ISSN (online): 2349-784X

Evaluation of Traffic Rotary & Design of Traffic Signal at Habibganj Naka Bhopal

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Abstract

In recent years, the intense growth of vehicles in Bhopal has caused heavier traffic congestions the roads and intersections, which are even worse during the peak time. The Habibganj Naka is most prominent palace in the city as it enables the various educational institutes. Presence of BU University and MP Nagar complexes the traffic arrangement, also Hoshangabad Road and Railway Line, Both creates chaos and occurrence of accidents is very common. Traffic Evaluation in necessary nowadays for better designing of traffic situations on habibganj naka rotary. The traffic jam & Collision on roads are because of improper and insufficient data to evaluate & design the signals which are most needed at Habibganj Naka Rotary Bhopal. Traffic signals are very effective in controlling vehicles especially at congested urban intersections (Rotary). Effective management of urban congestion derives directly from accurate from collected data from spot-survey by traffic count. The main objective of my work to evaluate and analysis the current traffic condition at Habibganj Naka rotary Bhopal to determine the resolution of problems containing congestion of traffic accidents and reducing traffic delays by designing signal system for better convenience of traffic.
Keywords: Traffic Arrangement, Traffic Evaluation, Habibganj Naka Rotary

I. INTRODUCTION

Bhopal is the capital of Madhya Pradesh is a fascinating amalgam of scenic beauty. It is the 11th century city Bhojpal, founded by Raja Bhoj, but the current city was established by an Afghan soldier, Dost Mohammed (1707-1740). His descendants build Bhopal into a beautiful city.

The city is under development. The rapid growth in industrialization and urbanization has increased transportation activities causing acute traffic problems particularly at intersections, due to mix complex flow pattern. It is important to design regulation system for this rotary stems for efficiency of operation, safety, speed, cost of operation, capacity are directly governed by design. A best design can reduce the major and minor accidents, delay and can orderly movement of traffic.

The need for traffic signal at Habibganj Naka:

- Traffic jams that occur frequently, causing delay.
- Frequent interruption in traffic flow.
- Traffic that travels at inappropriately high speeds.
- Poor access for pedestrians and cyclist along the roadways and intersection.
- Rapid increase in industrialization

II. METHODOLOGY

A. *IRC Method for Signal Design*

- The pedestrian green time required for the major and minor roads are calculated based on walking speed of 1.2 m/sec. and initial walking time of 7.0 secs. These are the minimum green time required for the vehicular traffic on the minor and major roads respectively.
- The green time required for the vehicular traffic on the major road is increased in the proportion to the traffic on the two approach roads.
- The cycle time is calculated after allowing amber time of 2.0 secs. Each
- The minimum green time required for clearing vehicles arriving during a cycle is a determined for each lane of the approach road assuming that the first vehicle will take 6.0 sec. And the yielding vehicles (PCU) of the queue will be cleared at a rate of 2.0 secs. The minimum green time required for the vehicular traffic on any of the approaches is limited to 16 secs.
- The optimum signal cycle time is calculated using Webster's formula The saturation flow values may be assumed as 1850,1890,1950,2250,2550and 2990 PCU per hour for the approach roadway widths (keb to median or centerline) of 3.0,3.5,4.0,4.5,5.0 and 5.5m; for width above 5.5m, the saturation flow may be assumed as 525 PCU per hour per meter width.

The lost time is calculated from the amber time, inter-green time and the initial delay of 4.0 secs. For the first vehicle, on each leg.

– The signal cycle time and the phases may be revised keeping in view the green time required for clearing the vehicles and the optimum cycle length determined in steps (iv) and(v) above.

III. DESIGN OF TRAFFIC SIGNAL AT HABIBGANJ NAKA BHOPAL

Design traffic on road 1 = 632 PCU/hour
Design traffic on road 2 = 398 PCU/hour
Width of road 1 = 14m
Width of road 2 = 12m

1) Pedestrian green signal time for road 1 = $\frac{14}{1.2} + 7.0$ = 18.66 sec.

Pedestrian green signal time for road 2 = $\frac{12}{1.2} + 7.0$ = 17 sec.

Green signal time for vehicles on road 2, G_2 = 18.66 sec

2) Green signal time for road 1, G_1 = 18.66 X $\frac{632}{398}$ = 29.63 sec

3) Adding 2.0 sec each to the clearance amber and 2.0 sec to the inter-green period for each phase

Total cycle time required = (2+18.66+2)+(2+29.63+2) = 56.29sec
Signal cycle time may be conveniently made in multiple of 5 sec.
So the cycle time will be 60 sec.
The extra 2.5 sec. per cycle may be assigned to the green time of road 1 and 2 as 1.5 and 1.0 sec. respectively.
G_1 = 29.63 + 1.5 = 31.13 ≈ 31 sec.
G_2 = 18.66 + 1.0 = 19.66 ≈ 20 sec.

4) Vehicles arrivals per lane cycle on road 1 = $\frac{632}{60}$

= 10.53 PCU
Minimum green time for clearing vehicles on the road 1= 6 + (10.53-1) 2
= 25.06 sec.
Vehicles arrivals per lane cycle on road 2 = 398\60
= 6.63 PCU
Minimum green time for clearing vehicles on the road 2= 6 + (6.63-1) 2
= 17.26 sec.
As the green time designed above for two roads by pedestrian crossing criteria are having values high, thus the above values can be accepted as they are alright and minimum.

5) Total lost time per cycle = (amber time + inter-green time + time lost for initial delay of first vehicle) for two phase
= (2+2+4)X 2
= 16 sec.
From IRC: 93-1985
The total lost time per cycle is equal to the total amber time per cycle i.e. 8 sec, plus 4 sec. reaction time for first vehicle in phase 1, plus 4 sec reaction time for first vehicle in phase 2, i.e. equal to total 16 sec.
Saturation flow = 525 X W PCU per hour
Where,
W = width of the approach measured from kerb to the inside of the central median or mentioned centre line of the approach.
The width lesser from 5.5 m, the values for saturation flow is taken from the table below:

Width in m	*3*	*3.5*	*4*	*4.5*	*5*	*5.5*
Saturation flow (PCU)per hour	*1850*	*1890*	*1950*	*2250*	*2550*	*2990*

Saturation flow for critical approach for road 1 = 3675 + $\frac{40X7}{5}$

= 3731 PCU/hour

Saturation flow for critical approach for road 2 = 3150 + $\frac{40X6}{5}$

= 3198 PCU/hour

$$y_1 = \frac{632}{3731} = 0.16$$

$$y_2 = \frac{398}{3198} = 0.12$$

$Y = y_1 + y_2$

$$Y = 0.16 + 0.12$$

Y = 0.28
The Webster's formula for optimum cycle time
$C_o = \frac{1.5L+5}{1-Y}$

Where ,
C_o = optimum cycle length in seconds
L = total lost time per cycle
Y = volume/ saturation flow for critical approach in each phase.

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

$C_o = \frac{1.5X16+5}{1-0.28}$

$C_o = \frac{29}{0.72}$

C_o = 40.27 sec

Thus the total cycle time of 60 sec is acceptable.

Road	*Green*	*Amber*	*Red*	*Cycle*
Road 1	*31*	*2*	*(25+2)*	*60*
Road 2	*27*	*2*	*(29+2)*	*60*

The phase diagram and details of signal setting are given as

PHASE 1: 31-GREEN + 2-AMB +25-RED= 60 sec

PHASE 2: 29-RED + 27-GREEN + 2-AMB= 60 sec

Table - 1

Date……23/04/15…..Day……Thusday…..Location……Habibganjnaka…….Direction…… Hoshangabad to Habibganj

Time	*Motorised Traffic*											*Non Motorised Traffic*					*Grand Total*
	Passenger Vehicles				*Goods*	*Vehicles*				*Agricultural*		*Passenger*	*Goods Vehicles*				
							Ord. Vehicles							*Animal Drawn*			
	Two Wheeler	*Three Wheeler*	*Car/Jeep*	*Mini BUS*	*BUS*	*Tempo/LCV*	*2-Axle*	*3-Axle*	*Multi Axle*	*Tractor with Trailor*	*Tractor*	*Cycle*	*Cycle Rickshaw*	*Animal Drawn*	*Horse Drawn*	*Hand Cart*	*Vehicle(No)*
6am-7am	*298*	*22*	*144*	*15*	*7*	*14*	*19*	*11*	*0*	*3*	*2*	*15*	*0*	*0*	*0*	*0*	*550*
7am-8am	*339*	*47*	*195*	*16*	*13*	*18*	*16*	*4*	*0*	*1*	*3*	*19*	*0*	*0*	*0*	*0*	*671*
8am-9am	*400*	*44*	*209*	*15*	*19*	*32*	*13*	*0*	*0*	*2*	*1*	*24*	*0*	*0*	*0*	*0*	*759*
9am-10am	*490*	*31*	*339*	*19*	*34*	*86*	*23*	*0*	*0*	*3*	*1*	*29*	*0*	*0*	*0*	*1*	*1056*
10am-11am	*539*	*49*	*437*	*20*	*36*	*87*	*22*	*0*	*0*	***1***	***0***	*30*	*0*	*0*	*0*	*0*	*1222*
11am-12pm	*501*	*41*	*408*	*15*	*36*	*90*	*12*	*0*	*0*	*0*	*3*	*26*	*0*	*0*	*0*	*2*	*1134*
12pm-1pm	*498*	*56*	*440*	*17*	*38*	*91*	*20*	*0*	*0*	*3*	*2*	*21*	*0*	*0*	*0*	*4*	*1019*
1pm-2pm	*597*	*31*	*501*	*43*	*53*	*126*	*50*	*0*	*0*	*6*	*3*	*22*	*0*	*0*	*0*	*0*	*1432*
2pm-3pm	*599*	*39*	*569*	*49*	*55*	*151*	*43*	*0*	*0*	*2*	*2*	*19*	*0*	*0*	*0*	*1*	*1529*
3pm-4pm	*609*	*47*	*599*	*39*	*59*	*131*	*37*	*0*	*0*	*2*	*1*	*10*	*0*	*0*	*0*	*4*	*1538*
4pm-5pm	*717*	*61*	*602*	*42*	*59*	*129*	*13*	*0*	*0*	*1*	*0*	*19*	*0*	*0*	*0*	*0*	*1643*
5pm-6pm	*899*	*102*	*667*	*19*	*61*	*132*	*23*	*0*	*0*	*2*	*0*	*23*	*0*	*0*	*0*	*2*	*1930*
6pm-7pm	*869*	*103*	*716*	*27*	*61*	*119*	*24*	*0*	*0*	*1*	*0*	*17*	*0*	*0*	*0*	*1*	*1938*
7pm-8pm	*870*	*130*	*714*	*22*	*57*	*120*	*18*	*0*	*0*	*0*	*3*	*20*	*0*	*0*	*0*	*0*	*1954*

8pm-9pm	660	91	600	23	49	104	6	0	0	0	1	29	0	0	0	0	1563
9pm-10pm	665	70	530	20	36	92	18	6	0	2	1	22	0	0	0	2	1464
10pm-11pm	549	74	441	21	18	88	26	8	5	1	2	12	0	0	0	1	1146
11pm-12am	534	19	406	9	19	42	199	49	5	1	0	6	0	0	0	0	1287
Total	10633	1057	8517	431	710	1652	582	78	10	31	25	363	0	0	0	18	24107
PCU	5317	1057	8517	862	2130	2478	1746	234	45	139.5	25	181.5	0	0	0	18	22749.5
Avg.H.T	590	5 8	323	24	40	92	32	4		1	1	20				1	1186

Table - 2

Raffic Count 1/5/2015 Friday Habibganj-Naka Habibganj to Hosangabad

Date……..Day……Location……Direction……

Time	Motorised Traffic											Non Motorised Traffic					Grand Total
	Passenger Vehicles				Goods	Vehicles				Agricultural		Passenger	Goods Vehicles				
							Ord. Vehicles							Animal Drawn			
	Two Wheeler	Three Wheeler	Car/Jeep	Mini BUS		Tempo/LCV	2-Axle	3-Axle	Multi Axle	Trailor	Tractor	Cycle	Cycle Rickshaw	Animal Drawn	Horse Drawn	Hand Cart	Vehicle(No)
6am-7am	209	9	100	10	2	10	11	1	0	3	1	11	0	0	0	1	368
7am-8am	209	11	103	19	2	11	9	0	0	2	1	10	0	0	0	2	379
8am-9am	222	11	117	11	2	13	8	0	0	4	1	9	0		0	3	401
9am-10am	261	12	121	13	2	14	7	0	0	3	2	7	0	0	0	1	443
10am-11am	271	13	141	14	1	15	0	0	0	***1***	***1***	3	0	0	0	1	461
11am-12pm	256	14	142	12	3	16	0	0	0	2	2	2	0	0	0	2	451
12pm-1pm	249	16	188	12	4	17	0	0	0	1	2	1	0	0	0	2	492
1pm-2pm	217	15	159	11	7	20	4	0	0	1	1	0	0	0	0	2	437
2pm-3pm	259	13	183	14	9	22	13	0	0	1	0	0	0	0	0	1	515
3pm-4pm	281	12	207	15	8	23	12	0	0	4	0	0	0	0	0	0	562
4pm-5pm	327	19	212	19	7	24	9	0	0	3	1	0	0	0	0	0	621
5pm-6pm	355	21	239	20	17	26	13	0	0	2	1	3	0	0	0	0	697
6pm-7pm	399	29	209	9	13	20	12	0	0	1	0	13	0	0	0	0	705
7pm-8pm	317	3	189	8	11	19	13	0	0	6	0	6	0	0	0	1	573
8pm-9pm	211	12	171	8	9	15	14	0	0	5	0	9	0	0	0	1	455
9pm-10pm	155	11	123	7	8	11	6	0	0	4	0	3	0	0	0	1	329
10pm-11pm	141	9	119	6	4	18	4	0	0	3	1	2	0	0	0	0	307
11pm-12am	100	1	89	4	2	16	0	0	0	0	0	0	0	0	0	0	212
Total	4439	231	2812	212	111	310	135	1	0	46	14	79	0	0	0	18	8390
PCU	2219.5	231	2812	424	333	465	405	3	0	207	14	39.5	0	0	0	18	7171
Avg.H.T	247	13	156	12	6	17	7			2		4				1	465

Table – 3

Traffic Count 17/5/2015 Sunday Habibganj-Naka Railway Gate to Bss College

Date……..Day……..Location…….Direction……

Time	Motorised Traffic											Non Motorised Traffic					Grand Total
	Passenger Vehicles				Goods	Vehicles				Agricultural		Passenger	Goods Vehicles				
							Ord. Vehicles							Animal Drawn			
	Two Wheeler	Three Wheeler	Car/Jeep	Mini BUS	BUS	Tempo/LCV	2-Axle	3-Axle	Multi Axle	Tractor with Trailor	Tractor	Cycle	Cycle Rickshaw	Animal Drawn	Horse Drawn	Hand Cart	Vehicle(No)
6am-7am	113	6	31	5	13	9	11	3	0	0	0	7	0	0	0	0	198
7am-8am	140	13	103	7	7	17	7	0	0	0	0	15	0	0	0	0	309
8am-9am	132	9	101	5	13	15	6	0	0	0	0	21	0	0	0	0	302

9am-10am	*152*	*23*	*117*	*19*	*15*	*23*	*4*	*0*	*0*	*0*	*0*	*15*	*0*	*0*	*0*	*1*	*368*
10am-11am	*147*	*17*	*121*	*15*	*23*	*41*	*7*	*0*	*0*	***0***	***0***	*5*	*0*	*0*	*0*	*2*	*377*
11am-12pm	*188*	*31*	*138*	*3*	*9*	*16*	*13*	*0*	*0*	*0*	*0*	*11*	*0*	*0*	*0*	*3*	*412*
12pm-1pm	*162*	*11*	*135*	*7*	*11*	*21*	*7*	*0*	*0*	*0*	*0*	*14*	*0*	*0*	*0*	*1*	*374*
1pm-2pm	*130*	*23*	*119*	*5*	*12*	*7*	*5*	*0*	*0*	*0*	*0*	*5*	*0*	*0*	*0*	*0*	*307*
2pm-3pm	*171*	*21*	*137*	*7*	*8*	*9*	*13*	*0*	*0*	*1*	*0*	*4*	*0*	*0*	*0*	*4*	*370*
3pm-4pm	*169*	*10*	*138*	*6*	*21*	*13*	*7*	*0*	*0*	*3*	*0*	*16*	*0*	*0*	*0*	*0*	*384*
4pm-5pm	*198*	*25*	*152*	*2*	*7*	*19*	*12*	*0*	*0*	*0*	*0*	*10*	*0*	*0*	*0*	*0*	*425*
5pm-6pm	*172*	*13*	*137*	*9*	*5*	*17*	*1*	*0*	*0*	*0*	*0*	*11*	*0*	*0*	*0*	*0*	*365*
6pm-7pm	*210*	*27*	*150*	*7*	*11*	*20*	*7*	*0*	*0*	*0*	*0*	*15*	*0*	*0*	*0*	*0*	*447*
7pm-8pm	*110*	*21*	*140*	*7*	*9*	*21*	*3*	*0*	*0*	*0*	*0*	*15*	*0*	*0*	*0*	*0*	*326*
8pm-9pm	*201*	*11*	*148*	*15*	*20*	*7*	*2*	*0*	*0*	*0*	*0*	*11*	*0*	*0*	*0*	*2*	*417*
9pm-10pm	*171*	*6*	*130*	*15*	*16*	*11*	*19*	*1*	*0*	*0*	*0*	*5*	*0*	*0*	*0*	*0*	*374*
10pm-11pm	*118*	*5*	*138*	*3*	*5*	*7*	*16*	*2*	*0*	*0*	*0*	*6*	*0*	*0*	*0*	*0*	*300*
11pm-12am	*62*	*4*	*35*	*10*	*14*	*4*	*25*	*4*	*0*	*0*	*0*	*4*	*0*	*0*	*0*	*0*	*162*
Total	*2746*	*276*	*2170*	*147*	*219*	*277*	*165*	*10*	*0*	*4*	*0*	*190*	*0*	*0*	*0*	*13*	*6217*
PCU	*1373*	*276*	*2170*	*294*	*696*	*415.5*	*495*	*30*	*0*	*18*	*0*	*95*	*0*	*0*	*0*	*13*	*5935.5*
Avg.H.T	*152*	*15*	*124*	*8*	*12*	*15*	*9*					*11*					*346*

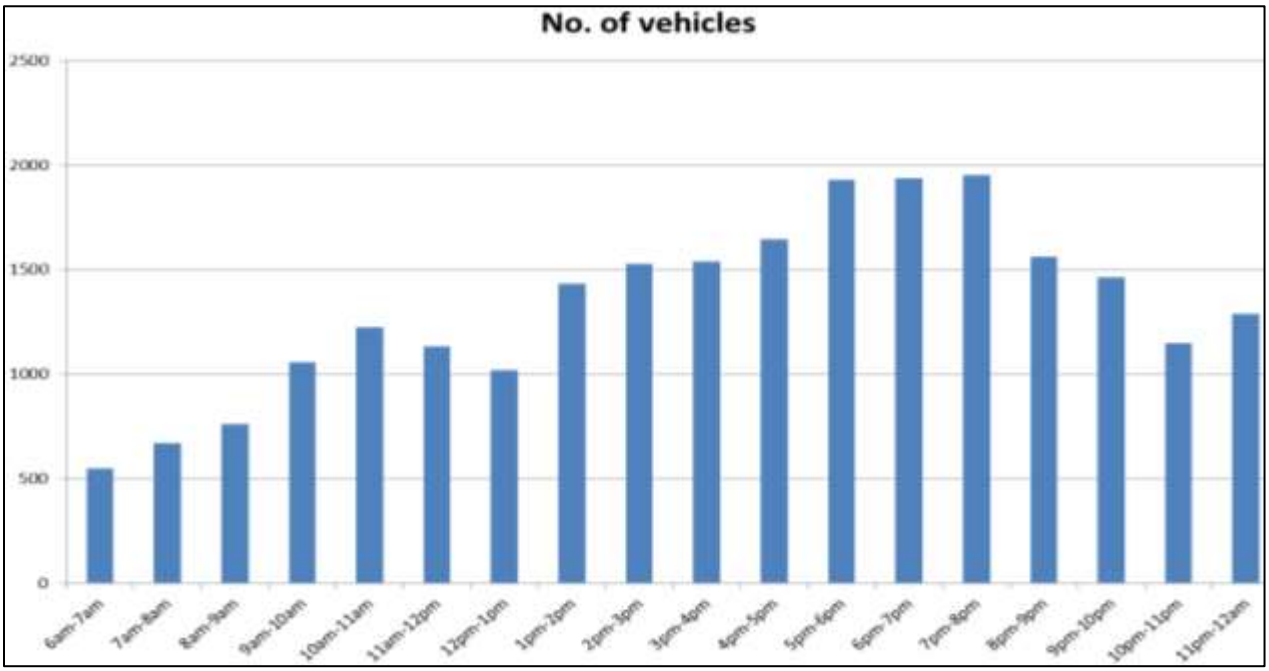

Fig. 1:

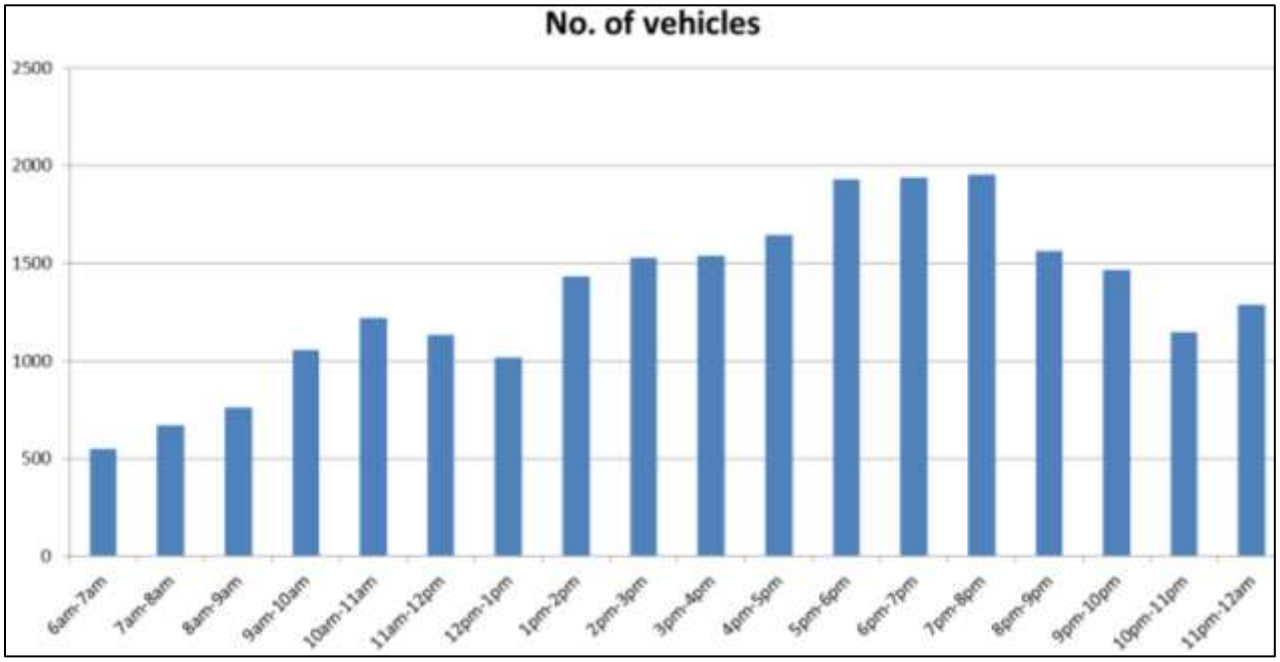

Fig. 2:

IV. CONCLUSION

In this work, i have concluded that the intersection at habibganj naka is very busy intersection thus to provide better mobility of vehicles thus I have evaluated the traffic rotary at Habibganj Naka, Bhopal (M.P.). i have selected this particular place because of the heavy traffic flow, big problem to pedestrian to cross the road, causes more chances to serious accident hence vehicle damage and human injury. In my work i have designed a very good traffic signal at habibganj naka so that we can control the accident at this rotary. Firstly we have done the survey manually for 18 hour per day for the one week in one direction (Hoshangabad to Habibganj). Same survey i have completed in remaining three directions (Habibganj to Hoshangabad, BSS College to railway gate and railway gate to BSS College). Then we measured the passenger car unit (PCU) in all the four directions and selected the two directions which have higher approach value of passenger car unit. Then I used this higher approach value to design the effective traffic signal at this rotary based on Indian Road Congress (IRC) guideline. There are many types of collision that will occurs at signal controlled rotary such as single vehicle, rear shunt (and lane changing) on the approach to the rotary, principal right turn collision, right angle collision, and pedestrian collision. These collision cannot occur if all drivers act according to the signals. Also these collision can be happens due to ineffective signal design.

Finally we are able to get accurate measurement of traffic flow variable hence the advantages of the signalization are reduction in the collisions, reduction in the number of occurrence of congestion queues, reduction in speed, reduction in mean queue length, reduction in delays.

V. SUGGESTION

According to my work it concluded that the rate of accident may be brought down to minimum if we adhere strictly to some guide lines as given below-

- Traffic sign are to be provided on roads.
- The maintenance of road is to be done on regular basis so that there may not be any point of Re-design Rotary is required to control the traffic in a proper way.
- Etches cuts etc. on roads.
- Point to point check is to be provided at road sides to measure the speed of vehicle, controlling is to be done to restrict the speed in order to avoid fatal accidents.
- Geometric feature such as sight distance width of pavement, horizontal and vertical Braking system, steering and lighting arrangement of public carrier are to be checked time to time.
- Alignment and design of intersection are to be thoroughly checked.
- Traffic rules may be taught at school level and college level as one of the subject.

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