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URBAN DESIGN AND UPGRADING TRAFFIC AND URBAN STREET SAFETY FROM THE PERSPECTIVE OF URBAN USERS (CASE STUDY: TUNALI HILMI-ANKARA RESIDENTIAL COMMERCIAL STREET)

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Abstract

Road network, with a high percentage of urban space, is one of the main elements in urban structure and activities, and by making connections between different parts of each city, in addition to the role of connectivity and access, they also have a social and cultural role and are closely linked to urban design. Streets have been used not only as communication lines but also as a space for social interaction whose security is effective in improving the quality of the environment and urban life. The purpose of this study is to investigate the effects of urban design on road and traffic safety and to compare the views of citizens and urban planning experts on the factors influencing the improvement of road and traffic safety. In the current research that is applied, the descriptive-survey research method is used. The statistical society of this study is Tunalı Hilmi Commercial-Residential Street in Ankara, which random sampling, field, and library studies were used. The questionnaire was used for data analysis. At the end of the research, the AHP method and SPSS and EXPERT CHOICE software were used for data analysis. The results of the distributed questionnaire analysis in the statistical society emphasize urban design intervention to improve the quality of roads at a minimum cost.

Keywords: Transport, Urban Accidents, Quality of Urban Space, Road Safety, Responsive Urban Design.

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1. Introduction

The city is a physical, yet dynamical system that formed from a combination of natural, social factors and man-made environments. It has been a place of human gathering that this concentrated population of this complex has become orderly and has begun to devise customs and learning science and expertise, but in terms of energy and food production, it is usually heavily dependent on natural or rural collections (Shia, 2004, 25) .

After the growth of cities, each city accepted a role that was appropriate to its economic, social, environmental, or religious potentials and concepts such as citizenship, city management, and urban environment quality were considered. Along with the development of the concept of city and township, the concept of transportation was also taken into consideration because of the human need to move from place to place or carry materials. After the Industrial Revolution, with the advent of new technologies, people became more inclined to live in cities and the demand for urban transport increased and as a result, the concept of traffic congestion was created in urban spaces. Increasing the speed of transport and the increasing willingness of people in urban areas to obtain transport services made traffic difficult and increased the risk of accidents for the city and reduced the safety of roads (Özçelik, 2013, 1; Şimşek, 2009, 6).

Since urban spaces are in fact the context of social interaction, they must be able to provide security for their users to enhance the vitality and dynamics of space (Shakouriasl, 2016, 78). In fact, urban security, as an important component in urban planning, is one of the essentials of urban life, which is one of the priorities of any urban planning.

The concept of security means that one can live comfortably in society, away from crime, injury, accident and other hazards. The concept of traffic safety has also been taken into consideration. The fact that people can avoid crime, injury, accident and other hazards in terms of meeting their transportation needs are related to ensuring traffic safety (Özçelik, 2013, 6) .

External factors affect traffic safety; therefore, proper planning of roads, asphalts, intersections, and similar areas, especially in built areas, facilitates traffic safety. In other words, it is not wrong to claim that there is a relationship between traffic safety and urban design. By studying the numerical data of the Ministry of Transport, Maritime Affairs and Communications, the importance of the traffic safety concept is better understood. According to information provided by the ministry, approximately 1,300,000 people die each year from traffic accidents worldwide. More people are injured. 4,300 people are injured in Turkey each year and 200,000 people died (Ulaştırma, Denizcilik ve Haberleşme Bakanlığı, 2011).

According to the World Health Organization, 1.25 million people are killed in traffic accidents each year. According to the report, the mortality rate is between 18.4 and 24.1 per 100,000 in middle- and low-income countries, which is 9.2 in developed countries (Dünya Sağlık Örgütü, 2018). Given the above and since most of the people affected by the crash are young age groups (Dünya Sağlık Örgütü, 2017), we will face very high spiritual damages if we do not pay attention to the quality and safety of access by managers and city planners in addition to the life-financial damage.

2. Improve traffic and road safety by urban design criteria

The main and effective criteria of urban design to improve traffic and road safety can be categorized into five main categories and their sub-criteria, which are summarized in Photo 1 (Welle, 2015, 21-85).

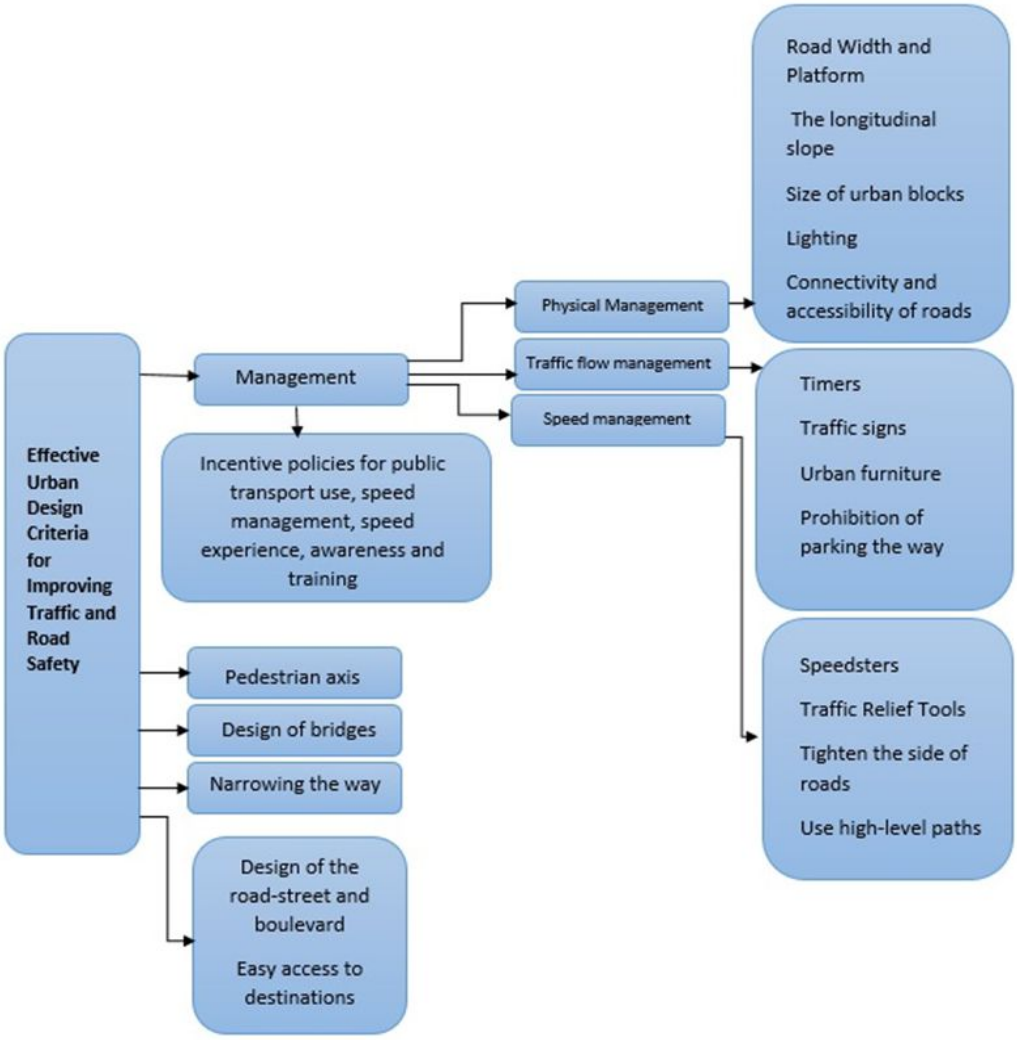


Photo 1: Main and Effective Urban Design Criteria for Improving Traffic and Road Safety (Welle, 2015, 21-85).

3. Materials and Method

The term AHP is the short form of the Analytical Hierarchy Process. This method is one of the most commonly used methods for ranking and determining the importance of factors that prioritize each criterion using comparing them to each other two at a time. The purpose of the hierarchical analysis process technique is to select the best option based on different criteria through pairwise comparison. The criteria are compared in binary matrices. After making the comparison matrix, the criteria are evaluated and according to the CR value, if the ratio is higher than 10%, the comparison is re-examined and if this ratio is less than 10%, the most appropriate alternative is selected (Balaji et al., 2014, 2222-2231). In this study, we examine the effects of urban design on road and traffic safety and compare the views of citizens and urban planning experts on the factors influencing the improvement of road and traffic safety on the Tunalı Hilmi Commercial-Residential Street in Ankara. The purpose of this study is apllied and descriptive-survey research method is used. The statistical society of this study is Tunalı Hilmi Commercial-Residential Street in Ankara, in which random sampling, field, and library studies were used.

In this study, questionnaires designed for distribution among non-specialists have two sections: The first part includes questions such as age, gender, etc., and the second section includes research questions and variables, including evaluating citizens' perceptions of the extent of risk and road risk in the study area, examining the negative factors in reducing traffic safety at Tunalı Hilmi Street and their suggestions.

The second questionnaire, in addition to the above, evaluated urban design sub-factors and factors affecting urban traffic from the viewpoints of urban planning and road and traffic experts. A two-step method was used to obtain the desired result. In the first and second stages, AHP and SPSS 23 methods were used, respectively. Tables containing frequency, percentage, and descriptive statistics were generated using SPSS program. In other words, the effective factors of urban design for accident reduction were first

extracted and then the weighting and importance of the research factors were determined using AHP and ExpertCHoice software. Factors affecting urban design in reducing accidents can generally be classified into 7 criteria and sub-criteria, which are summarized in Table 1. These factors were used in the distributed questionnaires and the extent of their impact was questioned (Welle, 2015, 21-85).

Criteria	SubCriteria
Physical infrastructure	Platform and bandwidth Longitudinal and transverse slope Intersections Island size Continuity of levels Lighting Continuity of access bars
Traffic flow	Traffic lights and timers Path readability Vertical and horizontal signs Urban furniture Park in the middle of the road
Pedestrian access	Pedestrian axis Passengers' islands Middle refuge Traffic light and timers of pedestrian Continuity of pedestrian axis Pedestrian-oriented areas
Bicycle access	Bicycle-specific axle Traffic lights and timers for cyclists Cyclists' safety on bridges and crossings Cyclists' security at the bus station
Speed	Speedsters Devious Ways Narrow the sides of the road High levels of way Speed limit
Public transportation	Easy access to public transport Bus specific way Stations Terminals and redirect points and stations
Management and organization	Incentive policies for the use of public transport Speed management Experience management Awareness and education Access and security of disadvantaged groups

Table 1. Effective Factors of Urban Design for Accident Reduction (Welle, 2015, 21-85).

4. Tunalı Hilmi Street

4.1. Tunali Hilmi Street

This street is one of the most famous streets in the city of Ankara, Çankaya district with socio-cultural-economic-political usage. The street name was derived from the famous politician in the years 1871-1928. Along this street, there are embassies, offices and public and private hospitals, numerous passages and bars for social interaction across all age groups, and at all times both the pedestrian and the cavalry have a lot of traffic (Ercoşkun, 2013, 29-44).



Photo 2: A) Location of the study area in Ankara. B) Tunalı Hilmi Street. (Source: Google Map, 2019).

In this study, 75 people of residents and taxi drivers of Tunalı Hilmi Street were randomly selected and 5 experts in urban planning, road and traffic have participated in Ankara. The results are as follows:

Of the participants, 50.7% (n = 38) were women and 49.3% (n = 37) were men. Most participants are in the age group of 20-40 years old and have a high school or university degree and most of them are students, or employees of governmental organizations, workers or working in private companies and 70.7% of people use this street regularly.

		Citizen use of Tunalı Hilmi Street							Total
		Everyday	1-2 times a week	3-5 times a week	1-5 times a month	Rarely, 1-5 times a year	First time	Only weekends	
Tunalı Hilmi	N	53	4	14	3	1	0	0	75
	%	70.7%	5.3%	18.7%	4.0%	1.3%	0.0%	0.0%	100.0%

Table 2. Shows the number of times a citizen uses from Tunalı Hilmi Street.

Of the participants, 22.7%, 18.7%, 14.7%, 2.7%, 2.7%, 2.7%, 1.3%, 1.3%, and 6.7% were pedestrians, personal vehicles, buses, taxis, metro, bicycles, other person's car, service, and personal and pedestrian cars, respectively and the rest of the people use all the transportation equipment. 77.7% of the participants had witnessed many accidents and 24% of the people considered the traffic to be risky. Therefore, it can be concluded that mild accidents are relatively high in the study area and over time, if not addressed, can affect the quality of the environment and increase the risk.

The following chart shows the evaluation of the factors affecting citizens' viewpoints on Tunalı Hilmi Street traffic safety. In this paper, after examining the main causes of accidents, they are divided into 6

general categories of drivers, pedestrians, passengers, infrastructure problems, car-related problems, management problems, and their impact type and the effect of each was questioned.

The results of the citizens and residents survey show that most accidents are caused by failure to observe the red light by pedestrians with 97.4%, behaviors without passenger control with 96%, careless while driving time with 95.7%, drivers not following traffic rules and pedestrians carelessly crossing the street with 89.3% and signaling problems and traffic lights and timers with 89% were the most common causes of accidents on the Tunalı Hilmi Street, which can prevent many traffic accidents by stricter laws to better enforce rules related to traffic lights by pedestrians and drivers (due to the equal impact of the drivers and pedestrians on the non-compliance of the red light), to inform and educate people in schools, Traffic classes, and TV programs and proper location and handling of problems related to the timers and traffic lights. Table 3 and Table 4. show classification of the main causes of accidents from the perspective of urban users and Factors affecting the reduction of traffic accidents from the point of view of users.

	The main cause of accidents	Impact rate %
Drivers	High speed	64%
	Drivers fail to comply with red lights	89%
	Careless driving	95.7%
	Violation of traffic rules	89.3%
	Nonconformity pedestrians	76%
	Park the way	45.4%
	Unusual beep	32%
Pedestrians	Pedestrian non-compliance with red light	97.4%
	Careless pedestrian crossing	89.3%
	No use of pedestrian axle	76%
	Use cavalry axis	82.7%
Passengers	Uncontrolled behaviors of passengers (Such as getting out of the car window and carelessly getting off the car)	96%
Infrastructure	Lack of traffic signs	81.3%
	Improper sidewalk width	58.6%
	Not enough lighting	81.3%
	Signaling problems	89%
	Shortage of pedestrian axis	64%
	Damage to pedestrian and cavernous axle structure and surface	21.3%
	Improper design of axes for vulnerable groups such as children, the elderly and the disabled	21.3%
Cars	High traffic on taxis	30.6%
	Carrying goods for shops and street stores	17.4%
	Traffic from wandering cars and searching for a park location	72%
Management and experience	Not enough experience	72%
	A management approach that adopts the vehicle's priority approach	50.7%
	Deficiencies in local management applications such as inadequate urban design, lack of parking space, inaccurate location for taxis	72%

Table 3. Classification of the main causes of accidents.

Factors affecting the reduction of traffic accidents from the point of view of users	Impact rate %
Urban Design	34.7%
Road safety and traffic safety training for pedestrian-drivers	26.7%
Effective and practical methods associated with the experience	17.3%
Train traffic safety and effective control practices for the driver-pedestrian- passenger	9.3%
Traffic safety information	0.67%
Using technology in transportation	2.7%
Using new technologies to improve traffic and road safety	2.7%
Other	0.0%

Table 4. Factors affecting the reduction of traffic accidents from the point of view of users.

By examining the factors affecting the reduction of accidents and the improvement of road and traffic quality and the increase of traffic safety in the case study, it can be concluded that for urban users, safety and road safety and traffic education for pedestrian-drivers, proper urban design and application programs to enhance the driving experience of drivers and the time of accident in basic driving training, fixing parking issues, introducing new rules for dealing with offenders, turning the study area into a pedestrian-specific axis can have a significant impact on reducing accidents and changing the current situation. Table 5 shows factors Influencing Citizen Traffic Security.

Factors Influencing Citizen Traffic Safety	
Factors	Impact %
Fixed problems with parking	28.0%
Adopt new rules for dealing with offenders	24.0%
Convert study area to the pedestrian-specific axis	22.7%
Fixed problems with parking Convert study area to the pedestrian-specific axis	12.0%
Planning and design for cyclists	4.0%
Fixed problems with parking Preventive rules to prevent driving violations	4.0%
Preventive rules to prevent driving violations	2.7%
Perform speed relaxation measures	2.7%
Development of public transport system in the study area	0.0%
Other	0.0%

Table 5. Factors Influencing Citizen Traffic Security.

After collecting and reviewing the views of Tunalı Hilmi Street users, the views of urban and road traffic experts on the factors affecting Tunalı Hilmi Street Traffic were analyzed as 7 main criteria and their sub-criteria and the rate of incompatibility of the criteria was calculated by Expert CHoice software using AHP method and completion of pair wised comparisons matrix. The criteria were weighted and ranked. The incompatibility rates of all the factors are less than 0.1, which indicates the compatibility and stability of the matrices. These criteria are previously shown in photo 2 A).

4.2. Investigating the Impact of Physical Infrastructure on Reducing Traffic Accidents

The Physical Infrastructure Criterion has 7 indicators, which their pair wised comparisons are listed below. The inconsistency rate of this pairwise comparison is 0.04 and, since it is less than 0.1, indicates acceptable consistency and accuracy of pairwise comparison.

	Bandwidth Platform	Longitudinal and transverse slope	Intersections	Island Size	Surfaces continuity	Lighting	Continuity of access bars
Platform and Bandwidth		3.987	1.037	1.783	1.246	1.124	0.678
Longitudinal and transverse slope			0.384	0.964	0.608	1.246	0.425
Intersections				1.585	1.201	1.380	1.149
Island Size					1.351	0.870	1.644
Surfaces Continuity						0.725	0.678
Lighting							0.561
Continuity of access bars							

Table 6. Paired Comparison of Physical Infrastructure Indicators from the Perspective of Road and Urban Experts.

After entering the paired comparisons into the Expert Choice software, the metrics are weighted as in Photo 3.

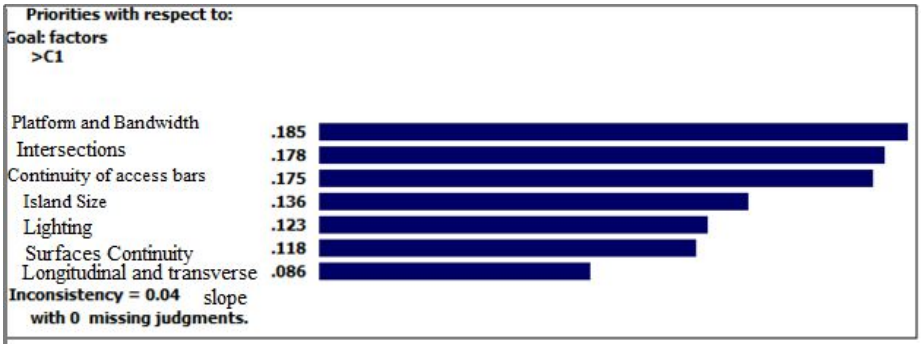


Photo 3: Weight of physical infrastructure indicators from the experts' point of view.

Weights of physical infrastructures' indices in Tunali Hilmi Street		
Criteria	Weight	Rank
Bandwidth and Platform	0.185	1
Intersections	0.178	2
Continuity of access bars	0.175	3
Island Size	0.136	4
Lighting	0.123	5
Surfaces continuity	0.118	6
Longitudinal and transverse slope	0.086	7

Table 7. Weight and ranking of indicators in physical infrastructure from the experts' point of view.

According to Table 7, "Bandwidth and Platform" is ranked first with a weight of 0.185. Intersections with a weight of 0.178 and Continuity of access bars with a weight of 0.175 ranked second and third, respectively.

4.3. Investigating the Impact of Traffic Flow on Reducing Traffic Accidents

The Traffic Flow Criterion has 5 indicators that are paired comparisons below. The inconsistency rate of this pairwise comparison is 0.05 and, since it is less than 0.1, indicates acceptable pairwise comparison.

	Traffic lights and timers	Path readability	Vertical and horizontal signs	Urban furniture	Park in the middle of the road
Traffic lights and timers		0.674	0.840	1.585	1.974
Path readability			1.108	4.743	1.821
Vertical and horizontal signs				3.438	1.719
Urban furniture					0.234
Park in the middle of the road					

Table 8. Paired Comparison of Traffic Flow Indicators from the Perspective of Roads and Urban Planners.

After entering the paired comparisons into the Expert Choice software, the metrics are weighted as in Figure 4 and Table 9.

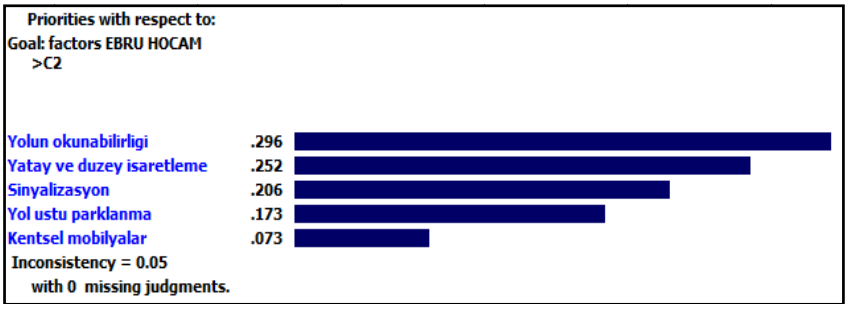


Photo 4: Weights of traffic flow indicators from the experts' point of view.

Weights of physical infrastructures' indices in Tunali Hilmi Street		
Criteria	Weight	Rank
Path readability	0.296	1
Vertical and horizontal signs	0.252	2
Traffic lights and timers	0.206	3
Park in the middle of the road	0.173	4
Urban furniture	0.073	5

Table 9. Weight and ranking of indicators in traffic flow from the experts' point of view.

According to Photo 2 B), path readability has gained the first rank with a weight of 0.296. Vertical and horizontal signs and traffic lights and timers with weights of 0.252 and 0.206 have won second and third rank, respectively.

In the same way, we analyzed the impact of pedestrian access, speed, bicycle access, public transport, management, and organization criteria, and achieved the following results:

- In the pedestrian accessibility index, traffic lights and timers of pedestrian-specific and turning into a pedestrian-specific area, the quality and design of the pedestrian axis in Tunalı Hilmi were earned the highest score.
- In the Tunalı Hilmi, speed limitation and the use of speed bumps and flattening sections of the road with the goal of slowing down have gained the most score.
- The bicycle accessibility index, cyclists' paths, cyclists' traffic lights, and timers, securing cyclists at the bus stop were ranked high.
- In terms of public transport index, easy access to public transport and the specific routes of buses and their stations ranked one to three, respectively.

- In terms of weight management and organizing traffic and routes indicators, incentive policies of public transport use, having experience and skills in speed and management have been a top priority.

5. Conclusion

Based on the results of the questionnaire analysis, it can be concluded that most of the causes of accidents in the viewpoint of the users of the Tunalı Hilmi Street were: not paying attention to pedestrians at the red light, careless pedestrians crossing the street, not using pedestrian axis and lack of sufficient drivers experience, which preventive measures, strict rules, and penalties are required with emphasis on traffic signals and traffic lights for both groups of pedestrians and motorists, increase warning signs and the use of radars and cameras for greater control.

In summary, it can be stated that the major cause of accidents in the study area is of human origin and in the occurrence of accidents, the role and impact of pedestrians is no less than that of drivers. Regarding the physical infrastructure of the street, the lack of traffic signs, the technical and spatial problems related to the timers and traffic lights can be effective in improving current conditions and the safety and quality of the street. It is important for both user groups and experts to emphasize the role and high impact of urban design on improving the quality of roads. In fact, urban design is the relationship between the needs and wants of the people and the plans of the professionals and managers of the city and utilizing it to increasing the quality and safety of roads at a low cost and taking into account the real needs of the area has led to a responsive design, and in addition to impacting the sense of security, it enhances the sense of identity and participation and will be an effective step towards achieving safety and sustainable development.

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