

e-ISSN: 2319-8753 | p-ISSN: 2347-6710

TEDIA

International Journal of Innovative Research in SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 6, June 2022

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.118

9940 572 462

6381 907 438

 \bigcirc





| e-ISSN: 2319-8753, p-ISSN: 2320-6710| www.ijirset.com | Impact Factor: 8.118|

||Volume 11, Issue 6, June 2022||

| DOI:10.15680/IJIRSET.2022.1106199 |

Design of a Modern Roundabout for an Uncontrolled 4-leg Intersection in Amravati

Mr. Prajwal P. Ingale, Prof. Aseem Tigga

M.Tech Student, Department of Civil Engineering, G. H. Raisoni University, Amravati, India

Department of Civil Engineering, G. H. Raisoni University, Amravati, India

ABSTRACT: Constructing a roundabout or rotary intersection, which is a unique type of at-grade intersection where all converging vehicles are required to drive around a central island in a clockwise direction, is one technique to control traffic at crowded crossings. The present study aims to design a rotary for an uncontrolled 4-leg intersection located at Biyani Square in Amravati, India. The intersection has four approach roads with two-way traffic in all theapproach roads and there is no signal or traffic police to control the traffic at present and henceexperiences traffic chaos during peak hours. For this, a video data collection was carried out for a duration of eight hours from 9.30 am to 1.30 pm and from 4.00 pm to 8.00 pm on a typical working day using a camera from the veranda of an apartment building located near the intersection. During the data extraction stage, each 15 min. traffic volume was extracted for all the five classes of vehicles considered and was converted to passenger car units (PCU). The analysis of traffic data showed that during peak hours from 5.45 pm to 6.45 pm, the proportion of weaving traffic, i.e., the ratio of the sum of crossing streams to the total traffic on the weaving section was found to be 0.78. This proportion can take any value between 0.4 and 1 according to Indian road congress (IRC) norms, and the determined value in this study is found to be within the prescribed range. Using the calculated values of the average entry width of the rotary and width & length of the weaving section, the practical capacity of the rotary was found to be 2900 PCU. For the effective Traffic Movement, The capacity of the rotary should not exceed 3000 PCU. So from the above recommendation, the Roundabout can handle the present traffic volume effectively.

KEYWORDS: Roundabout, intersection, vehicle, traffic, crossing, design, rotary.

I. INTRODUCTION

In India's main cities, the problem of traffic congestion and solutions must be addressed immediately. Traffic congestion in India is mostly caused by the exponential growth of personal vehicles, as well as an increase in journeys and trip lengths. In Amravat district, there are about 258995 registered vehicles and the numbers of registered vehicles are growing 7% per annum in Amravati (based on RTO data). According to traffic count data, the city's roadways had a total of 569652 vehicles on them. The traffic count data in given in table 1.

Vehicle Type	No. of Vehicles
2W	341394
3W	107270
Car	93454
4W	27534
Total	569652

Source: Green Health Foundation, 2018



| e-ISSN: 2319-8753, p-ISSN: 2320-6710| <u>www.ijirset.com</u> | Impact Factor: 8.118|

Volume 11, Issue 6, June 2022

| DOI:10.15680/IJIRSET.2022.1106199 |

A rotary can be circular, elliptical, oval, or rectangular with four approach roads/legs, or it can be a complicated intersection with several approaches, according to Indian Road Congress (IRC) specifications (IRC-65 1976). The majority of previous research on the design of a new rotary or capacity study of an existing rotary focus on intersections with only four legs intersecting at roughly equal angles. According to IRC rules, the technique for designing such rotaries with only four legs intersecting at right angles is easy and uncomplicated. The selected intersection has four approach roads as shown in Fig.1. The Old Bypass Road from Welcome Point to M.I.D.C. and Mother Terrassa road connecting Irvin Square to Amravati University are intersecting at the junction and two-way traffic exists on all the approach roads. Currently, there is no signal or traffic police to control the traffic and hence experiences traffic congestion during peak hours. In order to design the rotary, it is essential to have information on traffic volumes coming from the approach roads. For this, a video data collection was carried out, the details of which are presented in the following section.



Fig.1 Map showing the study location

II. DATA COLLECTION AND ANALYSIS:

The video data collection was done to get the current traffic volumes, which is the most important factor in rotary design. On a typical working day, data was collected for eight hours, from 9.30 a.m. to 1.30 p.m. in the morning and from 4 p.m. to 8 p.m. in the evening, using a handy-cam from the veranda of a building near the intersection. Figure 2 shows a sample of the footage that was obtained. During peak hours, the crossroads encounters traffic congestion because there is no signal or traffic police to govern the flow of vehicles. Each 15-minute traffic volume was retrieved for all five classes of vehicles evaluated during the data extraction step, namely Carandlight commercialvehicle(includingthreewheeler), Busesandmediumandheavycommercial vehicle, Motorcycleandscooter(twowheeler), Pedalcycle, and Animaldrawnvehicle. When obtaining the 15-minute traffic volume data, a total of 16 directions of traffic movements were taken into account. Table 1 lists the directions that have been considered. The PCU factors specified in IRC recommendations were used to convert the class-wise traffic volumes seen from video to passenger car units (PCU). The PCU factors considered is shown in Table 2.

IJIRSET

| e-ISSN: 2319-8753, p-ISSN: 2320-6710| <u>www.ijirset.com</u> | Impact Factor: 8.118|

||Volume 11, Issue 6, June 2022||

| DOI:10.15680/IJIRSET.2022.1106199 |

Table 2. PCUs values for different vehicles as per IRC 65-1976

1	Carandlight commercialvehicle(includingthreewheeler)	
2	Busesandmediumandheavycommercial vehicle	2.8
3	Motorcycleandscooter(twowheeler)	0.75
4	Pedalcycle	0.5
5	Animaldrawnvehicle	4 to 6

The number of PCUs in each of the 15 min. duration, i.e., 9.30 am to 9.45 am, 9.45 am to 10.00 am etc. was calculated till 1.30 pm to find out the morning peak hour volume. In the same way each 15 min. traffic interval was calculated from 4.00 pm to 8.00 pm to find out evening peak hour volume. The rotary was designed using the observed peak hour values, the details of which are given in the next section.

n

Sr. No.	From	То
1	Mother Teressa Road (West)	Amravati Old Bypass Road (North)
2		Amravati Old Bypass Road (South)
3		Mother Teressa Road (East)
4	Amravati Old Bypass Road (North)	Mother Teressa Road (West)
5		Mother Teressa Road (East)
6		Amravati Old Bypass Road (North)
7	Mother Teressa Road (East)	Amravati Old Bypass Road (North)
8		Mother Teressa Road (East)
9		Amravati Old Bypass Road (South)
10	Amravati Old Bypass Road (South)	Mother Teressa Road (West)
11		Amravati Old Bypass Road (North)
12		Mother Teressa Road (East)

| e-ISSN: 2319-8753, p-ISSN: 2320-6710| www.ijirset.com | Impact Factor: 8.118



Volume 11, Issue 6, June 2022

DOI:10.15680/IJIRSET.2022.1106199



Snapshot of the video showing vehicles coming from different approach roads at the selected intersection

III. IDENTIFICATION OF PEAK HOUR TRAFFIC VOLUME

The hourly traffic volumes from 9.30 am to 1.30 pm and 4.00 pm to 8.00 pm are shown in Fig.3 and4 for morning and evening hours respectively



Fig 3.Hourly traffic volumes between 9.30 am to 1.30 pm



Fig 4. Hourly traffic volumes between 4.00 pm to 8.00 pm

It was found that, from 11.30 am to 12.30 pm, the traffic volume was 7010 PCUs, which is the maximum as compared to other hourly traffic during morning hours. Similarly, during evening hours, between 6.15 pm and 7.15 pm, a maximum traffic volume of 6886 PCUs was observed. Thus the results showed that the maximum traffic volume during the eight hours' study period was 7010 PCUs and that has been used in the design of the rotary.

IV. DESIGN OF ROTARY INTERSECTION

The design of rotary for the selected intersection is performed following the IRC guidelines. The first step in design is to identify the peak hour traffic volume and for the present case study intersection, it was found to be 7010 PCUs. The direction-wise traffic volume in PCUs is shown in Fig. 6



Fig 6. Traffic Approaching the Roundabout in (PCU)



| e-ISSN: 2319-8753, p-ISSN: 2320-6710| <u>www.ijirset.com</u> | Impact Factor: 8.118|

Volume 11, Issue 6, June 2022

| DOI:10.15680/IJIRSET.2022.1106199 |

It can be seen that vehicles travelling in Old Bypass Road is very High from North to South (i.e. 1136 PCU) and from South to North (i.e. 1089 PCU). Also from the below Fig 6. it is clear that the sum of inflow and outflow volume on the Mother Teressa Road (East) is maximum i.e. about 3404 PCU. According to Kadiyali, the rotary's practical capacity should be more than this value in order for the design to be satisfactory.

The next step is to determine the diverging, merging, and weaving traffic from each of the five approach routes. This allows you to locate the part with the highest proportion of weaving traffic (p), i.e., the ratio of the sum of crossing streams (b + c) to the overall traffic (a + b + c + d).



Fig 7. Traffic negotiating the Roundabout

The intersection with the highest proportion was discovered to be Old Bypass road (south) and Mother Teressa road (west). That is

$$PCD = \frac{(b+c)}{(a+b+c+d)} = \frac{(1009+489)+(1089+749)}{(1009+489+443+1089+749+474)} = 0.78$$

The proportion can take any value between 0.4 and 1 according to IRC recommendations, and the computed value in this study is determined to be within the prescribed limit.

The next stage is to determine the rotary's practical capacity under the specified geometric parameters and weaving traffic percentage to total traffic. The following is an empirical formula for calculating the rotary's capacity:

$$Q = \frac{280w * (1 + (\frac{e}{w})) * (1 - \frac{Pmx}{3})}{1 + (\frac{w}{L})}$$

Where,

e - average entry and exit width, i.e, (e1+e2)/2,

w - weaving width,

- L length of weaving, and
- p proportion of weaving traffic to the non-weaving traffic



| e-ISSN: 2319-8753, p-ISSN: 2320-6710| <u>www.ijirset.com</u> | Impact Factor: 8.118|

Volume 11, Issue 6, June 2022

| DOI:10.15680/IJIRSET.2022.1106199 |

The proportion of weaving traffic in this case was calculated to be 0.78. The average entry width of the rotary was found to be 7 meters, and the weaving section was found to be 10.5 meters, based on the maximum width of the approach road (10.5 meters). The weaving length should be at least four times the width of the weaving section, according to IRC-65:1976. As a result, the weaving length for this study was estimated to be 42 meters. Using the above figures for the rotary's average entry width, weaving section width and length, and weaving traffic proportion, the rotary's practical capacity was estimated using the equation below.

$$Q_p = \frac{280 * 10.5 * \left(1 + \frac{7}{10.5}\right) * \left(1 - \frac{0.78}{3}\right)}{1 + \left(\frac{10.5}{42}\right)} = 2900 \ pcu/hr$$

As per IRC for the effective Traffic Movement, The capacity of rotary should not exceed 3000 pcu. Hence, the design can be deemed adequate for handling current approach traffic volumes. Finally, the suggested rotary intersection was sketched out as shown in fig. 8



Fig 8. Design Parameter of Proposed Rotary

V. CONCLUSION

Modern urbanization is a severe problem in most of India's big cities. Many people are relocating from rural to urban regions, which means that the number of automobiles on the road is increasing. Though vehicle growth is increasing at an exponential rate, infrastructure construction is not keeping pace, resulting in traffic congestion on metropolitan highways. Reduced use of public transportation enhances the traffic problem. Constructing a roundabout or rotary intersection is one approach to control traffic at crowded intersections. In this study, videographic techniques were used to obtain traffic volumes from several approach routes, which were then examined for peak hour traffic flow. Using that, an attempt was made to design the rotary intersection according to IRC requirements, and finally a drawing illustrating various design components for the proposed rotary intersection was prepared. When compared to grade separators, installing a rotary is a cost-effective and efficient option.

REFERENCES

- [1] IRC: 65 1976 *Recommended Practice for Traffic Rotaries* Indian Roads Congress, New Delhi, India.
- [2] Patel M 2014 Solution for reduction of traffic congestion: a case Study of Thaltej rotary intersection *International Journal of Applied Engineering and Technology* 4(1) 37-45.
- [3] S. Vasantha Kumar et al 2017 IOP Conf. Ser.: Mater. Sci. Eng. 263 032030Design of a rotary for an uncontrolled multi-legintersection in Chennai, India



| e-ISSN: 2319-8753, p-ISSN: 2320-6710| <u>www.ijirset.com</u> | Impact Factor: 8.118|

Volume 11, Issue 6, June 2022

| DOI:10.15680/IJIRSET.2022.1106199 |

- [4] Siteshkumarsingh, Karan Prabhakar "Statistical Traffic Rotary Analysis ofof Intersection" International Journal of Engineering Science and Research Technology. ISSN 2277-9655
- [5] Daniel Turner(December 2011)- Roundabouts: A Literature Review
- [6] Frank Gross a, Craig Lyon b, BhagwantPersaud c, Raghavan Srinivasan d- Safety effectiveness of converting signalized intersections to roundabouts
- [7] Kadiyali L R 2000 *Traffic engineering and Transport Planning* Khanna Publishers, New Delhi, India.
- [8] S. K. Khanna, C.E. G. Justo-Highway Enineering





Impact Factor: 8.118





INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY





www.ijirset.com