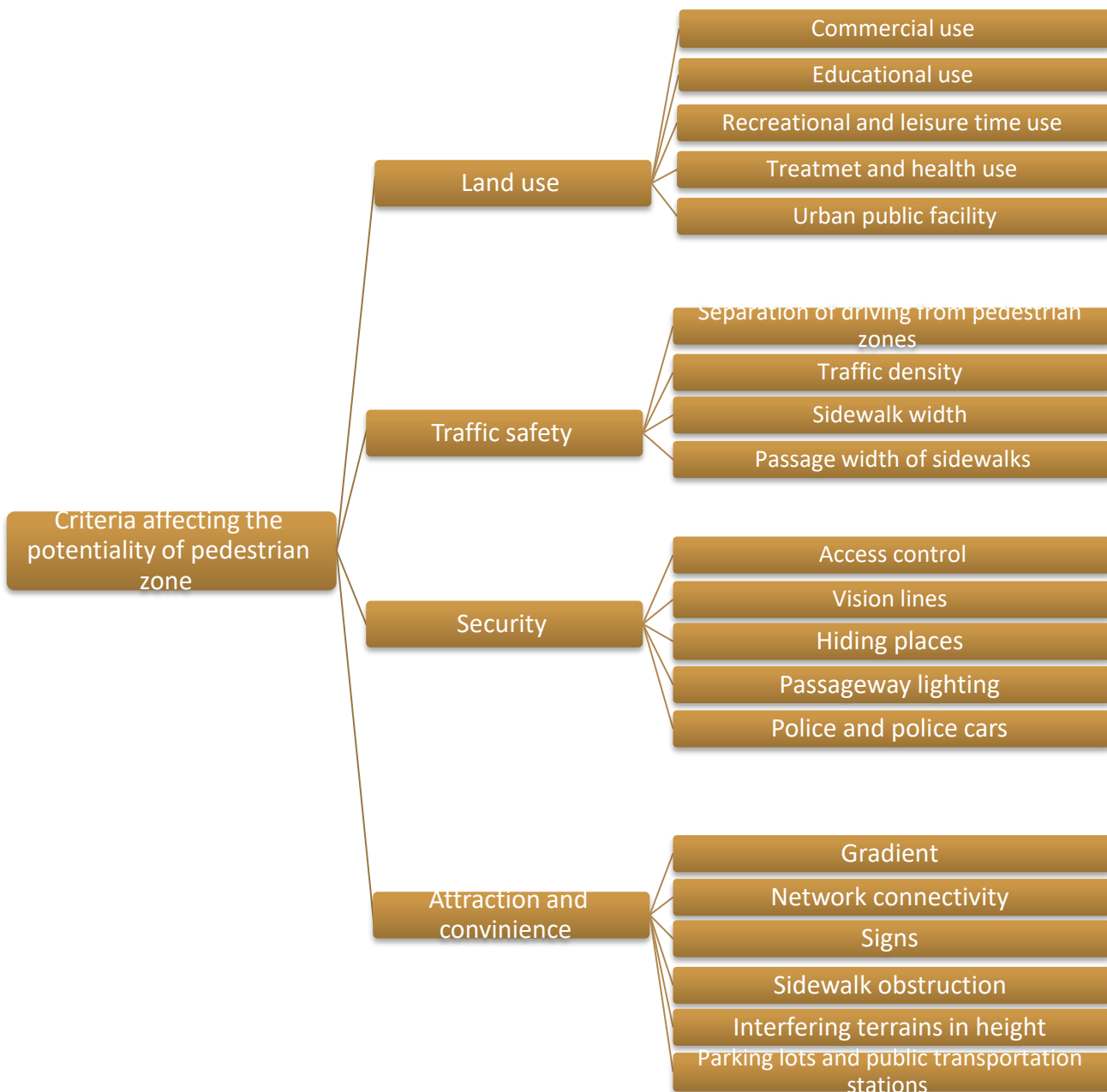


Figure 2: Hierarchical structure of criteria and sub-criteria affecting the potentiality of passageways

Study Area (Kermanshah City)

The city of Kermanshah is bordered by Mt. Farrokhshad to the north, by Mt. Tagh Bostan to the northwest, and by Sefidkouh to the south. This city is also seen as one of the communication axes that connects the east to the west of Iran, and one of the oldest ways to Mesopotamia [14]. Highlands and

ranges, vast plains, and narrow gorges formed between mountains, deep valleys on the foothills of flowing rivers, etc. have constituted rough areas of the city [15]. The total length of intra-city passageways of the city amounts to 214 km, 103 km of which are accessible and gathering passageways, 47 km are second-degree arterial passageways, 14 km are first-

degree arterial passageways, and 50 km are highways. The total area of the passageways inside the city is 6 million sq m. Out of this, 2.2 million sq m are sidewalks, green spaces, and middle refuge, and 3.8 million sq m are asphalt, 0.5 million sq m of this

asphalt is marginal parking space [16]. Because the city of Kermanshah is linear, most main communication lines have secondary ways used on both critical occasions and to reduce traffic loads from main axes [17].

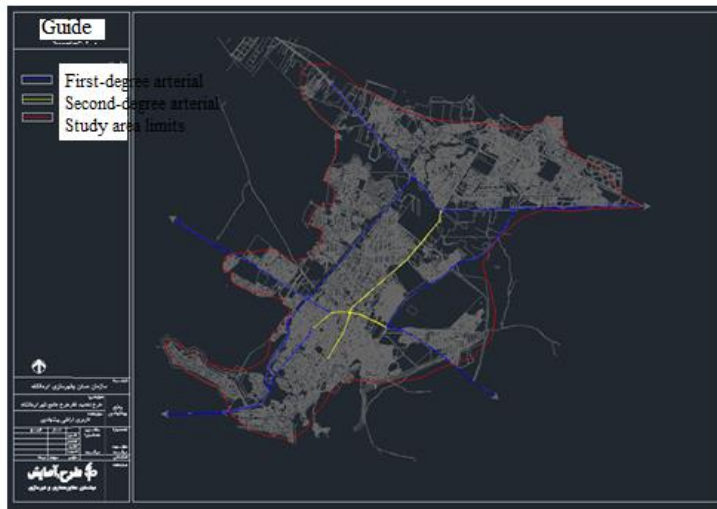


Figure 3: Grading Kermanshah City's passageways [18]

According to the 2005 Master Plan, Kermanshah was divided into six regions. Today, Kermanshah's Azadi Square is the main square of the city, which is important for its functions; also, its area and deployment in the central city, on the one hand, and relevant main streets, on the other hand, have added to the physical value of the city. The status of Azadi Square in the city of Kermanshah was investigated by surveying people's views. Around 32% of the respondents (pedestrians around the square) considered Azadi Square as one of the outstanding

places in the city. According to the survey, the places evaluated to be key areas included Tagh Bostan, Khosrow Parviz Hunting Ground, Moaven Al-Malek Monastery, and Saheb Al-Zaman Well [19]. Kermanshah's Azadi Square is currently grappling with numerous traffic problems and much vehicle traffic; for this, this traffic node has failed to function well and to reduce the growing urban traffic volume [4]. The features of the main streets in the area under study are given in Table 4.

Table 4: Features of the four arterial streets (from right to left facing outside) [20].

Street name	Sidewalks	Water canals	Driving zone	Middle refuge	Driving zone	Canal	Sidewalk	Total	Length
Modarrs	3.5	0.75	11.5	-	-	0.75	3.5	20	600
Karegar	4.5	0.7	9.9	1	9.20	0.7	4.5	30.5	700
Amjadian	4	0.7	10.15	0.85	10.1	0.7	4	30.5	650
Beheshti	4.9	0.8	10.7	1.95	10.9	0.8	4.9	35	3500



Figure 4: Study area for measuring the potentiality of pedestrian movement [13]

Indicators Affecting the Increased Pedestrian Mobility

People do not follow the same goal in walking, as studies have suggested pedestrians take a walk for different reasons, including “shopping, working, and public activities; recreational purposes and enjoying the urban environment, or a combination of the two”. The following deals with the identification of the basic indicators:

- a) **Land use:** The number of land uses situated along the paths, the way they are connected with the paths from a location point of view, their occupation levels, and relevant scales affect the paths.
- b) **Traffic safety:** By traffic safety, it is meant the safety of pedestrians against vehicles. To measure the safety level of traffic, some sub-criteria are taken into account.
- c) **Security:** Improving the quality of the living environment is not possible without the strong and active presence of the public. This presence in urban spaces, especially by all individuals and citizens across all hours of the day, requires people to have a sense of security [21].
- d) **Attraction and comfort:** People want convenience and enjoy excitement; if they find no new thing in their environment, the environment will be boring and annoying for them. If there is nothing for exploration and nothing attracts the attention of people, the intended place will not be attractive to users [16].

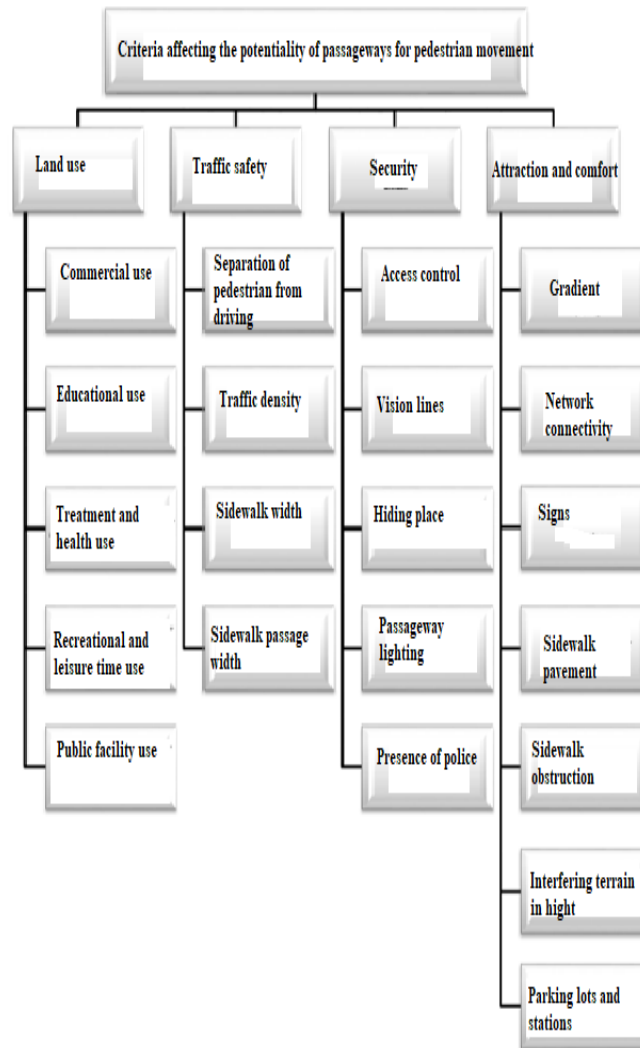


Figure 5: Criteria affecting the potentiality of passageways

Evaluating Criteria Through Hierarchical Analysis (AHP)

The present study used Expert Choice software, an applied AHP software, to calculate the coefficients of importance (weights) of all criteria and sub-criteria.

Findings

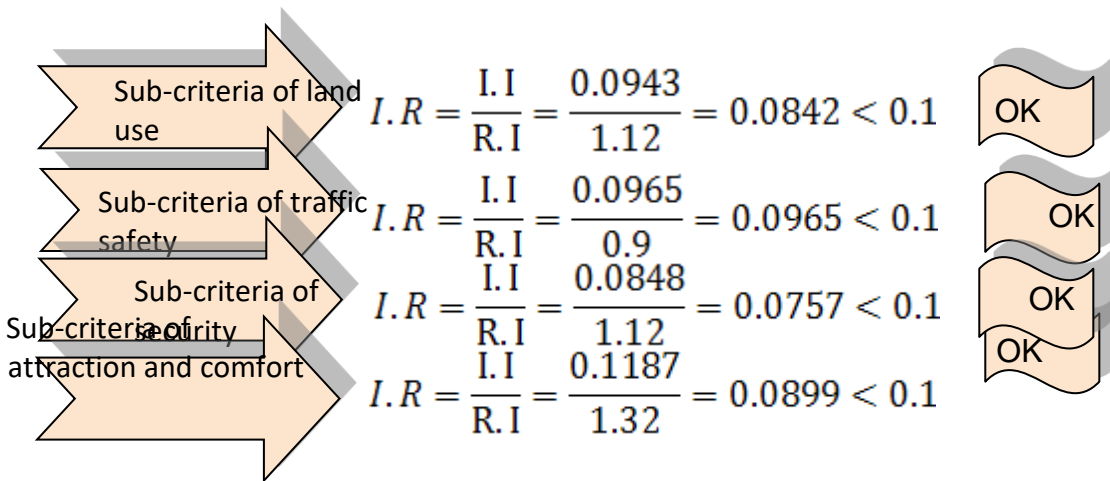
First, the weights of the criteria and indicators derived from the theoretical framework were determined to measure the potentiality of each of the passageways for pedestrian movement using the Delphi method and hierarchical analysis method.

Table 5: Weights calculated for criteria and sub-criteria

Criteria weights (second level)	Sub-criteria weight (third level)	Sub-criteria weights (fourth level)
Land use=0.39	Commercial use=0.54	Same value=1
	Educational and religious use=0.01	Appropriate=0.78
		Relatively appropriate=0.22
	Treatment and health use=0.03	Appropriate=0.74
		Relatively appropriate=0.21
	Recreational and leisure time use=0.27	Inappropriate=0.06
Public urban facilities use=0.06	Same value=1	
Traffic safety=0.07	Separation of pedestrian from driving=0.53	Same value=1
	Traffic density=0.18	Same value=1
	Sidewalk width=0.02	Same value=1
	Sidewalk passage width=0.9	Same value=1
Security=0.15	Access control=0.13	Same value=1
	Long vision lines=0.06	Same value=1
		Appropriate=0.78
	Hiding place=0.06	Relatively appropriate=0.22
	Passageway lighting=0.43	Same value=1
Presence of police and police cars=0.32	Same value=1	
Attraction and comfort=0.39	Gradient=0.27	Same value=1
	Network connectivity=0.18	Same value=1
	Signs= 0.05	Appropriate=0.78
		Relatively appropriate=0.22
	Pavement=0.07	Same value=1
	Long sidewalk obstruction=0.05	Same value=1
	Interfering terrains in height= 0.03	Relatively appropriate=0.73
		Relatively inappropriate=0.21
Inappropriate=0.06		
Parking lots and public transportation stations=0.35	Appropriate=0.78	
	Relatively appropriate=0.22	

Below are calculations on examining judgments about determining the coefficients of importance (weights)

of four-fold criteria for measuring the potentiality of passageways for pedestrian movement.



Formula 1: Determining the coefficients of the inconsistency of criteria and sub-criteria

Then, each of the passageways in the area under study (studied population) was quantitatively and qualitatively evaluated based on commercial, educational, treatment-health, recreational and leisure, and urban public facility [land] uses, the separation of sidewalks from the driving area, traffic density, the useful sidewalk width, and the width of

sidewalks passage. Also, other factors such as access control, vision lines, hiding places, passageway lighting, the presence of police and police cars, network connectivity gradient, signs, sidewalk pavement, sidewalk obstruction, interfering terrains in heights, parking lots, and public transportation stations were investigated.

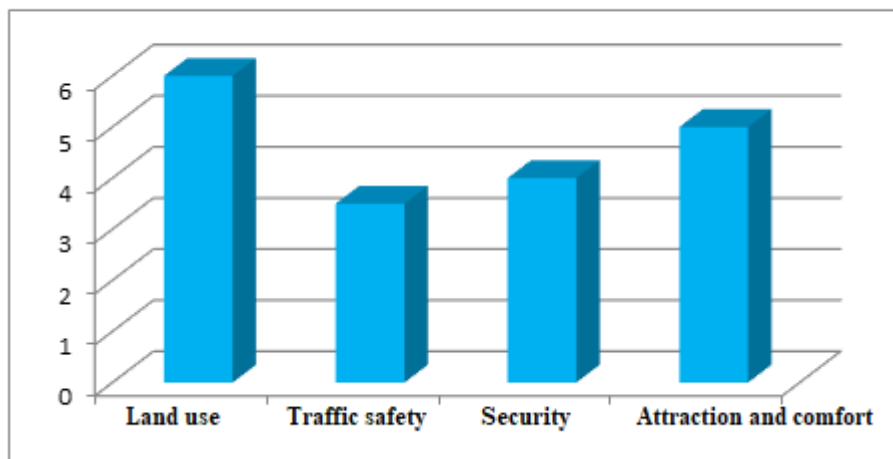


Figure 6: Major walkability indicators

Table 6: Summary of measuring the status of passageways concerning indicators

Criteria	Indicators	Passageway status	Description
Land use	Commercial use	Same value-appropriate	Number of commercial uses on either side of the passageway axe line and their functional scale
	Religious and educational use	Appropriate	The number of educational uses on either side of the passageway axe line and their functional scale

Criteria	Indicators	Passageway status	Description
		Inappropriate	The absence of educational and religious uses in the functional and religious radius
	Treatment and health use	Appropriate	The number of treatment and health uses on either side of the passageway axe line and their functional scale
		Inappropriate	None of the above
	Recreational and leisure time use	Appropriate	The number of recreational and leisure time uses
		Inappropriate	None of the above
	Pubic urban facility use	Same value appropriate	The number of public urban facilities uses on either side of the passageway axe line and their functional scale
Traffic safety	Separation of driving from pedestrian zones	Same value-relatively appropriate	Appropriate=canal+stream+green space
	Traffic density	Same value-inappropriate	High density= over 300-equivalent driving per hour for each passage line
	Sidewalk width	Same value-relatively appropriate	Obstruction in sidewalks
	Sidewalk passage width	Same value-appropriate	The lack of a middle line, reduced driving width, projecting intersections and pedestrians, narrow spans of streets by lowering right-turn radius, placing pedestrians before the opening of the intersection mouth
Security	Access control	Appropriate	-
	Long vision lines	Same value-appropriate	Presence of long vision lines of 300-350 m due to direct passageways chess Checkered form of fabric and lack of sharp corners and spiral passageways and long arches
	Hiding places	Appropriate	Lack of long narrow passageways, abandoned areas, vacant parks, dim-light streets, dense tree fields, and dark and hidden corners
		Relatively appropriate	Presence of short dead ends, without access to adjacent units and lack of enough lighting, indirect alleys without enough light

Criteria	Indicators	Passageway status	Description
	Passageway lighting	Same value-appropriate	Average lighting of 2-5 lux
	Presence of police and police car	Same value	Presence of a police station and police car in the functional radius
Attraction and comfort	Gradient	Same value	Less than 1.7%
	Network connectivity	Same value-appropriate	Examining the factors of access and connectivity to evaluate the network connectivity index
	Signs	Inappropriate	Presence and intensity of sign effects in the beginning, ending, and around the path
		Relatively appropriate	Presence and intensity of sign effects in the beginning, ending, and around the path
	Pavement	Same value-appropriate	Pavement / dry-stone pieces
	Long sidewalk obstruction	Relatively inappropriate	The number of electrical pylon guard rails, signposts, urban furniture, and stairways
		Inappropriate	Height difference (single-stair) and urban furniture
	Interfering terrain in height	Appropriate	Lack of cooler and cooler canal projecting from the building façade/ tree branches and levels as high as a pedestrian/gas riser pipe/ gutters of some buildings that have not continued until the pavement/ projected buildings lower than the permissible level/ installed elements and means hung from apartment balconies/ advertising tableaux, unprotected electrical cables/danger of construction hardware falling to the ground
		Relatively appropriate	None of the above

Criteria	Indicators	Passageway status	Description
		Relatively inappropriate	
		Inappropriate	All of the above
	Parking lots and public transportation stations	Appropriate	Access to the bus and taxi station within a radius of 200 meters/ Access to public parking within a radius of 200 meters
		Relatively appropriate	Access to the bus and taxi station within a radius of 200 meters

Conclusion

According to the criteria derived from various sources for the appropriate pedestrian movement and existing conditions in the study area, the potentiality of pedestrian movement at the main passageway and the historical square was examined. Then, considering traffic and transportation conditions and taking into account such issues as local and secondary passageways, the direction and number of pedestrians, the functional priorities of passageways, the historical situation, and the role of passageways in urban social interactions, policies, and strategies were used to propose some solutions to organize the traffic and transportation of the central part of Kermanshah City.

In evaluating the area under study, four main criteria, including land use, traffic safety security, and attraction and comfort were analyzed.

As regards measuring the potentiality of passageways concerning the land use criterion: By summing up weight values obtained for each of the passageways concerning commercial, educational, treatment and health, recreational and leisure time, and public urban facility use, a final score of for each of studied passageways (population under study) concerning the criterion of land use was obtained. Concerning the land use criterion, Beheshti Street and Modarres Street received higher scores due to educational and treatment use, and commercial and tourism use, respectively. The status of other passageways based on this indicator was almost the same. The reason why the scores were similar included the higher score of commercial use and the similar number of other uses in all four streets.

As regards measuring the potentiality of passageways concerning the traffic safety criterion: By summing up weight values obtained for each of the passageways concerning the indicators of the separation of driving from sidewalk zones, traffic density, the useful width of the sidewalk, and the width of sidewalk passage, a final score for each of studied passageways (population under study) concerning the criterion of traffic safety was obtained. Concerning the land use criterion, Beheshti Street and Modarres Street received the lowest scores. The status of other passageways based on this indicator was almost the same. The reasons for this result were the equality of street widths and the relatively equal volume of vehicles in the other two passageways, having relatively similar statuses.

As regards measuring the potentiality of passageways concerning the security criterion: By summing up weight values obtained for each of the passageways concerning the indicators of access control, long vision lines, hiding places, passageway lighting, police, and police cars, a final score of for each of studied passageways (population under study) concerning the criterion of security was obtained. Concerning the security criterion, Beheshti Street and Modarres Street narrowly received higher scores compared to the other two streets, which were due to the small number of alleys with insufficient lighting and spiral paths. Concerning other indicators such as vision line lighting and access control to streets, there was a similar situation in terms of the score for the studied criterion.

As regards measuring the potentiality of passageways concerning the attraction and comfort criterion: By summing up weight values

obtained for each of the passageways concerning the indicators of gradient, network connectivity, signs, sidewalk pavement, sidewalk obstruction, interfering terrains in height, parking lots and public transportation stations, a final score for each of studied passageways (population under study) concerning the criterion of attraction and comfort was obtained. Concerning the attraction and comfort criterion, Modarres Street received the highest score due to its appropriate status concerning the height interfering terrains and the presence of strong signs like the congregational mosque and traditional market, while Karegar and Amjadian streets ranked second and third due to the presence of multi-story parking lots and higher weights of this indicator. Beheshti Street, in the meantime, obtained the lowest score in the said indicator.

Considering the potentiality of the four streets around the city's Azadi Square, most main streets and the square enjoyed relatively appropriate conditions for pedestrian movement. Now, considering traffic criteria extracted from master plans goals, and policies, the following solutions are proposed to improve the traffic and transportation conditions of the area under study.

First proposed solution: Organizing traffic by restricting traffic hours and transferring bus terminal

This solution pertains to Amjadian Street and is executed in two parts. In the first section, the bus terminal in the street is transferred to one of the adjacent streets, and then, the buses' entry into the terminal is modified. This is done because this street, due to its certain width and wide sidewalks, is, most of the time, affected by the large number of buses that gather from all over the city and congest to enter the terminal in this street; this is because this creates heavy traffic, which leads to the square, causing disrupted traffic in Azad Square. The second part of this proposal, complementing the first part, is based on limiting traffic hours of driving vehicles, meaning that a traffic prohibition should be imposed on the street at certain hours of the day, mostly in the noon and afternoons, and this street should be made as a pedestrian zone for pedestrians. This is because due to the presence of vendors and various shopping malls in this street at the mentioned hours, the pedestrian population increases in a way that virtually makes car traffic impossible, thus imposing a traffic load on the square and disrupting movement.

Second proposed solution: Organizing traffic by restricting traffic hours and transferring taxi terminal

This solution applies to Karegar Street and is carried out in two parts. Because this street is highly similar to Amjadian Street and is situated along it, it follows, in fact, a similar solution. In the first part of this proposal, the taxi terminal is transferred to one of the nearby streets, because a large number of taxis and personal passenger cars at the beginning of this street have not only made it difficult for cars to commute but also the crowdedness of passengers there have caused several-meter traffic congestion, thus leaving negative impacts on the central section and Azadi Square. The second part proposes restricting traffic hours at certain times of the day. This timing, unlike the previous street, is administered at noon and the ending hours of office work hours. In the due time, this street can be operated as a pedestrian zone for pedestrians. This is because in this street, due to the presence of administrative buildings, numerous dealerships, and the presence of central branches of almost all banks across the city, the crowdedness of pedestrians intensifies by noon, thereby slowing down the streets, and putting much pressure on the main pressure.

Third proposed solution: Organizing traffic by increasing the sidewalk width and prohibiting personal passenger cars from commuting

This solution applies to Beheshti Street and is carried out in two parts as above. In the first part, sidewalks are widened to provide more area for pedestrians. This is because of the lack of appropriate space for pedestrians due to the presence of various treatment and health centers in the street. Also, most of the centers have, because of their land use, occupied parts of the sidewalks, such as by installing advertising billboards and obstructing their entrances using cement blocks, actually being part of their sidewalks. When widening the sidewalks, these obstacles that have systemic land use should be removed. The second part of this proposal applies to prohibiting personal passenger cars.

Fourth proposed solution: Organizing traffic by fully removing traffic and permanently allocating the path to the pedestrian zone

This solution applies to Modarres Street and is carried out in two parts, also. In the first part, the traffic of all sorts of vehicles, except for public transportation in the street, currently one-way, is prohibited, and another path from surrounding streets, located parallel to Modarres Street, is taken into account. In the second part, the traffic of public vehicles in this street is prohibited, and if necessary, (the need for businessmen to upload and download), only the dead times of the end of the night are announced as permissible for commuting. Also, it should be borne in

mind that the streets parallel to Modarres Street should have enough access to the street, and have the

appropriate access. The SWOT method was used to evaluate the proposed solutions, as given in Table 7.

Table 7: Evaluating the solutions proposed using the SWOT method

Evaluation solutions	Weaknesses	Strengths	Opportunities	Threats
First solution	<ul style="list-style-type: none"> - Non-congestion of buses in this street, caused by the transfer of bus terminals - Reducing traffic load applied to the square - Comfort of pedestrians at certain time limits of the day like people visiting commercial centers 	<ul style="list-style-type: none"> - High costs of transferring to the bus terminal that may not be economical. - Possible creation of increased traffic load at mentioned hours in adjacent streets 	<ul style="list-style-type: none"> - Possibility of designing the entire street as an urban space concerning walkability - Possibility of expanding commercial and tourism activities using the pedestrian axis 	<ul style="list-style-type: none"> - Opposition by relevant authorities - low capacity of adjacent streets
Second solution	<ul style="list-style-type: none"> - Non-congestion of taxis in this street, caused by the transfer of taxi terminals - Reducing traffic load applied to the square - Comfort of pedestrians when doing their banking and office affairs 	<ul style="list-style-type: none"> - Dissatisfaction of taxi drivers because of terminal transfer - Most office parking lots have entrances and exits inside the main street 	<ul style="list-style-type: none"> - Possibility of designing the entire street as an urban space concerning walkability - Possible reduction of traffic in the central part of the office and commercial area 	<ul style="list-style-type: none"> - Public dissatisfaction - Protests by offices and their employees
Third solution	<ul style="list-style-type: none"> - Reducing the traffic load of streets by directing passengers outside this area - Increased pedestrian interest in using the pedestrian zone and their tendency to walking 	<ul style="list-style-type: none"> - The need for traffic full-time police officers for continued presence in the area - People's lack of tendency to cover a longer distance for passenger use 	<ul style="list-style-type: none"> - Encouraging people to walk by improving the path quality - Organizing intra-city travels with greater monitoring 	<ul style="list-style-type: none"> - Rising costs of the subject - Pedestrians' lack of motivation for walking
Fourth solution	<ul style="list-style-type: none"> - Reducing traffic load - Protecting traditional and religious places - More comfort for people at shopping times and greater businessmen' satisfaction - Increasing tourist' satisfaction -Improving pedestrian safety 	<ul style="list-style-type: none"> - The need for traffic full-time police officers for continued presence in the area - Restricting driving access to the central part of the city 	<ul style="list-style-type: none"> - Possibility of reducing environmental pollution and increasing the walking culture - Possibility of expanding tourism and commercial activities at pedestrian axes 	<ul style="list-style-type: none"> - Weak traffic management - Low level of traffic culture among people

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