



Urban Intersection Improvement Strategy: Case Study of Raj Mohalla Junction at Indore City

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Abstract:

Increasing vehicular traffic on roads is a major concern of all the metropolitan cities in India. Mixed traffic conditions coupled with on street parking, hawkers and vendors add on to the worsening situation. Intersections are the critical elements on roads and are designed to control the merging and conflicting traffic at the same time delay needs to be avoided. Intersections can be ‘at grade’ or ‘grade separated’ depending on the levels of the meeting roads. Rotaries are at grade intersections provided to regulate traffic in all the directions of meeting roads. All the conflict points on the intersections are reduced into milder conflicts of merging and diverging traffic. The traffic entering the rotary moves in the clockwise direction and weaves out of the same in desired directions. Depending on the angles and traffic on the meeting roads traffic controlling devices and channelization is provided. The arrangement of rotary islands and channelizing islands also depend on the geometry and traffic conditions on the rotary. The current study is based on the Raj Mohalla junction identified as one of the critical junctions under the ‘Area Based Development’ approach for Smart City Indore project. Presently the junction is not signalized and is characterized by on street parking issues and congestion in the peak hours leading to chaos. Detailed topographical and traffic volume count survey was conducted in the peak hours in order to identify the issues in the traffic flow. Based on the field survey data analysis improvement measures have been recommended which will make the traffic flow smoother at this junction.

Keywords: urban, intersection, signal design, traffic volume count, peak hour volume.

I. INTRODUCTION

Raj Maholla Junction is one of the busiest junctions of Indore. The junction marks the end point of Jawahar Marg for the ABD area. It is a four arm intersection with roads leading to four different prominent areas namely Bada Ganapati, Gangwal circle, Ram Krishna Bagh and Malganj Square. The Junction has a prominent mixed traffic condition as Raj-Maholla is a commercial area and Vaishnav School is located at the square itself. Significant pedestrian traffic is also observed. Some prominent locations near by the intersection are: Gangwal circle, Malganj Square, Bada Ganapati Square and Biyabani Square.

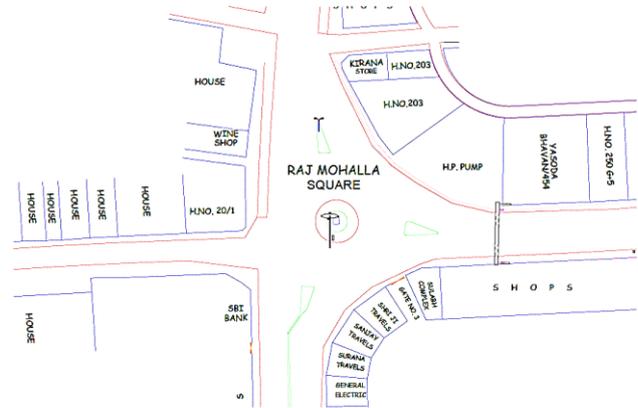


Figure.2. Topographic Map of Raj Mohalla Square

II. PROBLEM STATEMENT

Raj Maholla intersection experiences traffic jams particularly in the morning and evening peak hours. The traffic counts have clearly shown that there is a need to signalize this junction so as to ensure smooth flow of traffic in all the four roads meeting at the junction. There is lot of heavy vehicle traffic at the junction owing to the fact that the junction has close vicinity with the Gangwal Bus Stand (interstate bus stand services are available at this bus stand).

III. DATA COLLECTION AND ANALYSIS

In order to assess problems associated with the traffic flow of the junction, traffic count surveys were done. Variation of

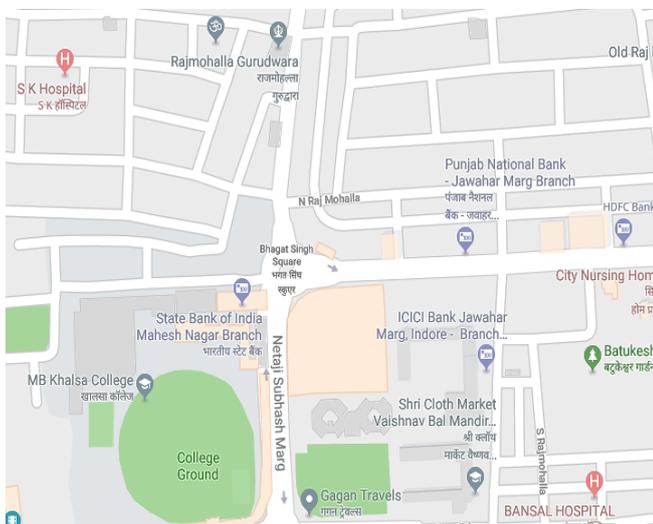


Figure.1. Location Map of Raj Mohalla Square

traffic along the four arms of Raj Mohalla Junction as per the traffic volume count survey conducted for 16 hours on a week day from morning 6:00 am to evening 10:00 pm are as follows.

III.I Road towards Bada Ganapati (Road-1)

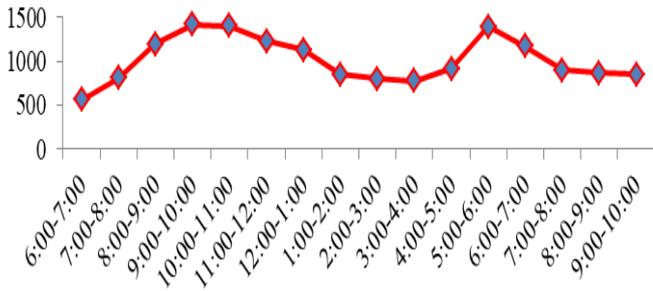


Figure.3. Hourly variation of traffic (road-1)
As per the master plan of Indore city, the proposed width of the road is 30m. The maximum hourly traffic is observed in morning and evening hours. This road is typically busy as it acts as the connecting link for the city areas and the international airport. Also there is predominantly mixed land use (residential and commercial) along the road which makes the road busier owing to the fact that commercial activities keep continuing all through the day.

III.II Jawahar Marg (Road-2)

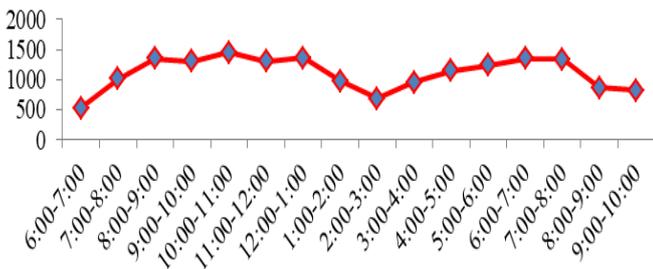


Figure.4. Hourly variation of traffic (road-2)
Jawahar Marg is an 18 m wide road. It is one of the main roads of Indore city that connects various areas of old Indore city. Afternoon slot observes lesser traffic as compared to morning and evening hours on this road.

III.III Road towards Gangwal Circle (Road-3)

As per the master plan the proposed width of the road is 30m. Gangwal Bus stand (Interstate bus terminal) is located at the Gangwal circle because of which there is heavy vehicle traffic along this road. Traffic variation graph clearly shows that there is more traffic in the evening hours as compared to morning and afternoon hours.

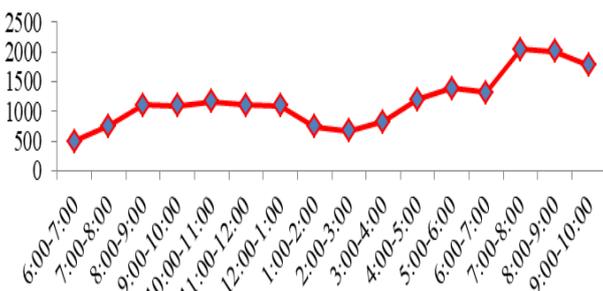


Figure.5. Hourly variation of traffic (road-3)

III.IV Road towards Ram Krishna Bagh (Road-4)

This is a sub arterial road essential a road leading to residential colony characterize by low commercial activity. This is the road with the least traffic amongst all the four roads. Maximum traffic is observed in morning hours as compared to afternoon and evening hours.

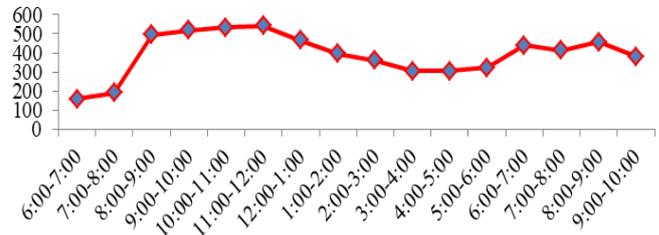


Figure 6: Hourly variation of traffic

III.V Total and Peak hour traffic count

Figure 7 given below depicts the total traffic count on all the four roads meeting at the junction. Blue color represents the vehicle count while in green is shown PCU count. It is evident that the PCU count on all the four roads is comparable to the vehicle count which shows that there is quite a good proportion of heavy vehicle traffic at the junction. The highest vehicle count comes for Gangwal circle road.

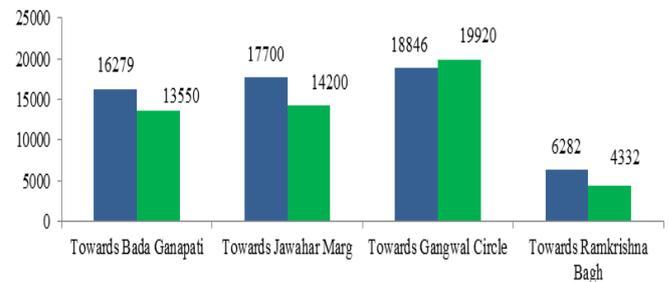


Figure.7. Total traffic volume count on roads

For all the four roads meeting at the junction the peak count comes in the morning and evening hours. Figure 8 given below depicts the peak hour traffic and PCU count on all the four roads in the morning slot.

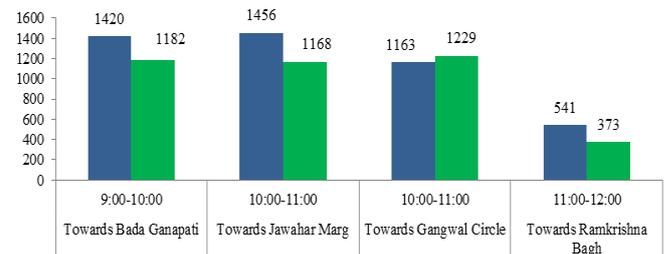


Figure.8. Peak Hour traffic count: Morning slot

Figure 9 given below depicts the peak hour traffic and PCU count on all the four roads in the evening slot.

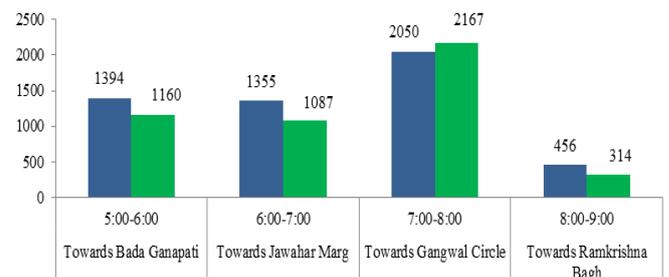


Figure.9. Peak Hour traffic count: evening slot

IV. IMPROVEMENT PROPOSAL

Improvement proposals that have been suggested as a part of this research study are: traffic signal designing and provision of channelising islands for the left turning vehicles.

IV.I Traffic signal design for the intersection

Traffic signal has been designed by Webster Method for signalization. [1] For the traffic signal designing, the conventions followed are as follows:-

1. Road No. 1: Towards Bada Ganapati
2. Road No. 2: Jawahar Marg
3. Road No. 3: Towards Gangwal circle
4. Road No. 4: Towards Ram Krishna Bagh

Four Phases for the signal cycle are as follows:

1. Gangwal circle (3) to Bada Ganapati (1) and Bada Ganapati (1) to Gangwal circle (3)
2. Bada Ganapati (1) to Ramkrishna Bagh (4) and Gangwal circle (3) to Jawahar marg (2)
3. Jawahar marg (2) to Bada Ganapati (1), Ramkrishna Bagh (4)
4. Ramkrishna Bagh (4) to Gangwal circle (3), Jawahar marg (2)

Calculation of Y for different phases of traffic signal is as follow:-

Here Y is maximum ratio of flow to saturation flow.

Phase 1

$Y_{31}=0.23$
$Y_{13}=0.17$

Selecting maximum value from above, so $Y_1=0.23$

Phase 2

$Y_{14}=0.07$
$Y_{32}=0.15$

Selecting maximum value from above, so $Y_2=0.15$

Phase 3

$Y_{21}=0.11$
$Y_{24}=0.05$

Selecting maximum value from above, so $Y_3=0.11$

Phase 4

$Y_{42}=0.17$
$Y_{43}=0.06$

Selecting maximum value from above, so $Y_4=0.17$

Total,

$$Y = \sum_{i=1}^4 Y_i$$

$$= 0.23 + 0.15 + 0.11 + 0.17$$

$$= 0.66$$

Using formula

$$C_0 = \frac{1.5L+5}{1-Y}$$

Where,

C_0 = Cycle Length (optimum cycle time)

L = Total lost time = $n \cdot l + R$

n = Number of phases = 4

l = 2 sec

R = All red time = 4 sec

$L = 4 \cdot 2 + 4 = 12$

$$C_0 = \frac{1.5 \cdot 12 + 5}{1 - 0.66}$$

= 68 sec

Green Time for different phases:

Using formula:

$$G_i = \frac{Y_i}{Y} (C_0 - L)$$

$$C_0 - L = 68 - 12$$

$$= 56$$

$$G_1 = 0.23 \cdot 56 / 0.66$$

$$= 20 \text{ seconds}$$

$$G_2 = 0.15 \cdot 56 / 0.66$$

$$= 13 \text{ seconds}$$

$$G_3 = 0.11 \cdot 56 / 0.66$$

$$= 9 \text{ seconds}$$

$$G_4 = 0.17 \cdot 56 / 0.66$$

$$= 14 \text{ seconds.}$$

Give amber time of three seconds for each phase. Phase diagram has been shown in the figure below (refer figure 10) showing green, red and amber time in seconds for each phase of the traffic signal.

Phase	20	3	13	3	9	3	14	3
1	Green	Amber	Red	Red	Red	Red	Red	Red
2	Red	Red	Green	Amber	Red	Red	Red	Red
3	Red	Red	Red	Red	Green	Amber	Red	Red
4	Red	Red	Red	Red	Red	Red	Green	Amber

Figure 10: Signal Phase diagram

IV.II Channelising islands

For the left turning vehicles channelising islands have been provided between Bada Ganapati road-Jawahar Marg and Jawahar Marg-Gangwal circle road. Channelising islands should be of sufficient size to provide direction to traffic. They can be of any shape depending on the geometry of the intersection. [1] Keeping consideration for the heavy vehicles and intensity of the traffic clear offset of 7.5 m is provided for both the islands as shown in the figure. Proposed islands and medians have been shown in green color. Along with the channelising islands, central Rotary Island has been relocated from its position for easy flow of turning vehicles. Proper road markings like zebra crossing and stop line are provided for pedestrian safety perspective in the proposed layout of the Raj Maholla junction. (Refer figure 11 depicting the proposed layout and channelising islands)

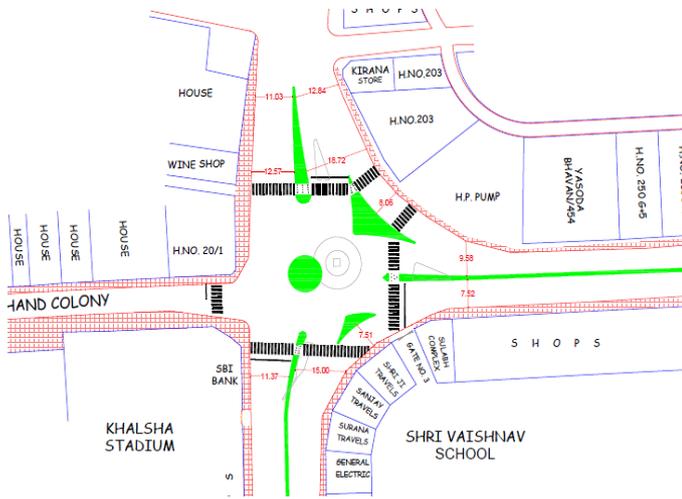


Figure.11. Proposed Layout of Raj Maholla junction

V. CONCLUSION

The improvement proposals are primarily made with the purpose to decongesting the junction and making the traffic flow from all the four directions easy. The rotary island has been located to a new position to make the turning movements easy and also the signal that has been designed that will make the traffic flow smooth and will avoid causes of conflicts at the junction. Such initiatives will definitely increase the efficiency of this important junction of Indore city.

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