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Planning and Design of Effective Flyover at Shahid Mazari Intersection in Kabul city, Afghanistan

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Abstract:

Kabul city the capital of Afghanistan is the most traffic crowded city in Afghanistan. During two decades after interior war the population of Kabul city has increased since 2000, day by day the immigrants are entered to Kabul city from Pakistan and Iran. Also because of lacking facilities in rural areas the most people are shifted to the cities. The traffic congestion is directly related to vehicles and population of a city, so Kabul city roads currently contains about 700 thousands vehicles, while the Kabul city roads normally capable of 100 thousands vehicles. Shahid Mazari Intersection (S.M.I) is one of the most traffic congested area in Kabul city.

This study involves planning and design of an effective flyover bridge over S.M.I in order to solve the traffic congestion and give a positive idea to the government that, the same project could remove the traffic congestion around the Kabul city. The approach for this thesis is based of mixed method, a combination of qualitative and quantitative research. Geometric data survey was obtained by secondary data collection via inserting satellite image in to arc GIS and approved by primary method, measuring the roads on the field site. Traffic data survey was recorded by primary method by counting the amount of vehicles on the field site.

The new flyover bridge was designed over S.M.I, Using IRC Indian Road Congress, AASHTO and other standard code. In conclusion the designed Flyover at S.M.I is being effective and full of advantages for more than 3 million people of Kabul city.

Keywords: designing flyover, geometric data survey, traffic data survey, traffic congestion.

1. INTRODUCTION:

Constructing a flyover and bridges over an intersection is only reasonable way in order to remove the traffic congestion and help the people to enjoy from traffic, this thesis contains planning and design of flyover that passes over an intersection in order to finish the crowding of the traffic from the intended area. This flyover which is located over Shahid Mazari Intersection (S.M.I), PUL-E-SOKHTA Kabul Afghanistan, contains 50m long graded road to the north ward , 70m graded road to the south ward and 4 span with 20m center to center, totally 80m flyover. The flyover is designed from Koteh Sangi toward the Darulaman, the flyover is designed according to Indian road congress (IRC). Every part of the project is standard and can be reasonable to solve the traffic problem in the study area. The figure of the intersection is shown in figure 1a.

(S.M.I) is a chowk between three main roads; KOTE SANGI road (60m, width) toward the north goes to city, Afshar, new city and airport, Faiz Mohammad Kateb (60m, width) goes to Darulaman and Shahid Mazari road (40m, width) toward the west goes to Dashte Barchi. The address of the project at master plan of Kabul city which is planned by ministry of and satisfied by president of Afghanistan is shown in figure 1b.

Figure 1a: Shahid Mazari Intersection (S.M.I).

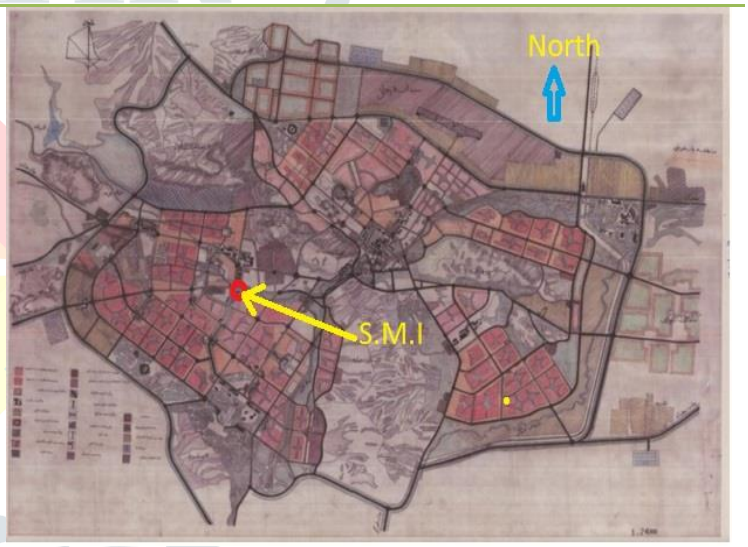

Figure1b: location at master plan of Kabul city.

2. OVERVIEW OF TRAFFIC PROBLEM AT (S.M.I):

The main causes of traffic congestion which currently exist at S.M.I are described in this section, this study classify the problems in to three parts as the following table.

Causes of traffic congestion

Table 1: classifying the causes of traffic congestion at S.M.I.

Lack of infrastructure	Misusing the roads	Lack of traffic system
• Crossing • Pedestrian bridge • Bus station • Parking • Lateral roads • Flyover bridge	• Using as bus station • Using for peddlers and vendors.	• Traffic light and sign • Breaking traffic law • In adequate traffic plan

2.1 Lack of Infrastructure:

Infrastructure is the set of facilities and systems that support the sustainable functionality of households and firms. Such as roads, flyovers, bus station, pedestrian bridge and etc. this research find out that the lack of public infrastructure caused traffic congestion and illustrate as follows.

2.2. Misusing the Roads:

Misusing the roads means using the roads in another purpose except traffic stream. The figure 1.5 and 1.6 clearly shows that more than half parts of the roads are used for bus station, vendors or peddlers and parking. In this case this action caused traffic congestion in the field.

Figure2: misusing the road for bus station.

Figure3: parts of the roads which are occupied by peddlers.

2.3. Insufficient Traffic System:

The third factors depend to traffic system, lack of traffic light and sign in the field, breaking traffic law from drivers and inadequate traffic plan caused traffic congestion.

3. OBJECTIVES OF THE RESEARCH:

- To evaluate the traffic problem at S.M.I.
- Obtain the correct volume of traffic stream at S.M.I.
- Draw the current view and traffic stream with AutoCAD.
- Obtain the current geometric situation via inputting the satellite photo of the field into arc GIS.
- Design a new plan and flyover for S.M.I according to Indian Road Congress IRC and AASHTO. In order to could solve traffic congestion.
- Providing the 3D of new plan and flyover with 3Ds Max.

4. METHODOLOGY AND DATA COLLECTION:

The approach for this thesis is based of mixed method, a combination of qualitative and quantitative research. Also both the primary data collection and secondary data collection were used in this dissertation to receive reliable and acceptable geometric and traffic data.

Primary data were collected from field visits consist of recording the number of different vehicles which are entering in to the S.M.I and the number of vehicles which exit from S.M.I along the roads. Measure the width of roads on the field site with meter. Different questionnaires and survey were organized with different taxi drivers. The author of this thesis evaluated the entire traffic situation from morning up to night; in this case he got complete familiarity with the situation of project area.

Secondary data were collected include various text book, engineering codes like AASHTO, IRC, research paper, thesis, videos, aerial photos and newspapers.

In this thesis different software were used, the geometric survey of the study area digitized by arc GIS (geographic information system), the 2D plan of the study area was drawn by AutoCAD, the 3D of the fly over at the study area was done with 3Ds MAX,

The following table collected all this data collection approach and clears to all the readers.

Table2: arrangement of data collection.

Primary method	Secondary method	Analyzing the data
counting the vehicles	Text book	arc GIS
measure the roads	Research paper	Auto Cad
evaluation of traffic situation	Newspaper	3D max
	Videos	
	Engineering Codes	

4.1. GEOMETRIC DATA SURVEY WITH arc GIS:

The basic purpose of geometric survey was to input the essential geographic data related to the proposed crossroad into arc GIS software to produce a map or draw the actual current shape of the crossroad.

At the first step of the field study, satellite imagery maps of the Kabul city were inserted into arc GIS. Second step digitized the borderline of roads, centerline of roads, and distinguished the circular shape at the center of crossroad. Third step found the coordination of basic points on borderline, ends of bridges and center of crossroad. Figure 4a shows satellite image inputted into arc GIS. Then the attribute table and map report are saved from this software. After finding all the dimensions of roads and crossroad via arc GIS the author could draw the 2D of the exact intersection and roads by AutoCAD with the help of arc GIS. In this case it could be done only the current behavior of the study area and prepare for next step.

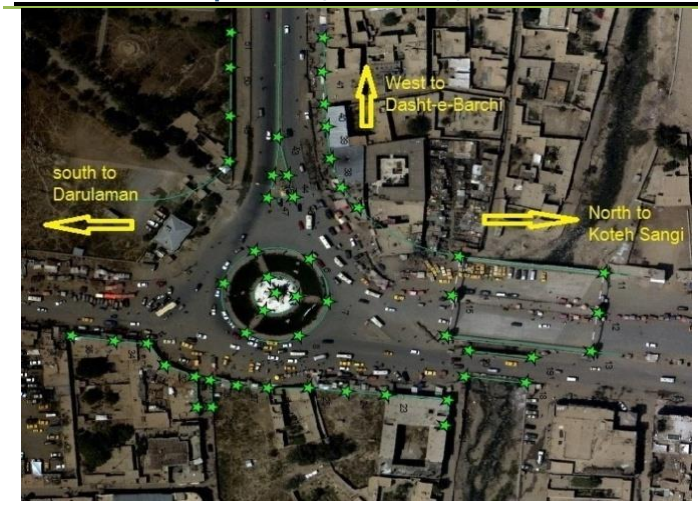

Figure 4a: satellite photo of the S.M.I.

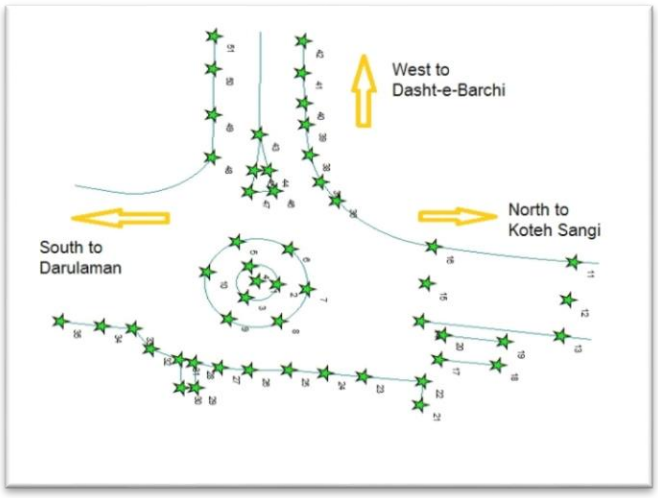

Figure 4b: reports from arc GIS.

Figure 4a, shows that the south part of crossroad is under planning. But the green line shows the actual size of roads according to updated photo of the crossroad. The width of road toward the south of crossroad is 60m, width of road to the west ward is 40m and width of road to the north ward is 68m.

Finally figure 2.3 shows the exact and current geometric shape of the S.M.I. this figure is drawn by AutoCAD and that is applicable for the next step like new planning and producing the 3 D of the crossroad.

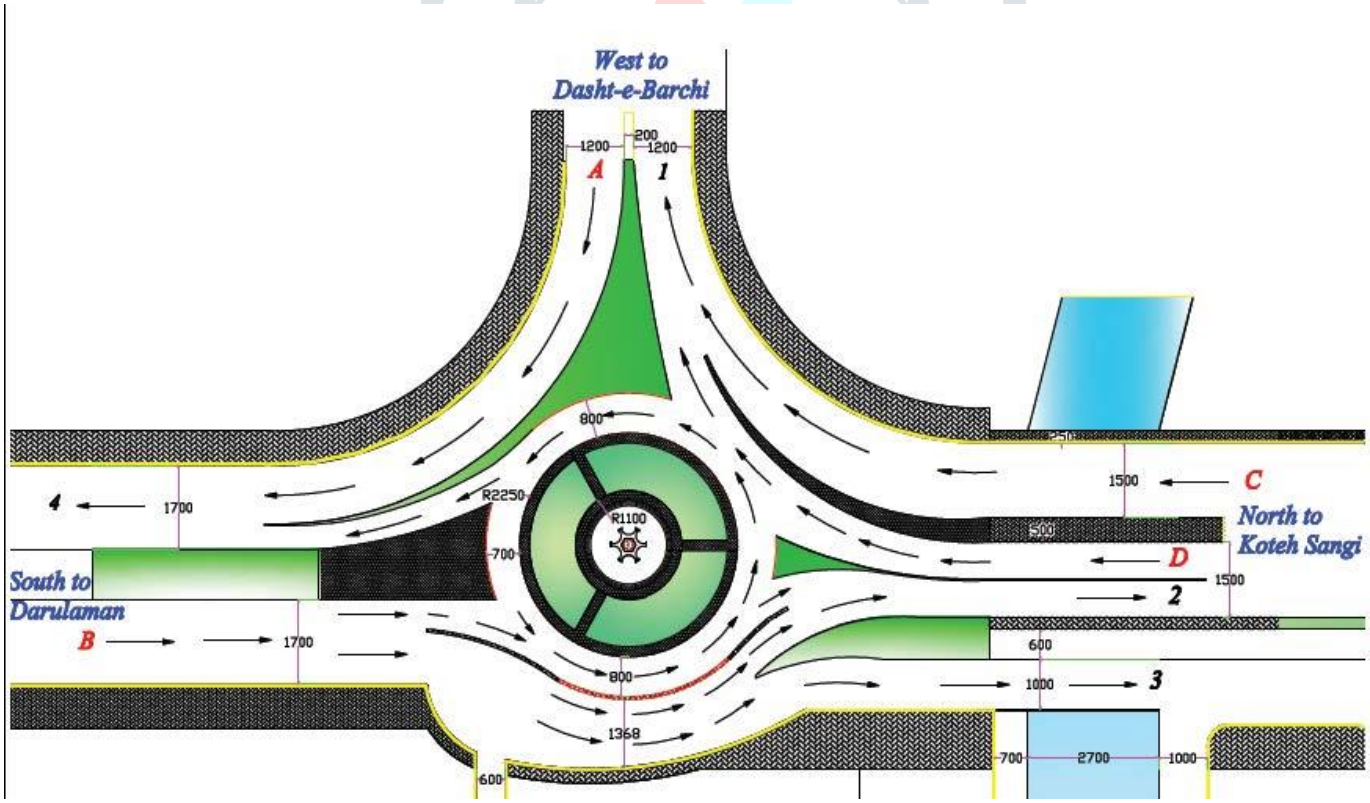

Figure5: Plan of the current geometric and traffic situation of the S.M.I.

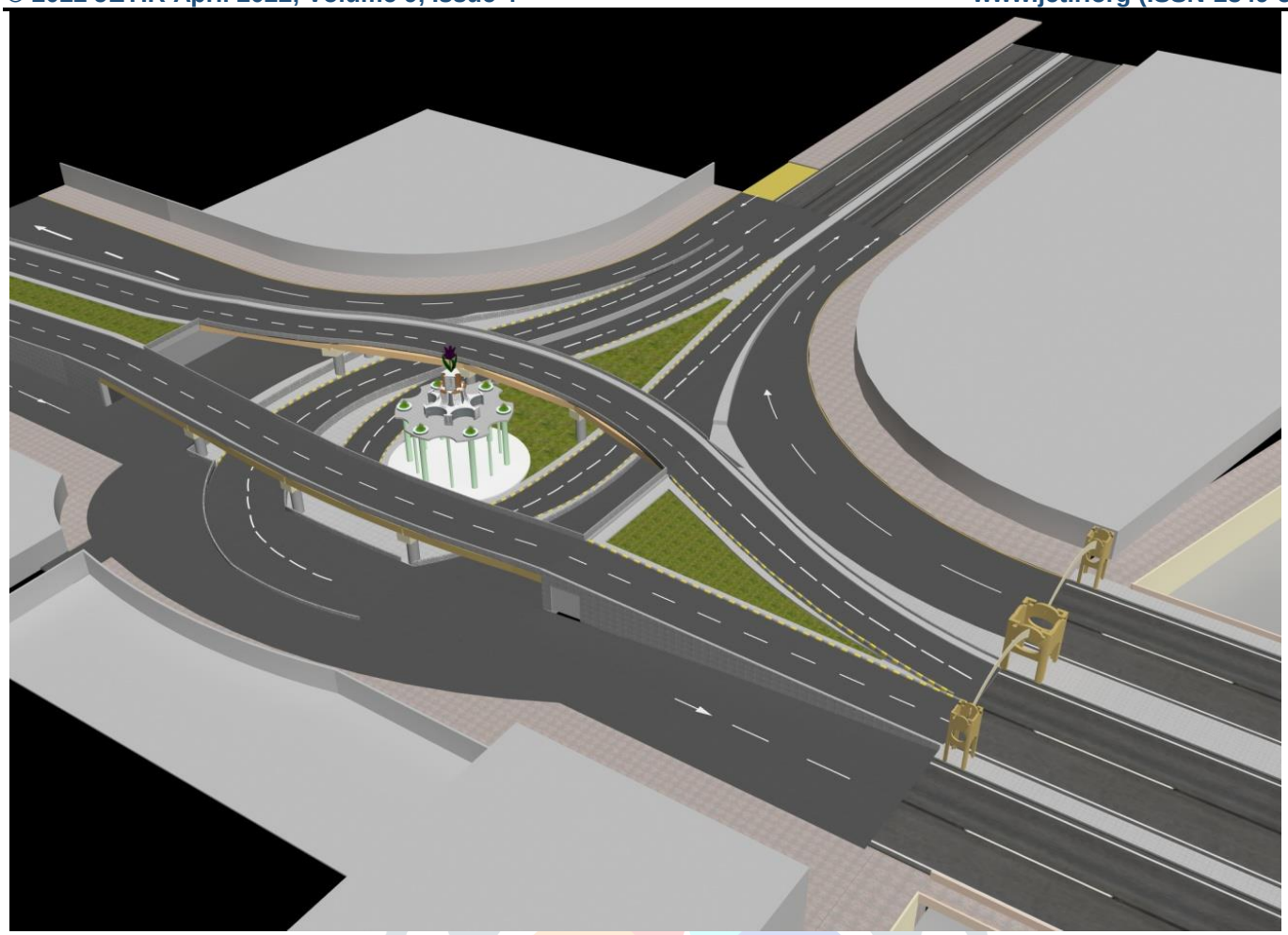

Figure2.4: 3D of the project.

4.2. TRAFFIC DATA SURVEY:

According to figure 5, vehicles which are entering to the intersection, are recorded in table 2.2. Entering points are named with capital letters like A, B, C and D. also all the vehicles which are exit from the intersection toward the west, south and north are recorded into table 3. Exit points are named as 1, 2, 3 and 4. All the vehicles are classified into 5 categories like corolla, townace, caster, mazda and Toyota. This classification of vehicles is shown in figure 6; corolla includes all private and small cars. Townace that is carried 10 passengers use only on transportation line. Caster is the most common vehicles which are working on Dasht-e-Barchi transportation line and carry 30 to 60 passengers. Toyota includes all high frame private cars like four runners, land cruiser, Toyota hilux, lexes and etc. the fifth category is Mazda which carry loads up to 10 tones among the city.

Corolla

Townace

Caster

Mazda

four runners

Figure 6: five category of vehicles.

The traffic data was recorded on 21/Feb/2021 Sunday at 4to 5:30 pm. Data of traffic volume is obtained b writing down all kinds of vehicles passing from points A, B, C, D, 1, 2, 3, and 4 during 15 minutes of time interval on crowding time between 4pm to 5pm. then it was converted into traffic volume with one hour of time interval then converted into Passenger Car Unit (PCU) by multiplying the number of vehicles with the PCEs. The speed survey conducted on this stretch of the roads indicated from 0 to 15km.

Table3: Recorded amount of vehicles at entrance and exit points during 15 minutes time interval.

point	direction	Corolla	TownAce	Caster	Mazda	Toyota	Total	Percentage
A	entrance	108	91	24	19	10	252	11%
B	entrance	193	118	22	24	60	417	19%
C,D	entrance	248	120	14	20	24	426	20%
1	exit	163	96	25	11	19	314	14%
2,3	exit	170	98	11	20	38	337	15%
4	exit	223	125	24	32	25	429	20%

4.2.1. Analyzing traffic Data:

In this part, the number of vehicles which are recorded for 15 minutes and shown in table 3, are calculated and evaluated for one hour period of time 4 to 5 pm, and shown According to figure 2.7, and following tables.

Table3: recorded vehicles entering from west (Dasht-e-Barchi), North and south to other side.

West	direction	Corolla	Townace	Caster	Mazda	Toyota	Total	Percentage
A,E,F	*	432	364	96	76	40	1008	100%
A-2,3	to city	380	272	44	48	20	764	76%
A-1	Turning	0	80	44	0	0	124	12%
A-4	Right	52	12	8	28	20	120	12%

North	direction	Corolla	TownAce	Caster	Mazda	Toyota	Total	Percentage
at C,D	*	992	480	52	80	96	1700	100%
C,D-1	to right	532	344	52	28	36	992	58%
C,D-4	Darul-an	460	136	0	52	60	708	42%

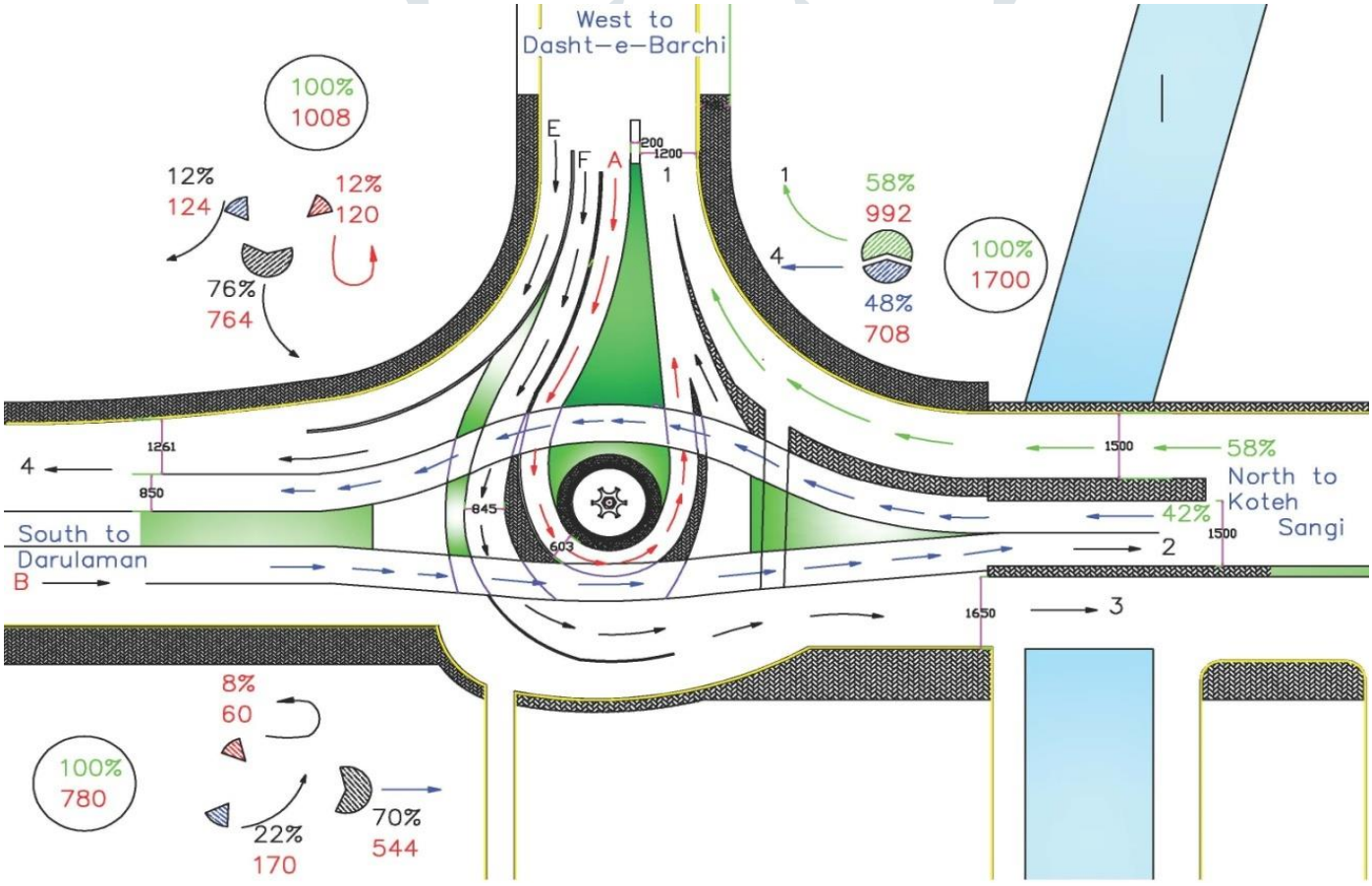

Figure7: percentage and amount of vehicles on new plan of S.M.I.

south	direction	Corolla	TownAce	Caster	Mazda	Toyota	Total	Percentage
at B	*	440	120	0	48	172	780	100%
B-2,3	to city	260	120	0	32	132	544	70%
B-4	Turning	60	0	0	0	0	60	8%
B-1	left	120	0	0	16	40	176	22%

4.2.2 Comparing current traffic situation with new plan of S.M.I:

According to figure7, the vehicles are entering from west side divided three parts:

- From 1008cpu per hour only 120cpu (12%) of vehicles like townace and caster turn back toward the west through road A to 1. These vehicles can use two lanes road A to 1 without disrupting other side and congestion.
- 124cpu (12%) of vehicles are passing toward the Darulaman south ward. The two lane road E to 4 could be appropriate for 1500cpu according to IRC, so this lane also can be without traffic congestion.
- 764cpu (76%) of vehicles entering from west ward pass under the flyover through two lanes road F to 3, go to Koteh Sangi. Two lanes road F to 3 is also for 1500cpu, in this case it can be effective for long times.

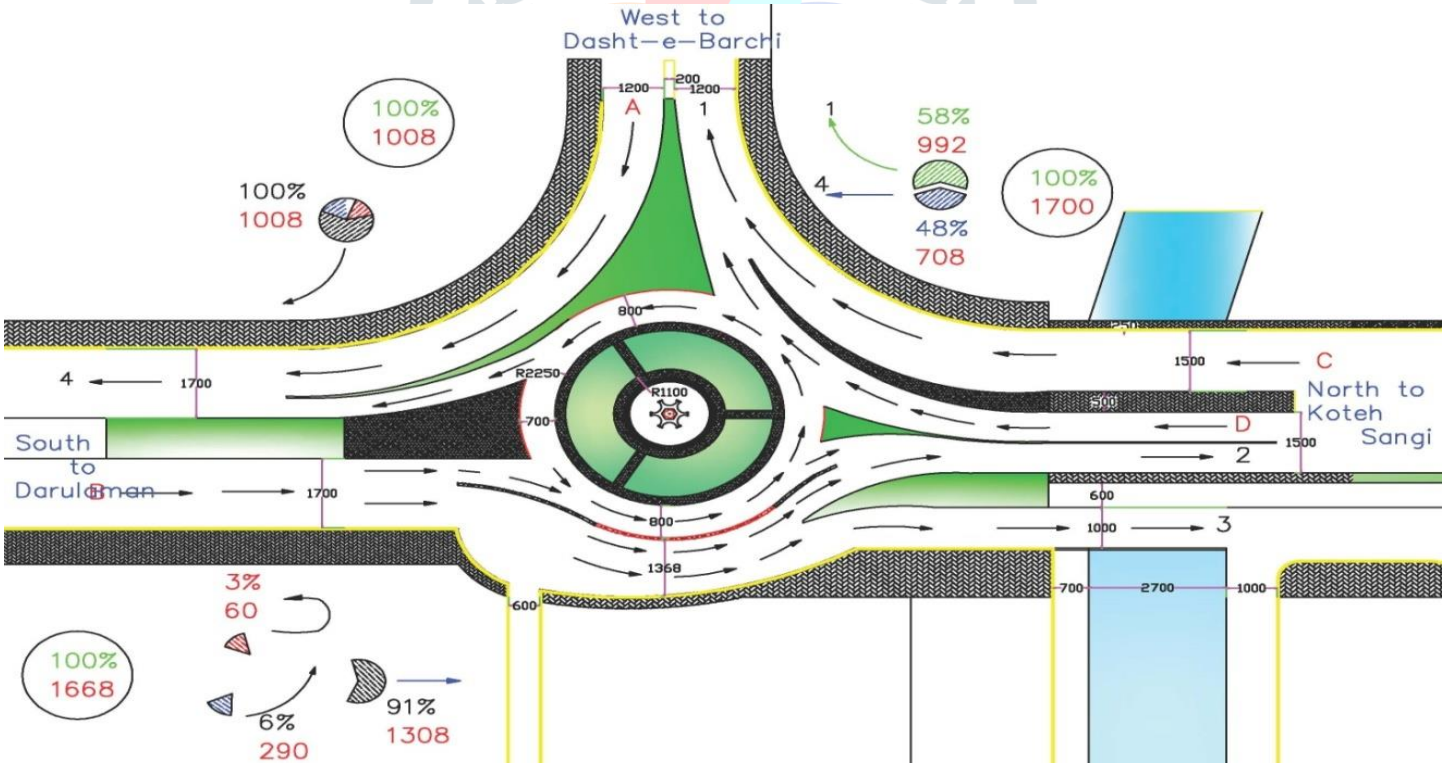

Figure8: percentage and amount of vehicles on current plan of S.M.I.

According to figure7, the vehicles are entering from west side make following problem:

- All the vehicles 1008cpu per hour (100%) turn to right side after passing 1km turn back to the intersection. At point 4 and B the numbers of vehicles increase to 1716cpu and 1668cpu per hour respectively. So they cause traffic congestion at points 4 and B.
- About 1668cpu per hour enter from south side to the crossroad. 6% (290cpu) of vehicles like Townice and Caster turn to west side they stand there to hold passenger, so they force another direction to stop and cause traffic congestion for long times. 1308cpu (91%) goes toward the Koteh Sangi, most of them stand at Pule Sokhta to hold passenger again they make traffic congestion.

5. CONCLUSION:

Traffic congestion is strongly boring issue around the Kabul city especially at S.M.I to all the people. During the morning and evening, because of lacking flyover bridges they make huge amount of congestions. The drivers are losing high volume of fuel because of traffic jams. The passengers also lose their time. All the people are suffering from this boring and dissolution traffic problems. The most reasonable factor is unbalancing between population growth and governmental services development. Ex: The numbers of vehicles are increased from 100 thousands to 700 thousands since 2000, while the government could not construct any flyover to decrease the traffic congestion.

The most reasonable treatment could be designing a flyover over the cross road. It has lessened the traffic jams. People can go their destination without any trouble. The impact of the flyover construction to curb traffic congestion problem has been assessed in terms of traffic decongestion, time saving, and fuel saving. The loss of fuel for combustion and the associated cost resulting from waiting for queue or round also estimated. And these are found to be significant.

The designed flyover at S.M.I could solve the traffic congestion. According to figure 7, two separated direction flyovers allow the vehicles which are entering from Darulaman, to pass the S.M.I without stopping and disrupting the other side. Also all the vehicles coming from Koteh Sangi could pass trough flyover without congestion. According to traffic data survey table 3, and figure 7 the amount of vehicles which are passing the flyover are 708cpu and 544cpu per hour from Koteh Sangi to Darulaman and vice versa respectively, While this flyover is designed according to Indian Road Congress (IRC) for 1500cpu per hour. So the result would be positive and effective for long times.

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