Journal of Fundamental and Applied Sciences

ISSN 1112-9867

Available online at http://www.jfas.info

Research Article
Special Issue

THE EFFECT OF USING ROAD SAFETY EQUIPMENT AND SYSTEMS AND DETERMINE THEIR ROLE ON THE SUBURBAN ROADS' SAFETY PERFORMANCE

G. Ghaffari[1,*] and H. Zoghi[2]

[1]Islamic Azad University, Ayatollah Amoli, Civil Engineering Department of Transportation, Amol, Iran

[2]Faculty of Engineering, Islamic Azad University of Karaj, Iran

Published online: 15 May 2016

ABSTRACT

In the present communities transportation is a critical component of human life, and one of the main categories in the specification transportation system is the subject of safety. Considering the number of road accidents and deaths caused by it, unfortunately Iran is at the top of countries with the highest number of deaths in traffic accidents, therefore, this has led to that causes of accidents be investigated. To achieve high safety many factors are involve, including appropriate geometric conditions, warning signs and marks, inhibiting rules, safer vehicles, driver familiar with the rules. In this paper, we investigate and evaluate each safety equipment on road performance and with case study on the Tehran-Firouzkouh road determine the existing traffic control equipment situation and by multi-criteria weighting systems AHP decision-making models has been set to evaluate the effects of these factors on safety function. Then according to existing road conditions and the contribution of roads' different sectors of these systems, a safety priority index number is defined between 0 and 100 and prioritize different levels were expressed in terms of risk.

Author Correspondence, e-mail: authorC@gmail.com

doi: http://dx.doi.org/10.4314/jfas.v8i3s.252

The results have shown that indices median, lighting and panel type and the road's longitudinal underlining have been identified to have the highest impact on safety. This issue considering sections with complex geometric design with plenty of horizontal curves are very important; also transverse road underlining and warning and regulatory signs in the road have the high weight. But what is noteworthy in this regard is that the total weight of road horizontal symptoms include (underlining and text lines and bumps) is obtained 0.306, and the total weight of the vertical signs (regulatory and warning signs, and traffic lights) 0.181. This issue shows that importance and the effect of horizontal systems on roads is far more than vertical signs of road's margins.

Keywords: Safety; safety equipment and systems; hierarchical analysis.

1. INTRODUCTION

Assessment of safety status quantitatively beside effective parameters such as design, implementation and adoption with environment in process management and project development has always been a challenging issue. However, the issue of safety is considered as an integral part of design policies based on desired uses. Although the geometric correction by itself can be very effective in quantitative reducing road accidents statistics, but reducing the severity of accidents, mostly will be possible by safety control rules. Unfortunately, nowadays there are many inhomogeneity on country roads and their physical and geometric margins that this caused a crisis in the severity of accidents in these areas. A safe road is a range without any objects and dangerous places and also requires the existence of safety equipment at the margins. For designing a road and its appurtenances, designers should use the geometric criteria, take into account all circumstances, reduce and evaluate the influence of possible outside of the road factors on the road safety. So the safety of the road network in a general classification requires attention to three major factors geometric design, maintenance and traffic control signs (Figure 1).

Fig.1. The road factor is one of the accident factors

Road factor consists of different factors that road and its margin are the most important. A number of other parameters that are considered as road factor are as following:

● Width and geometry of the road

● Lightening situation

● Natural obstacles which prevent adequate vision such as tree

● Lack of good protection on roadside

● Road signs and other control measures including horizontal and vertical signs

● Resorts and parking situation

● Rainy weather or fog

● Road surface condition in terms of drainage and superstructure

Horizontal and vertical signs, road safety equipment, control equipment, smart traffic and road safety equipment and all supply of road safety are used in order to regular and predictable traffic movement and thereby provide road safety, this aim is supplied with listed equipment and reduces accidents and increase safety. Therefore, in this thesis we will evaluate the performance of any of the safety equipment, and statistical modeling techniques will be used. Due to many losses of life and property that road accidents impose on human societies, considering the issue of safety as the first priority in transportation and land use management plans, is reasonable and acceptable. Prerequisite principles of sustainable development in road safety is providing a long-term or medium-term national-scale safety plan. In this regard, most recently in developed countries an issue is emerged called safety engineering which its aim is improving engineering design principles to enhance the level of road safety. The most effective step towards understanding the factors involved in road safety, e.g. the vehicle, humane, environment and the complex interaction of these factors, is conduct in-depth studies about problem-solving. Unfortunately, in developing countries information relating to these factors is rarely available or information and statistics often are not reliable, and are collected by different institutions to satisfy the periodic needs. Integrating this information is also time-consuming and sometimes impossible. In addition to the aforementioned problems in many developing countries, rapid growth in number of motor vehicles is also seen. Nowadays, the issue of security supply in transportation is one of the basics of traffic engineering, traffic and transportation planning. Each year, more than 1.17 million people die in road accidents, 70% of which is related to developing countries, and more than 10 million people are disabled and wounded. It is expected that in the next 10 years in developing countries, 6 million people will die and 60 million people will be injured, unless appropriate measures are taken to prevent it. The World Health Organization (WHO) show that in 1990, traffic accidents were in ninth grade on the list of the most important health problems and is predicted that until 2020 road accidents will be the third most important cause of death and disability in human societies. The harsh reality raised in the organization report imply that 50% of those killed are 15 to 44 years old and economically are considered as most influential persons in society. In general, road accidents approximately waste 1 to 3 percent of Gross National Products (GNP) that is very significant figure. No doubt these costs and damages are a huge obstacle in the way of economic and social development of developing countries.

2. RESEARCH BACKGROUND

One of the most important parameters assessed in most countries of the world, the international community and the United Nations is traffic safety. By study of traffic accidents we can identify factors in the occurrence of traffic accidents and by defining and describing factors in accidents we can improve transportation system. So that by decreasing and minimize the causes of the accident create a safer transportations system. Also, studies in the field of road accidents and fatalities in the worldwide suggests that road accidents even in developed and industrial countries is also top causes of death. Also, studies of World Health Organization show that in 2020 road accidents will be one of the three main causes of death in the world. Road safety experts divided effective factors in traffic accidents and injuries and deaths into four categories. The first factor is human and human errors which have most important roles in accidents. The second factor is the vehicle that each of these factors include detailed parameters. The third road environment factor and fourth factor is discussion about road safety management, which in recent years has been paying special attention to this fact. Figure 2 which is prepared by Piyark World Assembly and is published in road safety handbook by the same Assembly, can be considered as the result of one of most timely global analysis of three factors people, roads and vehicles, the contribution of each factor in absolute or in combination with other agents are shown by three circles.

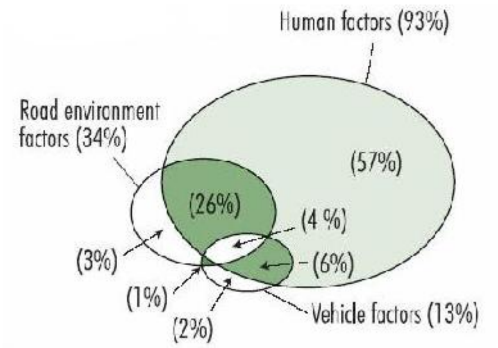


Fig.2. The curve of three factors in accidents

Assessment of safety status quantitatively beside effective parameters such as the design, implementation and adoption with environment in management process and project development has always been a challenging issue. However, the issue of safety is considered as an integral part of policy design based on user type. Although the geometric correction alone can be very effective in quantitatively reducing road accidents statistics, but reducing the severity of accidents, mostly will be possible by control safety principles in action. Nowadays, in the design of several tools quantitative assessment of both administrative convenience and compatibility with the environment plan is available. But the tools currently used for quantitative assessment of safety in the design are relatively new. Organizations related to safety issues in country should use them in the various project phases by increasing knowledge and information in connection with these tools and standards. Quantitative evaluation of safety, enables client and design consultant better understand the role of safety in the design process, and consider these factors, along with other factors in the design process of the project. Due to the high rate of road casualties in Europe (43,000 annually), RISER research project started at 2003 and lasted for 36 months to evaluate the severity of accidents. The CMF indicator-based projects showed that although only 10% of all accidents in Europe is related to ROR crashes, but this relatively low rate, approximately included 45% of deaths statistics. CMF is one of the tools that today's road transport organizations in the developed countries including the FHWA in U.S.A use it in order to increase safety in the different before and after phases of the design. Also original standard application that covers design and traffic control equipment locating, is Manual on Uniform Traffic Control Device (MUTCD). Federal roads Office is national publisher of MUTCD, which is considered as a minimum standard and is considered as a model for other instructions that are provided at different state levels. One of the major goals of MUTCD guidelines is integration and homogeneity in using, locating and designing traffic control equipment. MUTCD guidelines state that a purpose of traffic control equipment is improve road safety by establishing a regular movement of all users on the streets and roads. In addition, for carrying out this mission more effectively the guide has introduced five characteristics of effective traffic control equipment features.

3. RESEARCH METHODOLOGY

Therefore, we can outline the available traffic equipment and systems on the road as factors affecting safety and performance. Therefore, in this study by conducting a case study on the Tehran-Firouzkouh Road which includes three main parts Tehran-Boomehen, Boomehen-Damavand, Damavand- Firoozkooh, we identify the status of equipment and organization of road safety and traffic control systems and through multi-criteria weighting system through AHP decision-making models the impact of these factors on immune function has been investigated. According to existing road status and the contribution of different sectors of roads from these systems, a number defined as safety priority index and different levels were expressed in terms of risk. MADM models are used to select the most appropriate option from the m option. Hwang & Yoon defined multi-criteria decision making as: "Multi-criteria decision making refers to preferential decisions (eg, evaluation, prioritization and selection) from among the categorized options by multiple indexes (and often conflicting)”. As mentioned above, MCDM models are used to select the most appropriate choice among the possible options. These models are usually formulated by decision matrix. Analytic Hierarchy Process is one of the most comprehensive systems which is designed for multiple attribute decision making which is accordance to a strong theory based on axioms and has been built according to a paired comparison. Since in these methods all parameters have not been compared at once and criteria are compared in pairs, so weighting perform more accurately. This process in involved different options in decision making and provide sensitivity possibility on criteria and sub criteria. Analytical Hierarchy Process (AHP), which was presented by the Saaty (Saaty 1980) has been used in various place projects (Ying et al. 2007). Due to the uncertainty in describing and ranking criteria, we need a way to model uncertainty.

4. DATA ANALYSIS AND CASE STUDY

Tehran-Firouzkouh is considered as one of the main artery between Tehran and North of Iran. In addition to traffic of Pardis, Roodehen, Boomehen, Damavand and other relevant sectors, it also suffers inter-provincial traffic between Tehran and north of Iran. Therefore, it is considered as one of busy roads of the province with indicator of policymaking and importance. This road has three main sections in accordance with Table 1.

Table 1. Studying parts of Tehran-Firouzkouh highway

Road name	Part name	Length (km)	Kilometer	The average passing traffic	Percentage of traffic
Tehran-Firoozkouh	Tehran-Boomehen	26.350	0 than 26+350	33863	100%
	Boomehen-Damavand	27.650	26+350than 54+000	24838	75%
	Damavand-Firoozkouh	60.050	54+000than 114+050	8480	25%

It is necessary to say that the data such as geometry and the type and number of equipment and systems for ensuring safety in the highway is taken from Roads and Urban Development Office of Tehran Province which includes survey-based maps with proper placement signs and symptoms on it. In Figure 3 how to choose data by available maps is displayed.

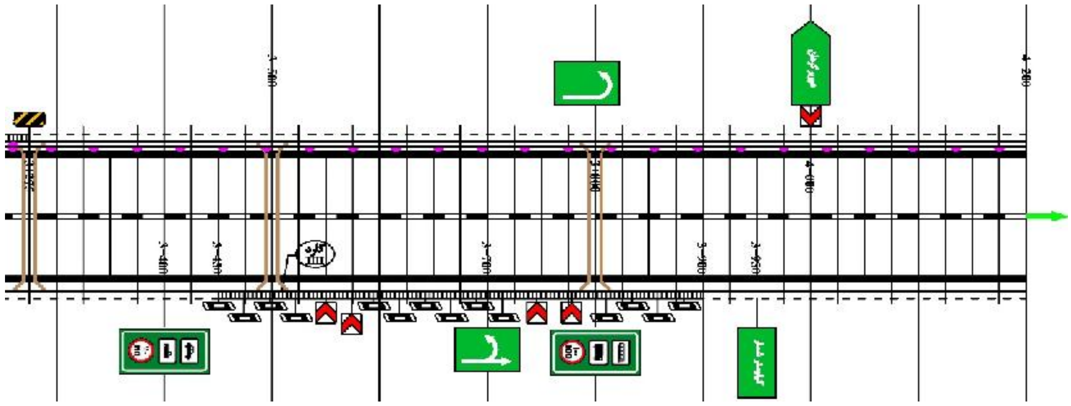


Fig.3. How to choose the necessary data by AutoCAD maps

After carried out reviews and gather information about the impact of systems and traffic control equipment on road safety performance and using collected data in accordance with Table 2, the weighting of each of the index will be discussed by AHP method. Considered equipment and indexes of road existing systems and equipment have been shown in Table 2.

Table 2. The data collection based on 12 indicators of existing equipment and systems

Road name	Route	Starting kilometer	Ending kilometer	Length of section	Safety equipment and systems											
					Disciplinary Panel (number)	The warning panel (number)	The news Panel (number)	Transverse striping (number)	Text lines (number)	speed hump (number)	Traffic lights (number)	Bumper (number)	Longitudinal striping (m)	Shield (m)	Brightness (m)	Median type new jersay 1 Guard rails 2

																Separated way 3
Tehran-Boomehen	Go	0	26+350	26.350	27	1.080	24	2	0	0	5	8	297.332	40.424	10.16	1&2
	return	0	26+350	26.350	23	1.115	23	10	0	0	5	9	151.203	35.841		
	total	0	26+350	26.350	50	2.195	47	12	0	0	10	17	448.535	76.265	10.016	1&2
Toward way length per meter				26.350	0.0009	0.0417	0.0009	0.0002	0.0000	0.0000	0.0002	0.0003	8.5111	1.4472	0.1901	
Boomehen-Firozkouh	Go	26+350	114+0.050	87.700	84	2.610	165	127	40	16	37	23	308.797	61.583	10.880	2&3
	Return	26+350	114+0.050	87.700	102	1.797	113	47	19	6	28	26	269.295	41.771	21.612	
	Total	26+350	114+0.050	87.700	186	4.407	278	174	59	22	65	49	605.092	103.354	32.492	2&3
Toward the way length per meter				87.700	0.0011	0.0251	0.0016	0.0010	0.0003	0.0001	0.0004	0.0003	3.4498	0.5892	0.1852	

Then, by help of Analytical Hierarchy Process (AHP) weighting of each of the 12 indicators shown in the table above will be discussed in order to amount and the present status of systems and traffic control equipment. Then, road safety priority number is given according to the weight of each indicator and the share of each indicator than the length of the piece. Therefore, to form the comparison matrix experts' opinions were used and the most important criteria in relation to one another according to experts is determined orally and then use the Table 3, expert opinion will be replaced with numeric scale. In this study population included 40 safety experts of General Directorate of Roads and Urban Development of Tehran Province, Firoozkooh, Boomehen and Roodehen.

Table 3. The value of the most important criteria than one another according to AHP method

Preferences		Numerical amount
quite important or very preferable	(Extend Perfected)	9
Preferences or strong desirability	(Very Strongly Perfected)	7
Preferences or strong desirability	(Strongly Perfected)	5
preferred or better	(Moderately Perfected)	3
Preferences or importance or the same desirability	(Equally Perfected)	1
Preferences among those period		8,6,4,2

It is obvious that despite the 12 criteria, we will have 12 x 12matrix, 4 main diagonal of this matrix because of the same preference than itself was one, that if a ij is one of its elements it will indicate that how a i will be superior and more important than a j.

Table 4. Comparison criteria matrix in AHP method

	Median type	Brightness	Shield	Longitudinal striping	Buffer	traffic light	Speed Hump	Script	Transverse striping	News panel	Warning panel	Disciplinary Panel
Median type	1	0.11	0.14	0.20	0.14	0.50	0.25	0.17	0.17	0.50	0.33	0.33
Brightness	9.1	1	0.13	0.17	0.50	0.25	0.33	0.25	0.20	0.25	0.50	0.20
Shield	7.3	8.07	1	0.25	0.20	0.33	0.50	0.50	0.25	0.50	0.50	0.20

Longitudinal striping	4.9	6.10	4.00	1	0.33	0.50	0.20	0.50	0.25	0.50	0.50	0.50
Buffer	7.1	1.96	5.45	3.12	1	0.50	0.50	0.50	0.33	0.50	0.50	0.33
traffic light	1.95	3.89	3.23	2.07	1.96	1	0.25	0.17	0.17	0.33	0.33	0.20
Speed Hump	3.86	3.11	2.2	5.08	1.89	4.15	1	0.25	0.20	0.50	0.33	0.25
Script	6.2	4.13	1.8	2.11	2.02	6.46	4.12	1	0.17	0.33	0.25	0.33
Transverse striping	6.0	5.06	3.89	4.14	2.91	4.15	5.09	5.90	1	0.50	0.50	0.50
News panel	2.33	4.11	1.89	2.09	1.88	2.89	1.94	2.91	2.09	1	0.17	0.11
Warning panel	3.12	1.98	1.93	2.11	2.23	2.80	3.12	4.07	2.23	6.04	1	0.14
Disciplinary Panel	3.06	4.87	5.03	3.14	3.04	5.11	4.33	3.23	1.86	8.94	7.26	1

Then, using pairwise comparison matrix for each criterion by geometric mean method, the weight of each criterion was calculated in AHP method. Following formula is used for using the geometric mean method to calculate the weight of each criterion.

$$w_i = \left(\prod_{1}^{n} a_{ij} \right)^{1/n}$$

$$w_i' = \frac{w_i}{\sum_{1}^{n} w_i}$$

Where w_i is the relative weight of i criteria and a_{ij} is the matrix AHP component of row i, column j and n is the number of criteria and for normalization of achieved weight w_i' is calculated. Notable point after the formation of matrix comparisons is calculation of incompatibility ratio which is calculated using the following equation.

$$CI = \frac{{}^{a}\max - n}{n-1} = \frac{1}{n(n-1)} \sum_{1 \le i \le j \le n} (£_{ij} + £_{ji} - 2)$$

$$CR = \frac{CI}{RI}$$

In the following equation ${}^{a}\max$ is the highest amount of Eigen value in comparing matrix and CI is compatible index and is related to $E = (£_{ij})$ turmoil matrix. RI is a random index, which is calculated using the AHP method provided values, CR also is compatible ratio and if CR amount will be less than 0.1 raised comparisons by experts are compatible with each other and otherwise comparisons must be repeated. As a result n numbers are obtained as normalized weight of each criterion (Table 5).

criteria	Median type	Brightness	Shield	Longitudinal striping	Buffer	traffic light	Speed Hump	Script	Transverse striping	Reports panel	Warning panel	Disciplinary Panel
Weight	0.167	0.147	0.121	0.107	0.078	0.044	0.051	0.063	0.085	0.038	0.064	0.035

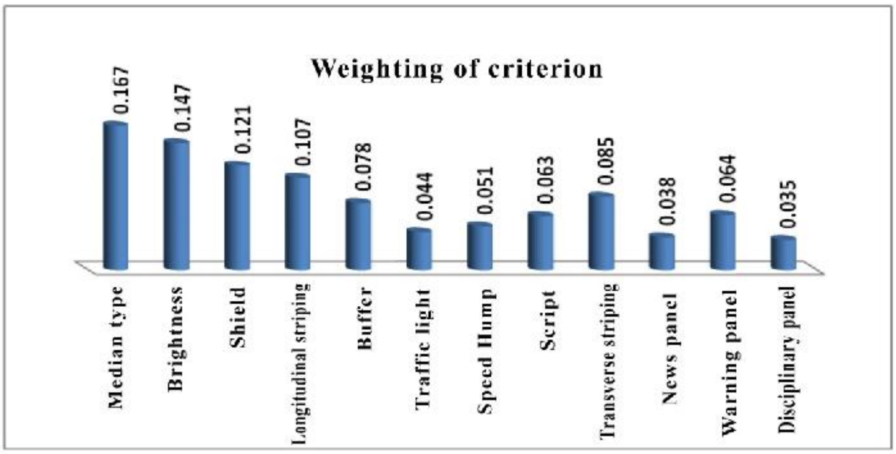


Fig.4. Road's each general indicators weights chart

As the table and chart related to the general indices of roads is shown, kind of a median, brightness and shields and longitudinal striping have been identified to have the highest impact on safety. This issue is more important according to sections with complex geometric design with horizontal curves. Also transverse striping, warning and disciplinary signs in the road have high weight. But what is striking in this way is the point that weight of horizontal marks (striping and text lines and Speed Hump) equals 0.306, and the total weight of the vertical mark (regulatory and warning signs, traffic lights) equals 0.181. This issue shows the importance and the effect of horizontal systems on roads more than marginal vertical signs. After determining the weight of each of the general indices related to equipment and security system in the road, risk index were calculated as the table below. The method of calculation is in this way that according to the share of each section of road signs and traffic facilities in the fourth quarter of this research is obtained by multiplying the weight of each criterion and finally, the risk taking of road has been introduced as number between 0 and 100, and as a percentage of a safe level. After accounting risk taking indicator of a cross section of road, we determine the priority of safety actions at that time. But according to the point that Tehran-Firouzkouh highway has different sections dealing with residential and marginal areas, and the amount of pedestrian movement in this road is high, and accident statistics indicate that the axis of pedestrian accidents have a significant contribution, therefore, this criterion is considered as a separate criterion and according to the accidents occurred at different times in the way. Therefore according to these two factors and the amount of movement in roads safety measures priority were numbered in order from 1 to 4.

- Priority 1: high general risk index and high risk of pedestrian
- Priority 2: above average general risk index and above average pedestrian's risk
- Priority 3: above average general risk index, and low risk of pedestrians
- Priority 4: low general risk index and low risk of pedestrian

Part of sub-sections risk taking calculation index categories in the case study is displayed in Table 6.

Table 6. Calculation of the sub-sections risk taking index in case study

Priority number	Risk taking amount of road	The risk amount of pedestrian	The average speed of movement	Amount of passing traffic	Length km	End km	Start Km
4	33	30	70	36.472	2.600	3.600	0
3	56	30			1.100	3.700	2.600
4	33	30			1.800	5.500	3.700
3	56	30			6.000	11.500	5.500
1	78	100			600	12.100	11.500
3	56	30			3.900	15.000	12.100
2	56	60			2.500	17.500	15.000
3	56	30			1.100	18.600	17.500
1	56	100			1.700	20.300	18.600
3	56	30			1.700	22.000	20.300

4	33	30			4.300	26.300	22.000

The general risk indicators and risk of pedestrians is shown in graph 5. From this graph we can easily identified risk index points.

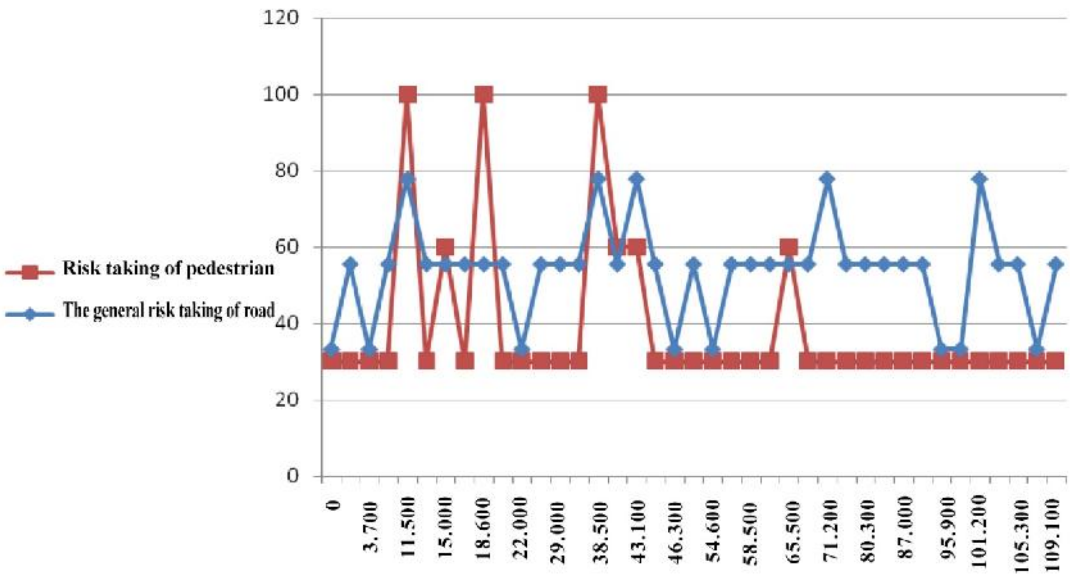


Fig.5. Risk taking indicators graph in different kilometers

5. PROVIDE SOLUTIONS

Due to budgetary constraints for development and improvement of roads, in many cases, improve the current status of way is done by low-cost and effective projects. The aim of such projects definition is that current status of roads vastly improve without doing demolition, reconstruction and renovation. In a way that in a short time and at low cost achieve tangible results in reducing the number and severity of accidents.

In this section proposed solutions are presented to promote road safety in the short-term and long-term time intervals. In Tables 7 to 10 some of the proposed short-term and long-term strategies are presented separately according to five groupings of risks.

Details of short-term strategies include: low cost and efficiency in the shortest time

Details of long-term strategies include: high cost, and efficiency in the longer time

Table 7. The proposed short-term and long-term strategies in marginal risk group

Suggested solutions		Risk reason		Risk group
Long term	Short term			
Alignment of margin and make it passable	Protection with side panel	-	Failure to provide barrier-free area	Margin
Displacement of panels using flexible board	Protect the base boards using a side panel or bumpers		Existence of unprotected obstacles	Margin
Making gables sloop measurable	Putting side panel	-	Gables steep slope and impassable for vehicles	Margin
Matching canal and bridge section with previous sections	Putting side panel	-	Canal and bridge	Margin

Table 8. The proposed short-term and long-term strategies in geometric design risk group

Suggested solutions		Risk reason		Risk group
Long term	Short term			
Geometric correction of curve and supply the required sight distance	use of horizontal and vertical warning signs	With a low radius and vision distance	Left-handed horizontal arc	Geometric design

Geometric correction of curve and supply the required sight distance	use of horizontal and vertical warning signs	With a low radius and vision distance	Right-handed horizontal arc	Geometric design
Geometric correction of curve and supply the required sight distance	use of horizontal and vertical warning signs	With low length	Convex vertical arc	Geometric design
Geometric correction of curve and supply the required sight distance	use of horizontal and vertical warning signs	With low length	Concave vertical arc	Geometric design
Considering the speed slow down length with the proposed Regulations	-	without deceleration line	Right level crossings with the possibility of turn to left	Geometric design
Use of Quater with proper length and angle to create the middle	-	-	Starting midway	Geometric design
Geometric correction of path	-	-	Failure to provide adequate visibility at intersections	Geometric design

Table 9. The proposed short-term and long-term strategies in areas with different land uses risk group

Suggested solutions		Risk reason		Risk group
Long term	Short term			
Construction of the ring road in the vicinity of residential areas	Warning to road users by means of signs and safety equipment	Passing the road through the area	residential areas	Areas with different land use
creating local tardigrade band and reducing traffic by adding it to the road from controlled intersection	Restrict user access to install warning signs and priority	Access to road without control and security	residential areas	Areas with different land use
Remove vision obstacles and provide needed sight distance	To provide brightness-warning signs – reduce traffic	-	Failure to provide adequate sight distance for pedestrians	Areas with different land use
Remove vision obstacles and provide needed sight distance	To provide brightness-warning signs – reduce traffic	-	Failure to provide adequate brightness for pedestrians	Areas with different land use
Creating pedestrian crossings without same level	Creating pedestrian crossings with same level	-	Low number of pedestrian walkways along the road	Areas with different land use

creating local tardigrade band and reducing traffic by adding it to the road from controlled intersection	Restrict user access to install warning signs and priority	-	Access to road without control and security	Areas with different land use

Table 10. The proposed short-term and long-term strategies in safety equipment risk group

Suggested solutions			Risk	Risk group
Long term	Short term	reason		
-	Install required panel in the proper position with dimensions specified in bylaws and standard side distance from paving edge	Left-handed horizontal arc	Lack of signage	Safety equipment
-	Install required panel in the proper position with dimensions specified in bylaws and standard side distance from paving edge	Right-handed horizontal arc	Lack of signage	Safety equipment
-	Install required panel in the proper position with dimensions specified in bylaws and standard side distance from paving edge	right Intersection exit	Lack of signage	Safety equipment

-	Moving the position of lighting and place it in a place with good visibility	The radiation angle of the sun	Installation of traffic lights	Safety equipment
Installation of ventilation system inside the tunnel	Warning to drivers and stop ban	-	Lack of ventilation system inside the tunnel	Safety equipment

Also in figures 6 to 8 examples of low-cost and quick measures have been displayed for promotion of the status of the equipment and safety systems and horizontally and vertically signs.

Fig.6. Vibration groove of road margin

Fig.7. Examples of bar lines in road margin to reduce speed

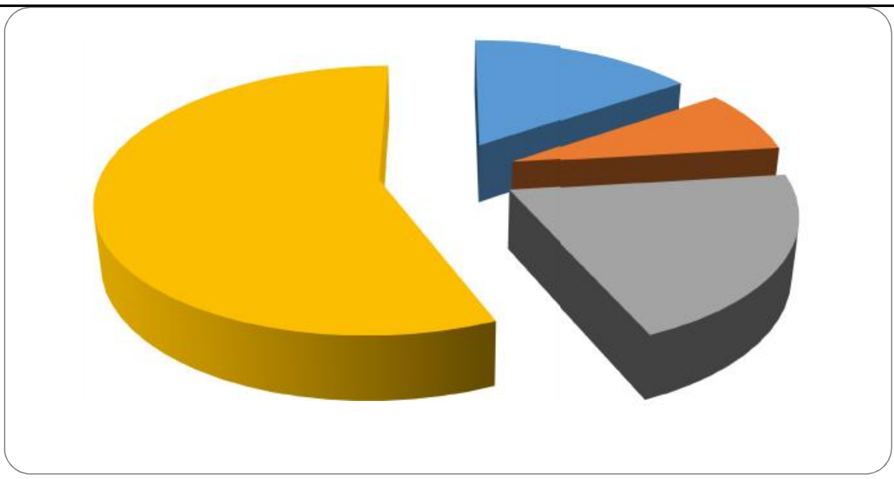
Fig.8. The combination of vertical and horizontal signs to reduce traffic

6. CONCLUSION

Improving road safety requires constant integrated and systematic efforts in various fields, such as safety management and coordination, proper system of collection, processing and presentation of data traffic, designing and building safe roads, improvement and elimination of accident-prone places, advertising and effective education of safety, vehicle safety standards, regulations and traffic rules and apply them, rescue and medical emergency, that determining the status of each one of them has various parameters. According to the recommendations by international bodies, determining the major indices that their obtaining is an essential condition for achieving improved road safety situation is necessary. The results of this study have shown that in addition to factors affecting the geometric design of roads, physical agents and equipment and signs on the road, as well as indicators related to their maintenance also have an important role in ensuring road safety. The total weight of roads' horizontal signs impact (striping and text lines and speed hump) were equal 0.306 and the total weight of road vertical signs (regulatory and warning signs, traffic lights) were equals 0.181. This shows the importance and the effect of horizontal systems on roads more than marginal vertical signs. That has up to 45 percent importance on road immune function. According to prioritize taken in this research, it was found that 56% have 4th priority in safety improvement, 21% have the third priority and 15% have first priority, 8% have second improvement Priority that are shown in Table 11.

Table 11. Percentage of sections priority to improve safety in case study

Priority number	Number of priorities
Priority 1	**6**
Priority 2	**3**
Priority 3	**8**
Priority 4	**22**



7. REFERENCES

[1] World Health Organization, "Road Safety not Accident", A Brochure for World Health Day, 7 April 2004.

[2] Ghaffari, Gh. Zoghi, h. The effect of using road safety supplying equipment and systems and determine their role in suburban road safety performance, 1394, A Thesis of Islamic Azad University, Ayatollah Amoli Science and Research branch.

[3] Ministry of Transportation, the Supreme Council of reform, determine the contribution of factors contributing to the occurrence and severity of road accidents, based on their abundance in 1381.

[4] La Torre, F., et al., Improving Roadside Design to Forgive Human Errors. Procedia-Social and Behavioral Sciences, 2012. 53: p. 235-244.

[5] Thomson, R., D06: European Best Practice for Roadside Design: Guidelines for Roadside Infrastructure on New and Existing Roads. 2006, Deliverable.

[6] Manual on Uniform Traffic Control Devices for Street and Highways, U.S. Department of Transportation, Federal Highway Administration, 2003 Edition.

[7] Asgharpour, MJ. "Multiple Criteria Decision Making", Tehran University Press, 191-296, Fourth Edition, 1385.

[8] Ghodsi Pour, H. "Analytic Hierarchy Process (AHP)", Amir Kabir University, Fourth Edition: 1384.

How to cite this article:
Ghaffari G and Zoghi H. The effect of using road safety equipment and systems and determine their role on the suburban roads' safety performance. J. Fundam. Appl. Sci., 2016, *8(3S), 631-653*.