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Design and Analysis of Rotary Intersection at Taat Mil Chauraha Kanpur

[1]Ankit Pandey, [2]Vaibhav Dubey

[1]Student, Transportation Engineering (Civil Engineering), Rama University, Kanpur, Uttar Pradesh, India

[2]Assistant Professor, Civil Engineering Department, Rama University, Kanpur, Uttar Pradesh, India

Abstract: *Rotary Traffic at intersections is a special way of changing the level of lanes to move the one-way traffic around a central traffic island. With the rapid growth of traffic, it seems that road widening and flyover provision have had to be overcome by major conflicts at road crossings such as collisions between right and left turns. In this way, major conflicts are transformed into smaller conflicts such as mergers and acquisitions. Rotary vehicles are well compelled to move in a clockwise direction. Then they weave from the rotary to where they want to be. Traffic jams are avoided by allowing all vehicles to converge on a rotating stream and then deviate from the desired radiation curve. Thus, cross-cutting conflicts end and transform into a weaving process or a merging function from right to deviant work to left. In this paper, designing rotaries at intersections is discussed and a software package is developed for use in road works. In this project we have carefully analyzed and designed the TATMILL CHAURAHA intersections. Therefore, that traffic flows efficiently and there will be no traffic jams or accidents.*

Reference Terms - Traffic, Intersection, Rotary, Design, PCU

I. INTRODUCTION

Rotaries are ideal if traffic congestion in three or more ways is equal. Rotaries are suitable when there are many lanes and there are no different lanes available for the right turn which makes the geometric complex of the intersection. Rotary traffic activities are three-

a) Diverging
b) Merging
c) Weaving

a) **Diverging:** when the vehicles moving in one direction is separated into different streams according to their destinations.
b) **Merging:** is referred to as the process of joining the traffic coming from different approaches and going to a common destination into a single stream.
c) **Weaving:** is the combined operation of both merging and diverging movements in the same direction.

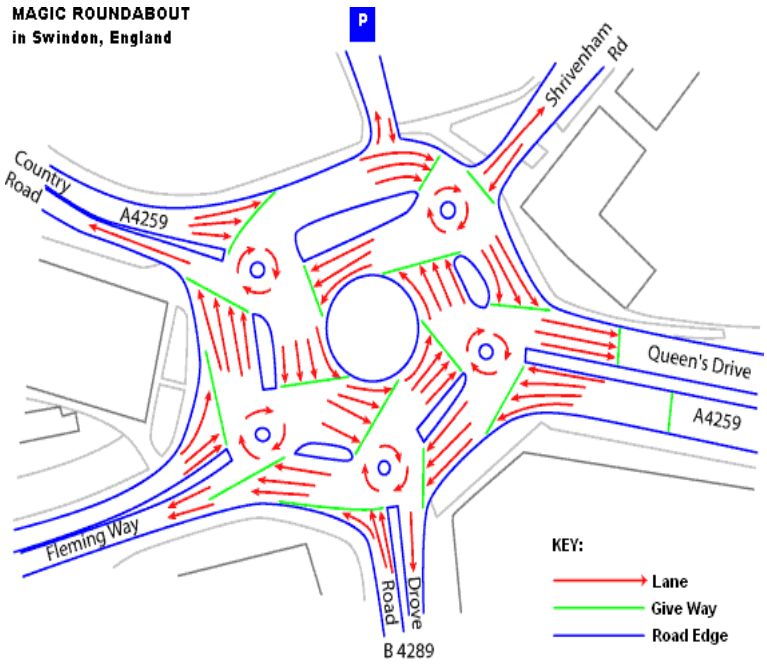

Figure no. 1 magic rotary

1.1 Design Speed

All vehicles are required to reduce their speed when rotating. Therefore, the rotary design speed will be much lower than the roads leading to it. While it is possible to design the environment without reducing the maximum speed, geometry may result in a much larger size that incorporates greater construction costs. It is common practice to maintain a design speed of 30 and 40 km / h in urban and rural areas respectively.

1.2 Entry, Exit and Island Radius

Radius at entry depends on a variety of factors such as design speed, height, and collision coefficient. Rotary entry is not straightforward, but a small curvature is introduced. This will force the driver to slow down. Approximately 20 km / h and 25 kmph are suitable for urban and rural design respectively. The exit radius should be higher than the entry radius and the rotary island radius so that the vehicles exit the rotary at a higher rate. It is a common practice to keep the exit radius as 1.5 to 2 times the input radius. However, if pedestrian movement is high on the exit route, then the exit radius may be set to the same as that of the entry radius. The radius of the central island is controlled by the design speed, as well as the radius of the inlet curve. The radius of the central island is about 1.3 times the curve for all realistic purposes.

1.3 Width of the Rotary

The diameter of the inlet and the width of the rotary exit are controlled by the traffic in and out of the intersection and the width of the approximate road. The width of the carriageway at the entrance and exit will be less than the width of the carriageway on the roads to allow for speed reduction. The IRC recommends that a 7 m wide two-lane road should be maintained at 7 m on urban roads and 6.5 m on rural roads. In addition, the 10.5 m three-lane road will be reduced to 7 m and 7.5 m respectively on urban and rural roads. Traffic rotaries reduce the complexity of crossing traffic by forcing it to run weaving operations. The shape and size of the rotary is determined by the amount of traffic and the rotation of the rotating motion. Rotary capacity testing is performed by analyzing a phase that has a large portion of traffic weaving.

The analysis is done by using the formula given by the width of the weaving section and it should be higher than the width at entry and exit. Normally this will be one lane more than the average entry and exit width. Thus, weaving width is given as,

$$W = \text{weaving} = (e_1+e_2)/2 +3.5$$

Where e1 is the width of the carriageway at the entry and e2 is the carriageway width at exit. Weaving length determines how smoothly the traffic can merge and diverge, Fig. It is decided based on many factors such as weaving width, proportion of weaving traffic to the non-weaving traffic etc. This can be best achieved by making the ratio of weaving length to the weaving width very high. A ratio of 4 is the minimum value suggested by IRC. Very large weaving length is also dangerous, as it may encourage over speeding.

1.4 Weaving Length

The weaving length determines the ease with which the vehicle can maneuver through the weaving section and thus determines the capacity of the rotary. The weaving length is decided on the basis of the factors, such as, the width of weaving section, average width of entry, total traffic and proportion of weaving traffic in it. It is desirable to prevent direct traffic cuts and this can be achieved by making the ratio of weaving length to weaving width large enough. A ratio 4:1 is regarded as minimum. The minimum values of weaving lengths as recommended by IRC are given below.

2. OBJECTIVES OF THE PROPOSED STUDY

- To flow Traffic flow, it has to be regulated on only one direction of movement, thus eliminating severe conflicts between crossing movements.
- All the vehicles which are entering into the rotary are to be gently forced, so that the speed of the vehicles can be reduced and also the movement of the vehicles are continued at a slower speed.
- Due to lower speed of the vehicles, various accidents and severe conflicts are avoided into the rotary and severity of the chances also become less.
- Rotaries are itself known as self-governing by this it does not have any need of police control or traffic signals.
- Rotary provide one-way movement in an orderly and disciplined traffic flow.

Design speed(kmph)	Minimum length of weaving(m)
40	45
30	30

- Inside the rotary, frequent stopping and starting of the vehicles are avoided.
- It generally avoids any conflicts which comes under it.
- Vehicles are easily turned in rotary.
- A rotary is specially designed and suited for the intersection legs ranging from 4 to 7.
- The capacity of rotary intersection is the highest of all other intersections at grade.

3. RESEARCH METHODOLOGY

3.1 Traffic demand or Transportation demand

Transport demand management, traffic demand management or travel demand management (all TDM) implementation of strategies and policies to reduce travel demand, or redistributing this need locally or periodically. In transportation, as with any network, demand management can be another inexpensive way to increase capacity. The transportation demand system has the potential to bring about better environmental results, improved public health, stronger communities, and more developed cities. TDM strategies connect and support public movement for sustainable transport.

3.2 Area calculation

Width of pavement (Taatmill towards Ramadevi) – 72 feet
Width of pavement (Taatmill towards Kidwainagar) – 66 feet
Width of pavement (Taatmill towards Bus-stand) – 72 feet
Width of pavement (Taatmill towards Railway Station) – 66 feet

Area= 72ft* 66ft

3.3 Traffic volume

Traffic/ Time	**March 2022 11:15pm to 12:20am**	**March 2022 9:30am to 12:30pm**	**March 2022 5:00pm to 9:00pm**
Days	**Thursday**	**Friday**	**Friday**
Car	**173**	**1294**	**2628**
Motorcycle	**239**	**3340**	**7277**
Bicycle	**23**	**257**	**505**
Van/auto rickshaw	**56**	**967**	**1092**
Small lorry	**19**	**983**	**767**
Articulated lorry	**16**	**14**	**03**
Bus	**38**	**142**	**361**
Construction vehicle	**02**	**01**	**01**
Farm vehicle	**07**	**01**	**04**
E-rickshaw	**52**	**313**	**629**
Tanga	**05**	**19**	**23**

3.4 Traffic volume data collected from the site

To examine that, our site **TAATMILL CHAURAHA** is favorable for the rotary intersection or not, we have collected traffic volume data at different – different time – sets. The obtain data is given below in the form of table-

Table No. 02 Total Traffic count of TAATMILL Chauraha

SIGN OF ROAD ROUTE	⇦	⇨	⇧	TIME
	Left	Right	straight	
	Ramadevi to Kidwainagar	Ramadevi to Ghantaghar	Ramadevi to bus-stand	morning
Car	137	138	112	9:30am to 10:30am
Motorcycle	477	388	295	9:30am to 10:30am
Bicycle	43	97	46	9:30am to 10:30am
Van/auto rickshaw	123	191	151	9:30am to 10:30am
Small lorry	15	13	20	9:30am to 10:30am
Articulated lorry	00	00	00	9:30am to 10:30am
Bus	00	29	20	9:30am to 10:30am
Construction vehicle	01	00	00	9:30am to 10:30am
Farm vehicle	00	00	00	9:30am to 10:30am
E-rickshaw	97	97	89	9:30am to 10:30am
Tanga	00	00	00	9:30am to 10:30am

3.5 DESIGN ELEMENT OF ROTARY INTERSECTION

At rotating road crossings, design materials include-

a. Design speed

b. Radius on entry and exit.

c. Login & exit width

d. Radius of the central island

e. Length and width of weaving

f. Power of rotary intersection

g. Warning Sign- Rotary

h. Lighting and Spatial Planning

i. Drain

Design Speed

All the vehicles are required to reduce their speed at a rotary. Therefore, the design speed of a rotary will be much lower than the road leading to it. The normal practice is to keep the design speed as 20 KMPH & 40 KMPH for urban & rural area respectively.

3.6 Radius of entry curve

The radius at the entry depends on various factors like design speed, super elevation & coefficient of friction. The entry to the rotary is not straight, but a small curvature is introduced. This will force the driver to reduce the speed. Required value of entry radius **R** is determining by following empirical formula –

$$R=V^2/127f$$

Where, V= design speed of rotary

f = coefficient of friction radius of entry curve for design speed 30 KMPH.

R = $30^2/127*0.15$ = 47.244 m

3.8 Radius of exit curve:

The exit radius should be higher than the entry radius and the radius of the rotary island so that the vehicles will discharge from the rotary at a higher rate.

A general practice so to keep the exit radius as 1.5 to 2.0 times the entry radius.

3.7 Capacity of a rotary intersection

Entry carriageway width e_1 = 7 meter

Exit carriageway width e_2 = 7 meter

Average width of carriageway,

$e = (e_1 + e_2) / 2$ $e = (7+7) /2$

e = 7 meter

Weaving width of section,

$W = [(e_1 + e_2) / 2] + 3.5$ $W = [(7+7) /2] + 3.5$

W = 10.5 meter

Ratio, e/W= 0.66 (ok) by **IRC Guideline ratio e/W** should be **0.4 to 1.0 weaving length,**

*L= 2.5 * W*

L = 2.5 * 10.5

*L= 26.25 meter by **IRC Guideline** Ratio **W/L** should be **0.12 to 0.4***

Proportion of Non weaving section to weaving section p = (b+c)/ (a+d+b+c)

p = (1686+743) / (893+652+1686+743) [Ramadevi road & Kidwainagar road]

p = 2429/3974

p = 0.6

Practical capacity of rotary intersection, $Q_p = [280W (1+ (e/W)) (1-p/3)]/(1+W/L)$

$Q_p = [280*10.5(1+0.66) (1-0.61/3)] / (1+10.5/26.25)$ $Q_p = 3855.516/1.4$

Q_p =2753.94 PCU/hr.

Q_p =2754 PCU / hr. (O.K.) By IRC Guidelines, value of Q_p should be 500 to 3000 vehicles / hr.

4.0 RESULTS

As part of our project work. We have chosen our theme which is DESIGN OF ROTARY INTERSECTIONS. With the Rotary Intersections project, we had chosen our site TATMILL CHAURAHA. First, we noticed that the traffic was light and there was a lot of jam. For these reasons, there have been many accidents that occur on a daily basis. To avoid this, we have visited and done some exploration work. After the research work we had collected various data there and after collecting the data we decided to make some changes there and then designed it accordingly. And the final result of our project is as follows.

Average width of carriageway,

e = 7 meter Weaving width section,

W = 10.5 meter Ratio = 0.66

Weaving length, L = 26.25 meter

Shape = circular

Type = mini roundabout

R entry = $V^2/127f = 30^2/127*0.43$ = 16 meter Central Island = R entry *4/ 3 = 21 meter

R exit = R entry * 1.5 = 24 meter

5. CONCLUSION

In a rotating or rotating design, the principle-based principles have a greater value than a set of rules. An engineer needs design methods based on the basic relationships between geometry, strength, and safety that will enable him to move from the proposed geometry to the actual scale of the working conditions. The result will be the practice of practicing and learning a circular structure based on the ability that performance problems arise from the following:

- Misunderstanding how site content affects construction;
- Designers do not always see the functional effects of their geometric design options;
- The overall structure is often overlooked in detail.
- Overall, it has been concluded that round or round tests are required from time to time.
- It analyses the need to improve traffic flow and safety for drivers and pedestrians.
- It analyzes the need for improved vehicle mobility and safety for drivers and pedestrians.

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[17] www.ijrise.org|editor@ijrise.org

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