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Safety Analysis on a roundabout on Madhya Marg and Vidhya Path in Chandigarh

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ABSTRACT

Transport is an all-prevailing industry. It penetrates into all phases of production & distribution of goods. In the production stage transportation is required to carry raw material & in distribution stages, transportation is required from production centers viz. farms & factories to the marketing centers for distribution to retailers and consumers. The inadequate transportation facility has the socio-economic development of country. Transportation improvement, has increased personal mobility, reduce travel time, permits greater freedom to the people their work and in carrying the goods. the existing traffic problem in the city, a continuing programme of traffic performance studies of road intersection in Chandigarh with reference to their geometric design, traffic control measures, some other relevant features and the redesigning them according to the present requirements and future forecasts of traffic has been initiated by the post graduate transportation engineering department of PEC university of technology, Chandigarh. As part of the programme, a comprehensive study of a heavily trafficked roundabout near P.G.I and the crossing of Madhya Marg and Vidhya Path being regularly locked-up during peak hours, has been carried out in the investigation, in order to arrive at the best intersection control measure, which provides the most effective and efficient traffic operation related to the traffic demands and performance of road users consistent with the site conditions at intersection.

The major conclusion drawn from this work is a unique one as it rejects the existing traffic rotary as well as it further improvement in view of the peak hour volume exceeding the capacity of the rotary, and suggests its improvement with signalised controlled intersection based on an extensive scientific research on the possible means and solutions to the problem. It is hoped that improving the traffic management measures may be helpful in suggesting the most suitable solution to the intersection control system in the city.

Keywords: Traffic Volume, Capacity of Rotary, Volume Capacity ratio, Approximate method.

I. INTRODUCTION

Transport is an all-prevailing industry. It penetrates into all phases of production & distribution of goods. In the production stage transportation is required to carry raw material & in distribution stages, transportation is required from production centers viz. farms & factories to the marketing centers for distribution to retailers and consumers. The inadequate transportation facility has the socio-economic development of country. Transportation improvement, has increased personal mobility, reduce travel time, permits greater freedom to the people their work and in carrying the goods. However the unprecedented growth in the vehicle ownership especially the small cars and 2-wheelers in recent years, our cities are beset with serious traffic problems like

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congestion and causalities particularly at road intersection due to land constraints. The accident situation is serious in India because of rapid growth of vehicles, in the past few years and the inadequacy of many of our roads and streets to cope up with this traffic. The mixed traffic conditions prevailing on the roads in India has been made the traffic problem very much acute. Thus India has the dubious distinction of leading the world in fatal road accidents. India has the highest road traffic accident rates worldwide with over 140,000 deaths annually. Every hour, nearly 14 lives are lost due to road accidents in India. There is consensus forming among the general public due in part to emphatic reinforcement of the accident statistics by traffic authorities that the human element is the key causal factor of road accidents occurrence. As the number of vehicles on the road is increase much faster rate than the road increasing rate. Generally major road accidents are take place at the road level crossing or intersection. More than 60% of the total accidents occur at the intersection of roads. The urgent talk is therefore, rationalisation of the design of road intersections and the regulations governing road users. In addition greater attention also needs to be given to the organisation of first aid development of surgical facilities like regional trauma center.

II. AIM OF INVESTIGATION

The aim of this study is to increases the safety at an intersection on Madhya Marg and Vidhya Path in Chandigarh.

III. ROADS IN CHANDIGARH

Roads: Chandigarh, which is the capital of Punjab and Haryana is a union territory, it stands at the foothills of Shivalik range. It has a grid iron pattern of roads spread over the length and breadth of the city. The roads in Chandigarh can be divided into seven categories (V1 to V7). The planning was so done as to separate the fast moving traffic from the slow moving traffic. These roads termed by Le-Corbusier the seven V's cover all the roads, from those coming into the city to the roads approaching the houses in different sectors Le-Corbusier said that the V's act as blood streams of the city.

V1: These represent always the regional highway leading into the city from outside. In the case of Chandigarh, this would be the national trunk road from Delhi on one side and Shimla on the other side.

V2: These form the main horizontal axis of the city (Madhya Marg) intersecting the street leading to capital complex called Jan-Marg, alsoV2 which borders the business centers and intersects at the lower edge,V2 road has a system of separate lanes to accommodate the various classes of traffic, fast and slow moving vehicles and pedestrians.

V3: These surround the residential sectors forming the grid pattern of the city and they are reserved for fast moving traffic. Access to the sectors from these streets is limited and there is no frontage development permitted.

V4: Bisecting each sector is V4 or shopping street. This is intentionally open to a variety of traffic but permitting only relatively slow movements. It may be noted that in the V4 the geometric grid is replaced by a somewhat irregular street. These were intended to convey an individual quality of urban liveliness.

V5: Intersecting V4 at the two points is V5, a loop road distributing low traffic within the confines of sectors and connecting the adjoining sectors. Thus fast traffic could move throughout the city on the V4 and V5 streets.

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V6: The extremities of the network are the V6 paths leading to the doors of the houses.

V7: These are the paths designed to carry cyclists and pedestrians through the park belts of the city.

As a survey conducted by RITES on the Chandigarh to find the volume capacity ratio so that importance can be given to a particular road according to that. The data of that survey is shown in the form table as:

Table 1: Traffic Volume Survey Conducted By RITES on Chandigarh Roads

Serial No	Name of Road	Volume Capacity Ratio
1	Vidhya Path	0.8
2	Udyan Path	0.7
3	Jan Marg	0.8
4	Himalaya Marg	0.7
5	Sarovar Path	0.8
6	Sukhna Path	0.8
7	Chandi Path	0.6
8	Purv Marg	0.8
9	Madhya Marg	1.2
10	Udyog Path	1.1
11	Dakshin Marg	0.8

As per survey data the volume capacity ratio for Madhya Marg is 1.2 highest among the all roads and that the traffic flowing on it exceeds its capacity value. So it is the most important road in Chandigarh as per number of users according to safety purpose. Also lane provided on it are not sufficiently wide enough to meet the IRC norms that also decrease the safety standards on it. As Madhya Marg is 6 lane road providing 3 lanes on each leg but the width of each leg is only limited to a range of 9.9 to10.2 meters which is not enough according to standards set by IRC.

IV. STUDY AREA

The junction number 15 which lies on the intersection of Vidhya Path and Madhya Marg in Chandigarh is considered for the study. As stated above the Madhya Marg is one of the most important road in Chandigarh as it join the city with neighbouring cities and Vidhya Path is also important as major educational institution lies adjacent to it. The location of the considered study area is shown in fig.

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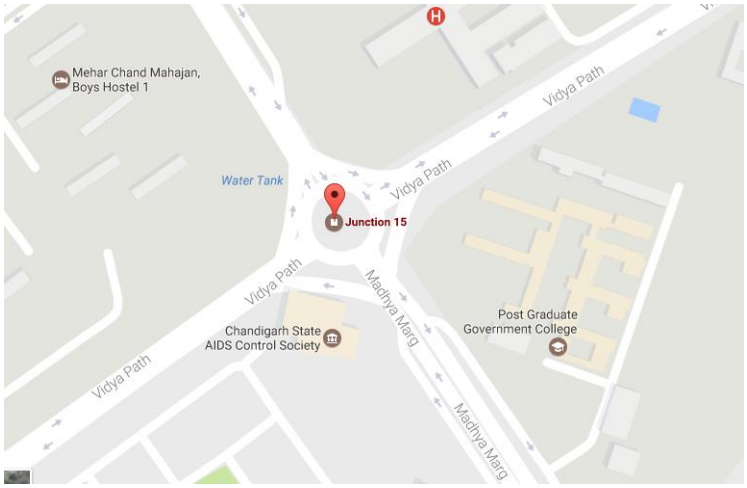

Fig 1: Location of the Study Area

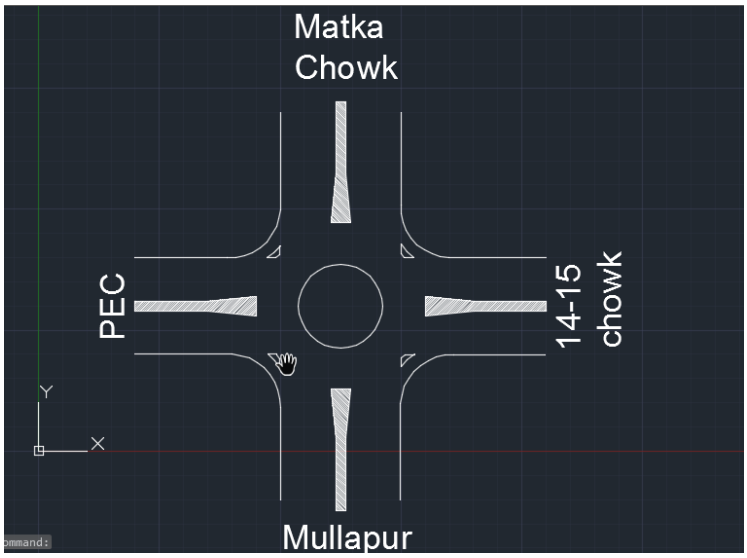

Fig 2: Drawing of the Intersection

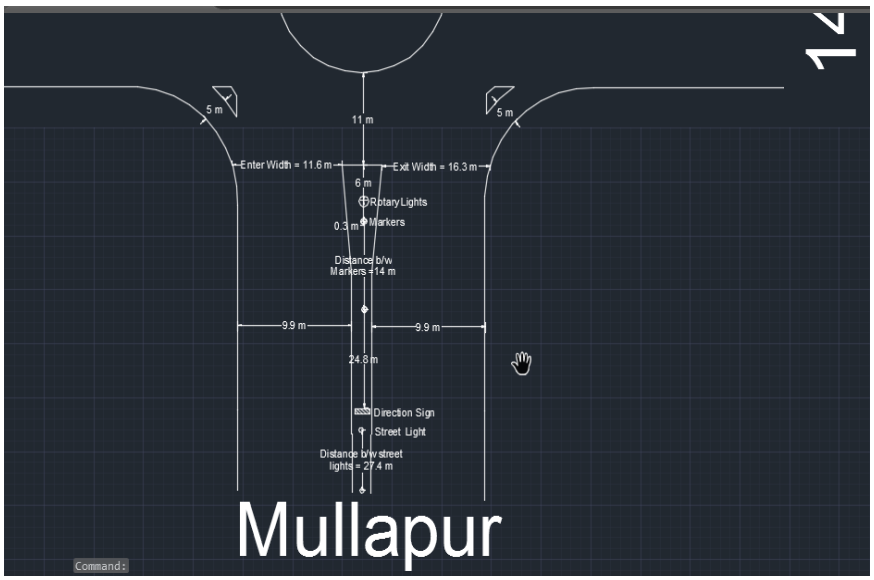

Fig 3: Road features at intersection from PGI side on Madhya Marg

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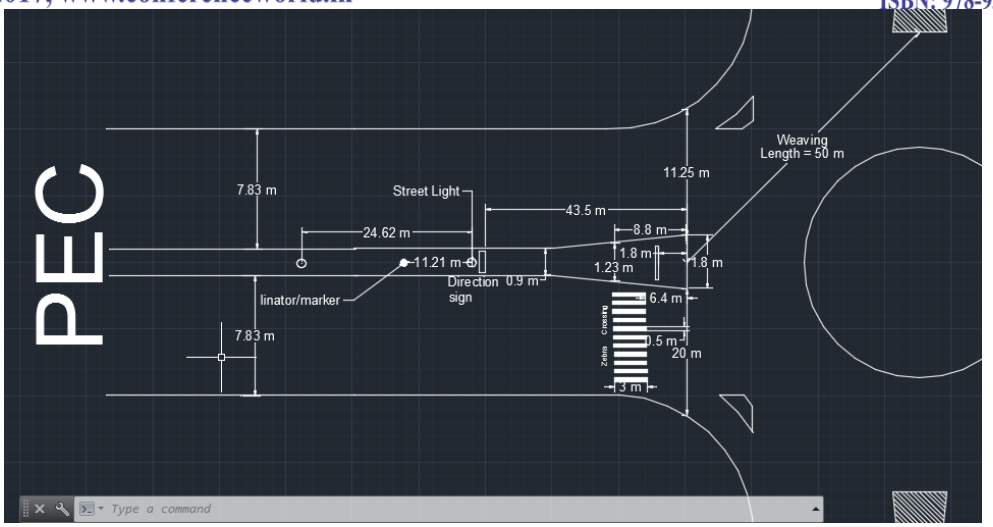

Fig 4 Road features at intersection from PEC side on Vidhya Path.

From the fig 3 the enter width to the rotary is 11.6 metres and the width of the carriageway for traffic on Madhya Marg for one leg is 9.9 metres, the number of lanes are 3. So the width of single lane on Madhya Marg is 3.3 metres which is not appropriate according to IRC norms.

From the fig 4 the enter width to the rotary is 11.25 metres and the width of the carriageway for traffic on Vidhya Path for one leg is 7.83 metres, the number of lanes are 2. So the width of single lane on Vidhya Path is 3.91 metres which is appropriate according to IRC norms.

V. ANALYSIS AND RESULTS

Number of Road Users: The original plan of the city was based on the gridiron defined by a system of seven types of roads, which was called the 7Vs. The system was designed to provide safe mobility to children and pedestrians within and between the sectors, while also permitting the benefits of fast movement for vehicular traffic. Sixty years later, although most elements of the original circulation system remain intact, it is the private car which rules the roost today. On an average per year vehicle registration increase in Chandigarh is 45000 but for the year 2016 number of newly registered vehicles increase touch the mark of 69699 which is 54 % more than the average growth rate of last 5 years.

Table 2: Number of Vehicle registered per year in Chandigarh

Year	Total number of vehicle registered	Growth in registered vehicles
2009	949364	
2010	999824	50460
2011	1048579	48755
2012	1100047	51468
2013	1145450	45403
2014	1198432	52982
2015	1241003	42571
2016	1310672	69669

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Traffic Volume: Traffic volume is the number of vehicles crossing a section of road per unit time at any selected period. Traffic volume is used as a quantity measure of flow, commonly used units are vehicles per day and vehicles per hour. The complete study carried out by recording the volume of various classes of traffic, the distributions and turning movements per unit time.

Table 3: Composition of PCU/hr at Intersection in Morning

MORNING PEAK HOUR 8AM – 10 AM			
APPROACH	LEFT TURNING	STRAIGHT	RIGHT TURNING
PU (672 PCU/hr)	207	197	268
PGI (1485 PCU/hr)	182	1059	234
16-11 CHOWK (1750 PCU/hr)	322	985	443
PEC (745 PCU/hr)	240	140	325
TOTAL PCU = 4652PCU/hr.			

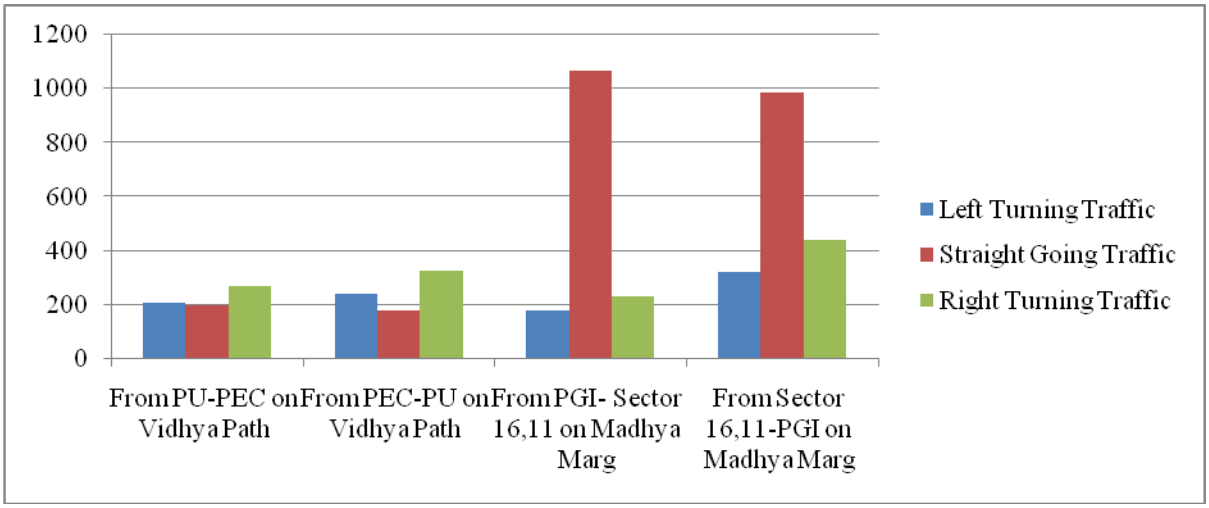

Figure 5: Directional Traffic Data on Various legs of Intersection from 8:00 to 10:00 AM

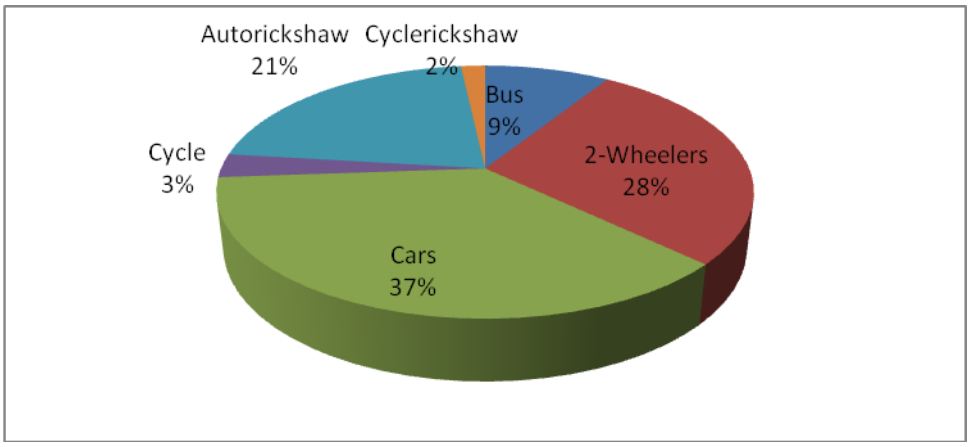

Figure 6: Composition of Traffic at Intersection from 8:00 to 10:00 AM

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Table 4: Composition of PCU/hr at Intersection in Evening from 5:00 to 7:00 PM

EVENING PEAK HOUR 5 PM – 7 PM			
APPROACH	LEFT TURNING	STRAIGHT	RIGHT TURNING
PU (903)	275	338	290
PGI (2060)	524	1227	309
16-11 CHOWK (1876)	322	1059	495
PEC (1065)	319	323	423
TOTAL PCU = 5904PCU/hr.			

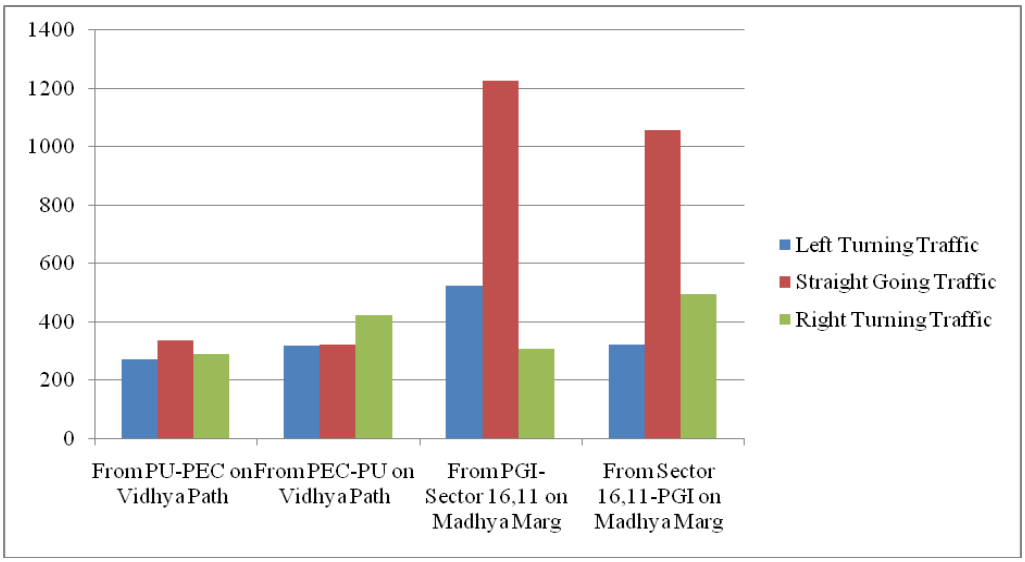

Figure 7: Directional Traffic Data on Various legs of Intersection in Evening from 5:00 to 7:00 PM

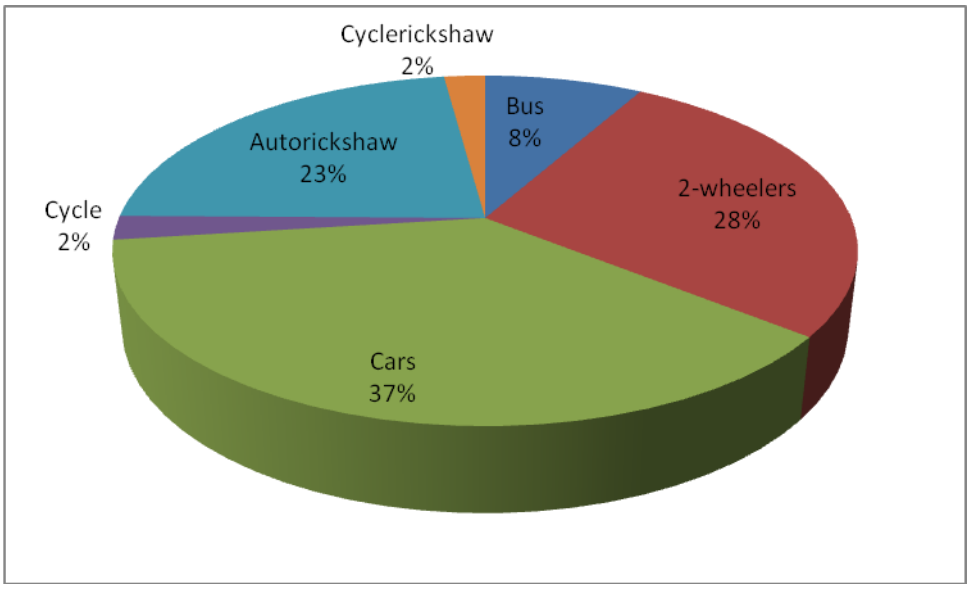

Figure 8: Composition of Traffic at Intersection from 5:00 to 7:00 PM

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Dimensions of Rotary at Intersection and its Capacity

Width at Entry of Rotary (e1) = 11.6 m

Width at Non Weaving Section of Rotary (e2) = 16.3 m

Average Width at Rotary (e) = 13.95 m

Width of Weaving Section (w) = 17.25 m

Length of Weaving Section (L) = 50 m

Proportion of Weaving Traffic from PEC-Sector 11,16 =0.542

Proportion of Weaving Traffic from Sector 11,16-PU = 0.745

Proportion of Weaving Traffic from PU- PGI = 0.731

Proportion of Weaving Traffic from PGI- PEC = 0.747

Proportion of Weaving Traffic at intersection (p) = 0.747

Capacity of Rotary according to formula given in IRC 65 1976 (c) = 280*w*(1+e/w)*(1- p/3)/(1+w/L)

= 280*17.25*(1+13.95/17.25)*(1-0.747/3)/ (1+ 17.25/50)

= 4877.87 PCU/hour

Volume Capacity ratio at the Rotary in the Morning = 0.759

Volume Capacity ratio at the Rotary in the Evening = 0.915

So from the volume capacity ratio value at the rotary in the morning and in the evening it is clear that the traffic volume is very high at the intersection on peak hours of the day. Also according to IRC 65 1976 the maximum traffic volume that a rotary can handle efficiently is 3000 PCU/hour from all the legs. So the present traffic volume at the rotary approaching from all the legs in the morning and in the evening exceeding that limit also. So to increase safety and to reduce accidents at the intersection we have to provide Signal with rotary.

Design of Signal

Maximum traffic volume approaching the intersection on Vidhya Path = 746 PCU/hour

Number of lanes provided on Vidhya Path for one leg = 2

Maximum traffic volume per lane on Vidhya Path (T_{AM}) = 373 PCU/hour

Total width of road on Vidhya Path (W_A) = 16.56 m

Maximum traffic volume approaching the intersection on Madhya Marg = 1554 PCU/hour

Number of lanes provided on Madhya Marg for one leg = 3

Maximum traffic volume per lane on Madhya Marg (T_{BM}) = 518 PCU/hour

Total width of road on Madhya Marg (W_B) = 20.7 m

Minimum green time required for pedestrian on Vidhya Path (G_{PA}) = $7+W_A/1.2$

G_{PA} = 21 seconds

Minimum green time required for pedestrian on Madhya Marg (G_{PB}) = $7+W_B/1.2$

G_{PB} = 25 seconds

Green time for pedestrian on Vidhya Path(G_{PA}) = Red time for traffic on Vidhya Path(R_A) = 21 seconds

Red time for traffic on Vidhya Path(R_A) = Green time for traffic on Madhya Marg(G_B) + Amber time on Madhya Marg(A_B)

Assume Amber time on Madhya Marg(A_B) = 5 seconds

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Green time for traffic on Madhya Marg (G_B) = R_A - A_B = 21-5 = 16 seconds

Green time for pedestrian on Madhya Marg(G_{PB}) = Red time for traffic on Madhya Marg(R_B) = 25 seconds

Red time for traffic on Madhya Marg(R_B) = Green time for traffic on Vidhya Path(G_A) + Amber time on Vidhya Path(A_A)

Assume Amber time on Vidhya Path (A_A) = 5 seconds

Green time for traffic on Vidhya Path(G_A) = R_B - A_A = 25-5 = 20 seconds

Now considering the Green time for traffic on Vidhya Path (G_A) and calculating the Green time for traffic on Madhya Marg by using maximum traffic volume per lane on Madhya Marg and Vidhya Path respectively:

As per formula:

$G_A/G_B = T_{AM}/T_{BM}$

$G_B = G_A * (T_{BM}/ T_{AM}) = 20*(518/373) = 28$ seconds

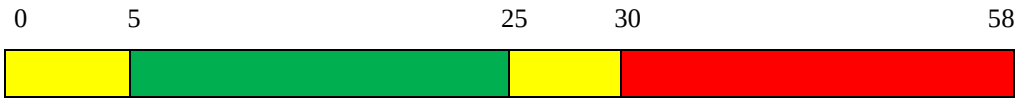
Green Time for Traffic on Vidhya Path (G_A) = 20 seconds

Green Time for Traffic on Madhya Marg (G_B) = 28 seconds

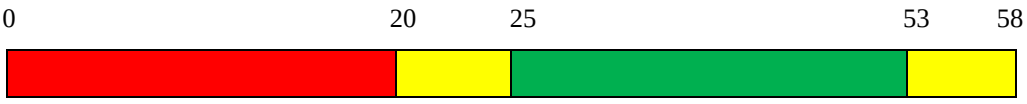
Total Cycle Length (C_O) = $G_A + A_A + G_B + A_B$ = 20+5+28+5 = 58 seconds

Green Time for Pedestrian on Vidhya Path (G_{PA}) = $C_O - G_B - A_B$ = 25 seconds

Green Time for Pedestrian on Madhya Marg (G_{PB}) = $C_O - G_A - A_A$ = 33 seconds



Phase Diagram for Vidhya Path



Phase Diagram for Madhya Marg

VI. CONCLUSION

From the above analysis the result may be cocluded :

1. Rotary capacity is more than IRC norms as its limits upto 3000 vehicle per hours.
2. During peak hours the traffic volume exceeds the capacity of rotary.
3. Number of accidents increase per year at intersection
4. Traffic signal with phase diagram shown above. should be provided.
5. Pedestrian crossing also provided at all legs.

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