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

Shivam Kushwaha[1] Mr. S.S. Goliya[2]
[1]P.G. Student [2]Assistant Professor
[1,2]Samrat Ashok Technological Institute Vidisha M.P 464001

Abstract— In India number of vehicles are increasing day by day hence major cities in India like Bhopal facing to many problems such as traffic jam that occur frequently causing delays, loss of time, increased in fuel consumption, increase in noise pollution and frequent interruption in traffic flow. The city Bhopal has too many intersections. In this paper an attempt has been made to study the Habibganj naka intersection Bhopal, so as to minimize the delays at these intersections and consequently improve level service at Habibganj naka intersection the existing traffic has been estimated and then signal designed improve the level of service at intersection and to minimize delay. For some aspects of signal design there is a conflict between safety and delay. The behavior of pedestrian has been much more widely studied than their safety. The main objective of this project 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.

Key words: Traffic Signal, Traffic Rotary

I. INTRODUCTION

The problem of congestion and accident is very acute in highway transport due to complex flow pattern of vehicular traffic, presence of mixed traffic and pedestrian. Traffic accident may involve property damage, personal injuries or even causalities. The main objectives of traffic engineering is to provide safe traffic movement. The Bhopal 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 primary aims of signal control at a rotary intersection are.

- To reduce and hence the potential for accidents.
- To better regulate and orderly traffic movement, and
- Hence reduce delays.

Bhopal the capital of Madhya Pradesh with about 1.437 million people is the centre point of majority of the economic activities of the city. With rapid urbanization.

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. TRAFFIC SURVEY& DATA COLLECTION

	Motorised Traffic											Non Motorised Traffic					Grand Total
	Passenger Vehicles				Good	Vehicles				Agricultural		Passenger		Goods Vehicles			
Time	Two Wheeler	Three Wheeler	Car/Jeep	Mini BUS	BUS	Tempo/LCV	Ord. Vehicles			Tractor with Trailor	Tractor	Cycle	Cycle Rickshaw	Animal Drawn		Hand Cart	Vehicle(No)
							2-Axle	3-Axle	Multi Axle					Animal Drawn	Horse Drawn		
6am-7am	209	9	100	10	2	10	11	1	0	3	1	11	0	0	0	1	368
7am-	209	11	103	19	2	11	9	0	0	2	1	10	0	0	0	2	379

8am																	
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.HT	247	13	156	12	6	17	7			2		4				1	465

Table 1: BSS College to Railway Gate

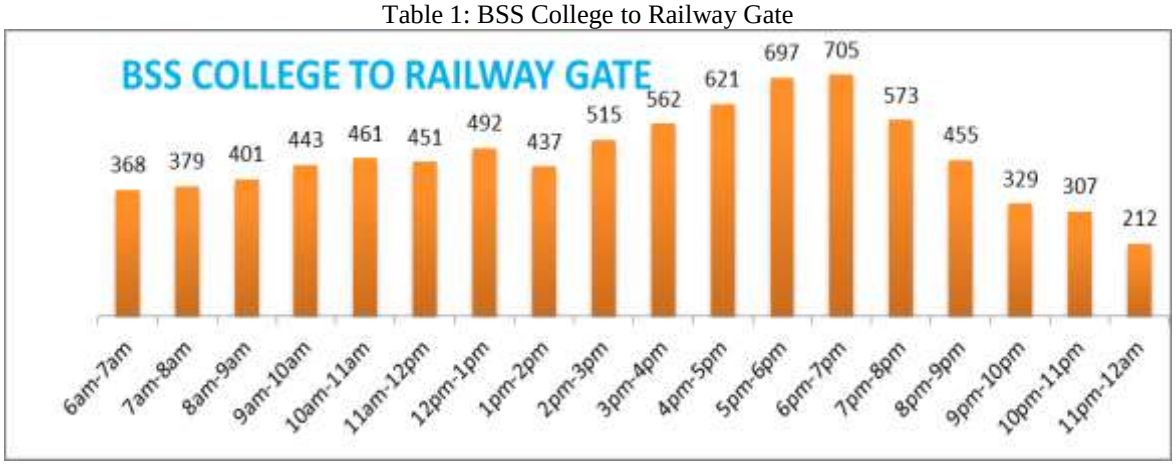

Fig. 1: BSS College to Railway Gate

	Motorised Traffic				Non Motorised Traffic		Grand Total
	Passenger Vehicles	Goods	Vehicles	Agricultural	Passenger	Goods Vehicles	

	Two Wheeler	Three Wheeler	Car/Jeep	Mini BUS		Tempo/ LCV				Tractor with Trailor	Tractor	Cycle	Cycle Rickshaw	Animal Drawn		Hand Cart	Vehicle(No)
							Ord. Vehicles										
Time								3-Axle	Multi Axle								
					BUS		2-Axle							Animal Drawn	Horse Drawn		
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: Hoshangabad To Habibganj Station

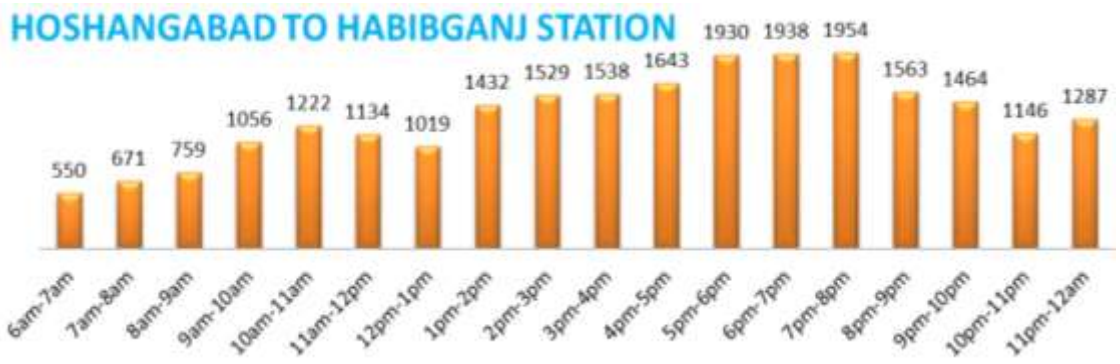

Fig. 2: Hoshangabad To Habibganj Station

	Motorised Traffic											Non Motorised Traffic					Grand Total
	Passenger Vehicles					Goods Vehicles				Agricultural		Passenger	Goods Vehicles				
Time	Two Wheeler	Three Wheeler	Car/Jeep	Mini BUS	BUS	Tempo/LCV	Ord. Vehicles			Tractor with Trailor	Tractor	Cycle	Cycle Rickshaw	Animal Drawn		Hand Cart	Vehicle(No)
							2-Axle	3-Axle	Multi Axle					Animal Drawn	Horse Drawn		
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

Table 3 – Railway Gate to BSS College

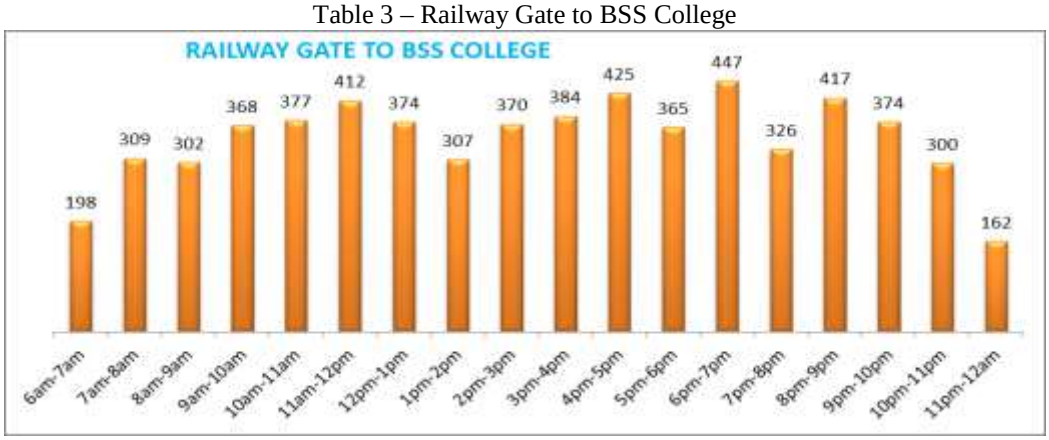

Fig. 3: Railway Gate to BSS College

	Motorised Traffic											Non Motorised Traffic					Grand Total
	Passenger Vehicles				Goods	Vehicles				Agricultural		Passenger		Goods Vehicles			
Time	Two Wheeler	Three Wheeler	Car/Jeep	Mini BUS	BUS	Tempo/LCV	Ord. Vehicles			Tractor with Trailer	Tractor	Cycle	Cycle Rickshaw	Animal Drawn		Hand Cart	Vehicle(No)
							2-Axle	3-Axle	Multi Axle					Animal Drawn	Horse Drawn		
6am-7am	278	30	120	15	8	11	30	8	0	0	0	12	0	0	0	0	512
7am-8am	300	41	187	20	15	38	27	4	0	3	0	27	0	0	0	0	662
8am-9am	331	47	221	25	18	58	18	1	0	0	0	18	0	0	0	3	740
9am-10am	398	55	270	35	28	111	17	0	0	1	0	20	0	0	0	1	936
10am-11am	421	61	391	40	29	120	15	2	0	**0**	**0**	17	0	0	0	1	1097
11am-12pm	435	39	395	41	35	138	28	0	0	0	0	2	0	0	0	0	1113
12pm-1pm	408	35	321	38	41	131	11	0	0	2	0	8	0	0	0	0	995
1pm-2pm	421	31	341	45	60	122	18	3	0	0	0	10	0	0	0	1	1051
2pm-3pm	398	42	351	42	51	117	21	0	0	3	0	15	0	0	0	2	1042
3pm-4pm	435	48	402	58	47	141	12	1	0	0	0	21	0	0	0	1	1166
4pm-5pm	481	58	412	51	38	152	15	0	0	1	0	17	0	0	0	0	1225
5pm-6pm	547	43	475	47	35	121	18	0	0	0	0	15	0	0	0	0	1301
6pm-7pm	598	52	521	38	28	122	28	0	0	1	0	22	0	0	0	2	1412
7pm-8pm	627	47	550	56	21	130	16	0	0	0	0	25	0	0	0	2	1474
8pm-9pm	543	38	503	35	15	112	35	5	0	0	0	27	0	0	0	1	1314
9pm-10pm	511	41	427	38	25	70	41	20	1	1	0	12	0	0	0	0	1187
10pm-11pm	413	35	381	25	11	65	45	77	10	0	0	7	0	0	0	0	1069

11pm-12am	350	41	299	15	18	15	75	81	15	0	0	5	0	0	0	0	914
Total	7895	784	6567	664	523	1774	470	202	26	12	0	280	0	0	0	14	19210
PCU	3948	784	6567	1328	1569	2661	1410	606	117	54	0	140	0	0	0	14	19197.5
Avg.H.T	439	43	365	37	29	98	26	11	1			15					1064

Table-4 Habibganj Station to Hoshangabad

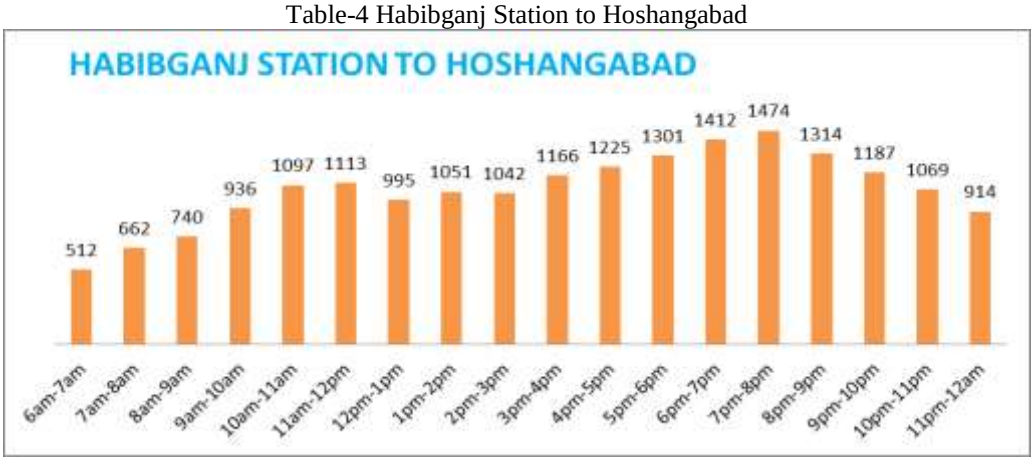

Fig. 4: Habibganj Station to Hoshangabad

A. Design of Traffic Signal at Habibganj Naka Bhopal

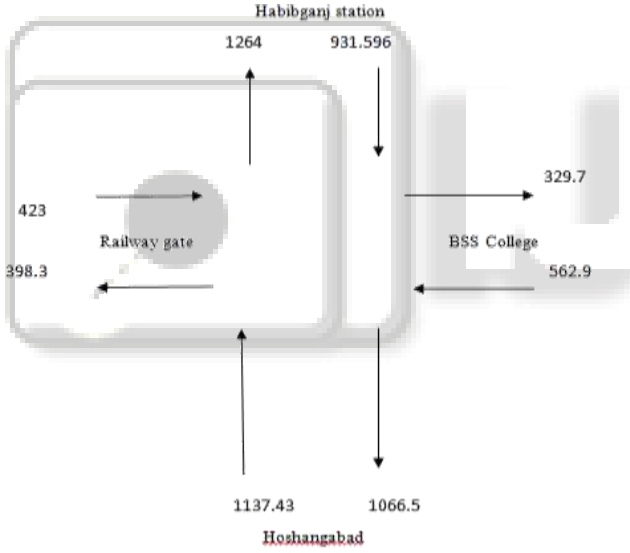

Fig. 5: Traffic flow at Habibganj Naka rotary in all four directions

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.

$G_1 = 29.63 + 1.5 = 31.13 \approx 31$ sec.

$G_2 = 18.66 + 1.0 = 19.66 \approx 20$ 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.

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

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

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

$$C_o = 40.27 \text{ sec}$$

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

IV. CONCLUSION

In this project, I have evaluated the current traffic flow at Habibganj naka rotary intersection. This 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 traffic signal at Habibganj naka so that we can control the accident at this rotary. So traffic congestion should be minimized and accident can be avoided to maximum possible extent.

REFERENCES

[1] Justo &Khannna, "new age publications".
[2] "L.R.Kadiyalikhanna publications".
[3] IRC-93:1985 "Guidelines on Design and installation of road traffic signals".
[4] Per Garder may 2004 "Traffic signal safety"
[5] Dr.Tom V.Mathew "Design and Evaluation of Adaptive Traffic control system for Heterogeneous Flow conditions" Indian institute of technology, Bombay, India.
[6] Noman Hyder and Md. Rahul Amin December 2013 "Traffic Signal Design of an Isolated Intersection for Dhaka City Condition".
[7] Booz Allen Hamilton Iteris, Dec.2009. "Improving Traffic signal Management and operations"
[8] Road accident in india Government of india of ministry of Road Transport And highways Transport Research Wing New Delhi 2010

