

Feasibility Study on Creation of Bike Paths Network in Urban Transport (Case Study: Rasht City)

Ali Gerami Matin*, Fereidoon Moghadasnejad

Department of Civil Engineering and Environment, Amir Kabir University of Technology, Tehran, Iran

Keywords:	Abstract
Bike, Bike path network, Questionnaire, Traffic flow.	Increasing growth in the extent of urban traffic raises numerous problems including air pollution, heavy traffic and waste of time in city of Rasht. One approach to reduce this problem in most of developed countries can be considering bicycle riding in the existing transport methods, that huge benefits can be resulted in case of proper execution of this approach. In this study, for the purpose of feasibility study, creation of bike paths networks in city of Rasht was considered starting from the Shahr-dari square and passing streets Shariati, Motahari, Imam Khomeini and returning to the square. In this study, using traffic data taken from this path and random distribution of questionnaires among the users in these paths, the predictions about effect of establishment of special bike paths networks on the traffic flow were prepared. Using the results of the questionnaires, it is forecasted that using the vehicles especially taxi has been diminished in case of proper execution of this project, and using bike will increase for 25 times as a human-oriented transport method.

1. Introduction

By increasing population and urbanization as well as coming and going inside the city, numerous problems have been raised in transport system. Heavy traffic, increase in travelling time, increase in accidents, air pollution, noise pollution are assumed as the outcomes from instable transport system within urban regions. Stability is not acquired only through creation of changes in design of paths, patterns of management of vehicles, but it is considered as the need to changing the thinking style to the recognition and assessment of possible approaches to resolve transport problems [1]. In the past, design of paths, spaces and spatial communications has been in a way that a special attention has been paid to humans as the leading users of pathways and routes, and maximum terms and conditions have been considered for the human transport and communications. Indeed, due to expansion of vehicles after industrial revolution, expansion of routes, roads, intra-urban and inter-urban routes has come to realize, regardless of the terms and conditions with their main origin as human and nature, whereby

* Corresponding Author :
E-mail, geramimatini.ali@gmail.com

complicated problems have been raised in the urban transport network especially in the big cities and urban centers. One of the approaches which has been implemented in the developed countries is the creation of bike paths besides individual and public transport paths, enabled to play a major role in reducing transport problems [2].

Unique advantages of bike indicate the bike as a transport method in most of the countries worldwide, that bike riding is a common method for travelling in the countries throughout the world. Bike's higher displacement speed than speed of vehicle in short urban travels, needing to less space for park and coming and going, low possession cost, more adaptability with sustainable environment, less threat to pedestrians, helping for reducing air pollution and noise pollution are considered as advantages of bike riding. Further, studies indicate that bike riding plays a major role in citizens' general health that is under risk due to lack of movement [2, 3]. To the individuals without the possibility to use vehicles, ride biking can be a way to reach to the destination, especially in the travels which require long walking or in the travels in which there is no possibility to use public transport vehicles [4]. Under the conditions that there is the possibility to use bike besides use of public transport systems, travelling time in the travels can substantially reduce so far as the users of personal vehicles change their idea to using this vehicle [5]. There are a variety of factors which affect using bike riding that can be characterized in personal and family characteristics, structure of city, weather conditions, infrastructures and facilities of ride biking. Age, gender, characteristics of body, structure of family can be considered as the most important personal and family characteristics. Some studies have refers to women's less desire to ride biking compared to men, with an emphasis on positive correlation between men population and bike riding [3, 6, 7, 8]. Depending on where the bike paths will be established, and how is the region in which the bike paths will be established, and to how much is the extent of existing space for establishing these paths, a variety of bike paths are used. In generally, there are four type of bike paths as follows:

- Exclusive path: this path is separate from the path considered for other vehicles, developing only for bike riding. The width of this path ranges from 2.4 to 3.6 meters, developing in the leisure areas, parks and the regions out of city in which there is no spatial limitation and there is the possibility to separate the routes [2].
- Semi-exclusive paths: under the conditions that there is less space for bike riding and there is limitation for development of bike riding, the semi-exclusive paths are used. These paths are separated via physical barriers such as difference on surface, development of wall. Width of these routes ranges from 1.5 to 1.8 meter [2].

- Complex paths: these paths are designed in a complex way for ride biking, and their width ranges from 2.4 to 2.6 meter. These leading routes are specified through flooring, symptoms and separated boards [2].
- Joint paths for bike riding and pedestrian: in the cases that volume of vehicles goes beyond the practical capacity of street or the width of street does not allow to provide an extra bar for bike rider's coming and going, or decreasing width of roadway is not possible, common use of pedestrian and ride biker will occur, where it must pay a particular attention to this point that volume of coming and going to the allocated space be sufficient. Width of these paths ranges from 1.5 to 1.8 meter [2].

2. Problem Statement and Aims of Research

As the Rasht county has been transformed to one of the metropolises in Iran, and traffic and air pollution and noise pollution especially in summer that a large number of passengers refer there have increased, the necessity of establishment of special bike paths network is felt in this city in future years. Feasibility study on creation of bike paths network in urban transport has been considered in the present research. This study aims to forecast the changes in pattern of traffic flow by adding bike riding to the urban transport system in the city of Rasht. Further, some suggestions at the area of development of special bike paths networks at the streets under study have been proposed.

3. Research Method

With regard to the recent studies on traffic in Rasht County, the data of traffic flow has been taken from two central rings in several streets. In this study, the downward ring which has started from Shahr-dari square, and passed streets Shariati, Motahari, Imam Khomeini, finally returned to the square, is considered. This ring has been indicated in Figure 1. These data include traffic flow from three streets Shariati, Motahari, Imam Khomeini which have been transformed to the ride biking. At their times including morning, noon and evening, there results have been represented in tables below. In table 1, the coefficients for transforming the vehicles to the bike riding have been represented. The duration for extraction at three periods of times including morning, noon and evening during 2 hours in turn 7:15, 11:30 and 17:45 has been represented.

Table 1. Coefficients for transforming the vehicle to the riding

Coefficients for riding	Vehicle
1	Riding
2	Truck
2	Bus
0/33	Motorcycle
0/2	Bike

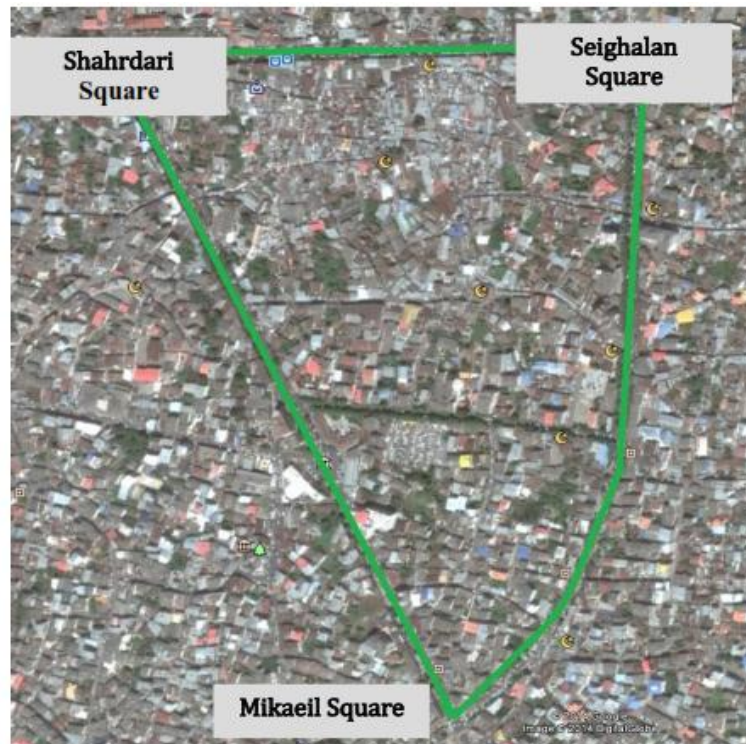


Figure 1. The region to extract information from traffic flow

In Tables 2-4, the traffic flow in three aforementioned streets has been represented. As specified in these tables, the highest traffic flow associates to street Motahari in morning.

Table 2. Volume of traffic passing through Motahari Street

Street : Motahari	The vehicle as the riding per hour		
	Morning	Noon	Evening
Shariati(Zarchoob), Motahari	552	358	587
Hajiabadi, Motahari	55	107	144
Shariati(Shahr-dari), Motahari	1035	863	697
U-turn	101	81	117
Motahari, Seighalan square	1514	1413	1255
Sum of directions	3257	2822	2800
Maximum directional traffic	1743	1409	1545

Table 3. The volume of traffic passing through the streets of Imam Khomeini

Street : Imam Khomeini	The vehicle as the riding per hour		
	Morning	Noon	Evening
Saadi, Imam Khomeini	259	176	164
Shariati, Imam Khomeini	190	152	209
U-turn	484	505	427
Hajiabad, Imam Khomeini	112	66	72
Imam Khomeini, Shahr-dari square	648	664	641
Sum of directions	1693	1563	1513
Maximum directional traffic	1045	899	872

Table 4. Crossing the road traffic law

Street : Shariati	The vehicle as the riding per hour		
	Morning	Noon	Evening
Shariati, Elm olhoda	57	176	45
Saadi, Shariati	191	62	164
Shariati, Imam Khomeini	193	222	207
Shariati, Shahr-dari square	1402	1377	1338
Sum of directions	1843	1837	1754
Maximum directional traffic	1402	1377	1338

In this study, for feasibility study on establishment of special bike paths networks in city of Rasht, 600 questionnaires were distributed among various users at the considered ring area. In these questionnaires, various questions including age, common methods for travelling at present time and users' views about this project were asked. After collecting the questionnaires and examining them and removing the improper ones, 500 questionnaires were considered for analysis. These 500 questionnaires were considered as the statistical population which has been selected in random. After analyzing the results from pooling and considering the existing traffic data, it can represent a proper estimation for the change in travelling methods at the area of considered ring. In following, an investigation into the proposed questions and the results of pooling has been represented.

4. Results and Discussions

By analysis of the collected questionnaires, the results below were obtained:

Age of the users who were asked the questions can be seen in Table 5 and Figure 2. As shown, over half of the users are in age group 25-40 years old.

Table 5. Frequency of age group of the participants

1	18-25 years old
2	25-40 years old
3	40-50 years old
4	Older than 50 years old

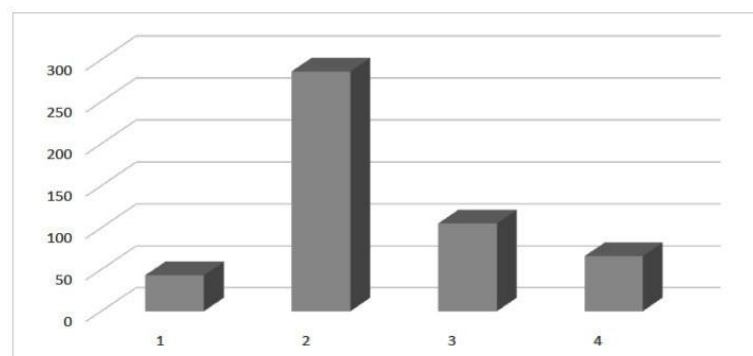


Figure 2. frequency of age groups of the participants

In the questionnaire, after describing the aforementioned project and strengths and weaknesses from use of bike as one of the travelling methods, the participants were asked to announce their agreement or disagreement with the considered project. The results have been represented in Figure 3.

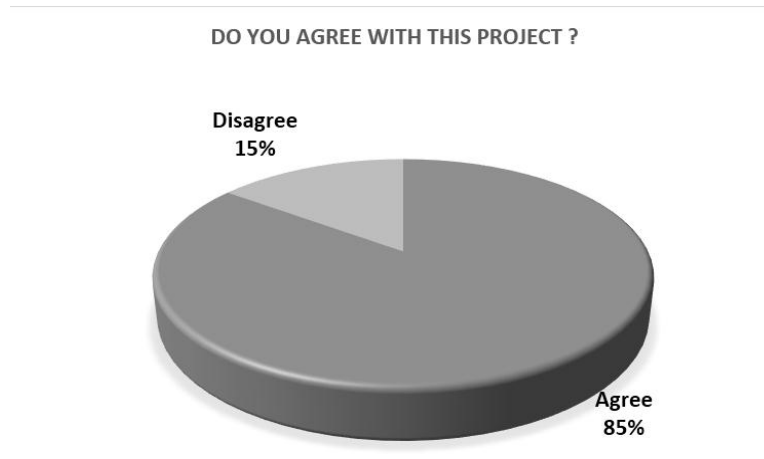


Figure 3. The user agrees to the plan

This implies that a majority of users will welcome travelling via bike in case of proper conditions for bike riding. As the questionnaires had been distributed at the area of considered ring, the users were asked “what method is used at this area”. The results were as follows:

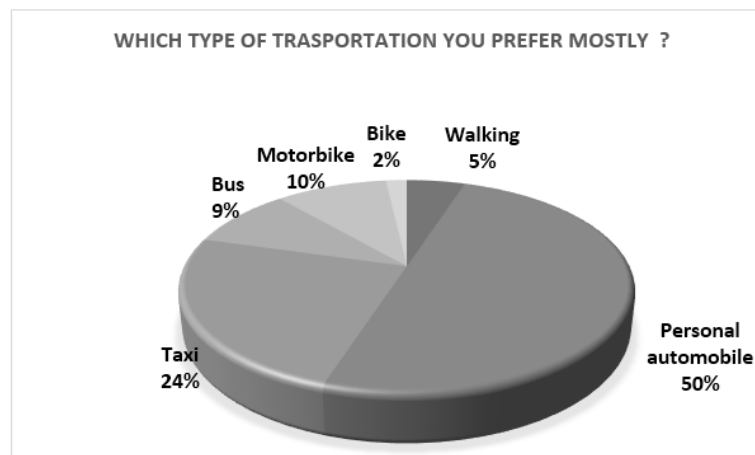


Figure 4.Proportion of vehicles used in the present study Ring

As shown in Figure 4, currently 50% of the users use their personal automobile at this path. The extent of using personal automobile is very high, which differs from that of in developed countries. 24% of users have introduced taxi as their traveling method at these paths. Motorbike (10%) and bus (9%) have been considered as the next travelling methods. At the current conditions that there are no bike paths networks in Rasht County, only 2% of users use bike for their coming and going in this

ring. On the whole, 7% of the users use the human-oriented methods for their travelling at this area, indicating this figure very low compared to that of in developed countries. In another question, the users were asked to mention three transport methods which are currently used at intra-urban traveling concerning the options existing in the questionnaire. The existing options have been represented in Table 6.

Table 6. The methods used by users at their intra-urban travels

Which of traveling methods are considered by you in your intra-urban travelling methods?	
1.	Walking
2.	Personal automobile
3.	Taxi
4.	Bus
5.	Motorbike
6.	Bike riding

In this question, to simplify the analysis and organize the results, 10 combinations have been selected, and then the users were asked to select one of 10 combinations. Walking as the travelling method was considered at all these combinations.

Table 7. Composition of travel for Members

1--2--3	1
1--2--4	2
1--2--5	3
1--2--6	4
1--3--4	5
1--3--5	6
1--3--6	7
1--4--5	8
1--4--6	9
1--5--6	10

In the next question, after describing the project for establishment of bike paths network and describing the advantages and disadvantages in this projects, the participants were asked to describe their three transport methods likewise the previous stage. Figure 5 indicates the results associated to this question.

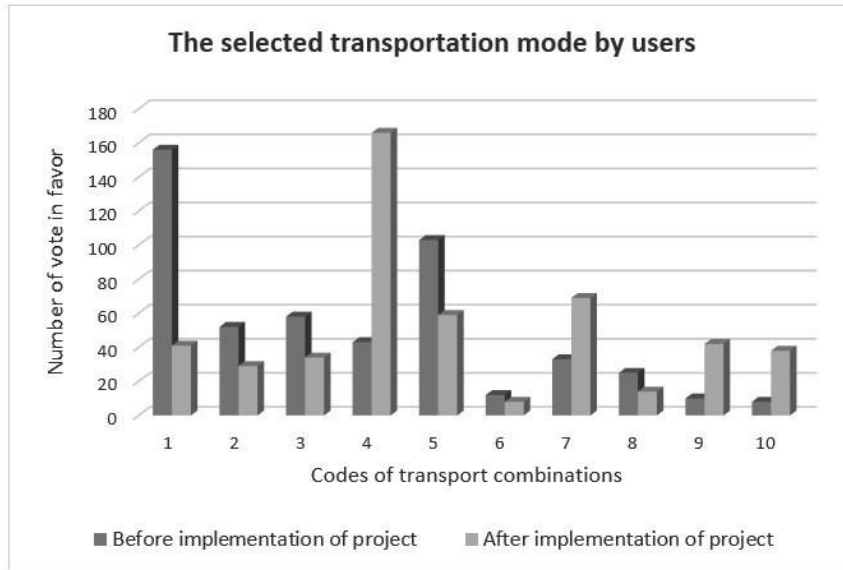


Figure 5. Comparison of the composition of the trip, before and after the construction of a network of bike paths according to users

According to the figure, it can observe that combination of walking, personal automobile and taxi is the most used travelling method in Rasht County. By proper implementation of bike paths networks, walking, personal automobile and bike riding are forecasted as three prevailing methods for intra-urban travels by the users in Rasht County. Further, it can forecast that human-oriented transport reaches to 25 times to the current conditions in future. With regard to the data in Tables 2, 3 and 4, maximum traffic is represented with 1743 riding per hour associated to street Motahari. Using the formula below, traffic at the tenth year has been obtained :

$$\text{Traffic at the } n\text{th year: current traffic} \times (1+r)^n$$

In this equation, r represents the percent of annual traffic growth, that has been considered equal to 3% regarding the studies on traffic. n represents the year under study that 10th year has been assumed as the basis for evaluation.

$$\text{Traffic at the 10th year: } 1743 \times (1+0.03)^{10} = 2343$$

As the capacity of intra-urban two-way streets is about 2200 vehicles per hour, this street under the current status cannot meet the needs in future. With regard to the results from pooling, it can forecast that traffic flow will reduce in case of reducing use of vehicles and establishing bikes paths networks. It should be noted that the possibility to use bike will not be provided at rainy seasons. Hence, in designing bike paths networks, it must avoid physical separators so as to use bike paths networks at rainy seasons. For this, it is suggested using complex paths or separators by traffic signs.

5. Conclusions

With regard to the studies, it can conclude the factors below

1. About 85% of the statistical population agrees to use bike as an urban transport method. It can conclude that the users will welcome this project in case of creation of bike paths networks.
2. With regard to the results of this study, in case of proper implementation of this project, it is forecasted that use of transport methods especially taxi has been diminished and using bike will increase for 25 times as a human-oriented transport method.
3. With regard to the reduction in use of taxi and personal automobile in future, it is forecasted diminishing traffic.
4. It is suggested using complex paths or separators by traffic signs to design bike paths in Rasht County.

References

- [1] Sustainable Development of Urban Studies and Planning: Urban sustainable transport initiatives in Canada, October, 8910, 12-17 (2010).
- [2] Applied Sociology: Measures of location and design of bicycle paths (with emphasis on the city), Fall, 135-152 (1390).
- [3] Turzny Asgari, A., Habibian, M.: The Identification of Effective Policy on Bike Sharing System in Tehran, Iran, Thirteenth International Conference on Transportation and Traffic Engineering, Milad Tower Conference Center, 1-19 (2014).
- [4] Wen, L. M., Rissel, C.: Inverse Association between Cycling To Work, Public Transport and Overweight and Obesity: Findings from a Population Based Study in Australia, Preventive Medicine, (2007).
- [5] Murphy, N. B., Knoblauch, R.: Hispanic Pedestrian and Bicycle Safety. The Federal highway administration (FHWA) and national highway transportation safety administration, (2004).
- [6] Sayarshad, H., Tavassoli S., Zhao, F.: A Multi-periodic Optimization Formulation for bike Planning and Bike Utilization. Applied mathematical modelling, (2011).
- [7] Sener, I. N., Eluru, N., Bhat, C. R.: An Analysis of Bicyclist and Bicycling Characteristics: Who, Why And How Much Are They Bicycling? , Transportation Research Board, National Research Council, Washington DC, (2009).
- [8] Parkin, J., Wardman, M., Page, M.: Estimation of Determinants of Bicycle Mode Share for the Journey to Work Using Census Data. Transportation Research Board, National Research Council, Washington DC, (2008).