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Review On the Need for Rotary Intersection At Tatmil Chauraha, Kanpur

[1]Yash Kushwaha, [2]Vijay Bahadur, [3]Abhishek Yadav, [4]Abhishek Yadav [5]Abhishek Kumar Singh
[1234]Student, Transportation Engineering (Civil Engineering), AITM, Kanpur, Uttar Pradesh, India
[5]Assistant Professor, Civil Engineering Department, AITM, Kanpur, Uttar Pradesh, India

Abstract: Traffic Rotary at road intersections is a special form of grade change of lanes to channelize movement of vehicles in one direction around a central traffic island. With rapid growth of traffic, it is experienced that widening of roads and providing flyovers have become imperative to overcome major conflicts at intersections such as collision between through and right-turn movements. In this way, major conflicts are converted into milder conflicts like merging and diverging. The vehicles entering the rotary are gently forced to move in a clockwise direction. They then weave out of the rotary to the desired direction. The crossing of vehicles is avoided by allowing all vehicles to merge into a stream around the rotary and then to diverge out to the desired radiating road. Thus, the crossing conflicts eliminate and convert into weaving section or a merging operation from right and a diverging operation to the left.

With hike in road traffic due to globalization, it has become a necessity to develop a transportation network which could handle the present as well as the future traffic efficiently. To do so, proper designing and analysis of various infrastructures is to be done. One such infrastructure induced in road network to increase the efficiency of intersections by reducing the delay is roundabouts. Presently, as such no robust model is available for Indian traffic conditions to determine the performance of roundabouts. So, an attempt has been made to develop a model to determine the performance of roundabouts based on capacity. From the existing global models, it was observed that the geometrics of the roundabout played a crucial role in addressing the roundabout capacity. Thus, with this aspect as foundation, a model for entry capacity was developed for heterogeneity in Indian traffic. For modelling, data from various roundabouts with varying geometry and flow properties were selected for including affect due to variations. In all, five geometric elements were observed to have significant impact on capacity.

Reference Terms – Traffic Intersection, Rotary Design, Passenger Car Unit,

I. INTRODUCTION

Rotaries are suitable when the traffic entering from three or more approaches are relatively equal. A total volume of about 3000 vehicles per hour can be considered as the upper limiting case and a volume of 500 vehicles per hour is the lower limit. Rotaries are suitable when there are more approaches, and no separate lanes are available for right-turn traffic thus making intersection geometry complex.

Kanpur is one of the most important cities of our state. It is also an industrial hub, having industries like leather, cotton, etc. Now a day's our city is suffering from many serious problems like insufficient supply, traffic jams etc. Out of which the problem of traffic jams has become very serious. The main reason behind the traffic problem is that the no. of vehicles on the road is increasing with a rapid rate. This rapid growth has given rise to an increase in volume of vehicles on the roads. To deal with such a huge volume of traffic flow, there is a need to redesign the traffic regulation network having focus on the Design of the rotary intersection. The traffic operations at a rotary are three, diverging, merging and weaving.

Diverging: When the vehicles moving in one direction is separated into different streams according to their destinations.

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.

Weaving: is the combined operation of both merging and diverging movements in the same direction.

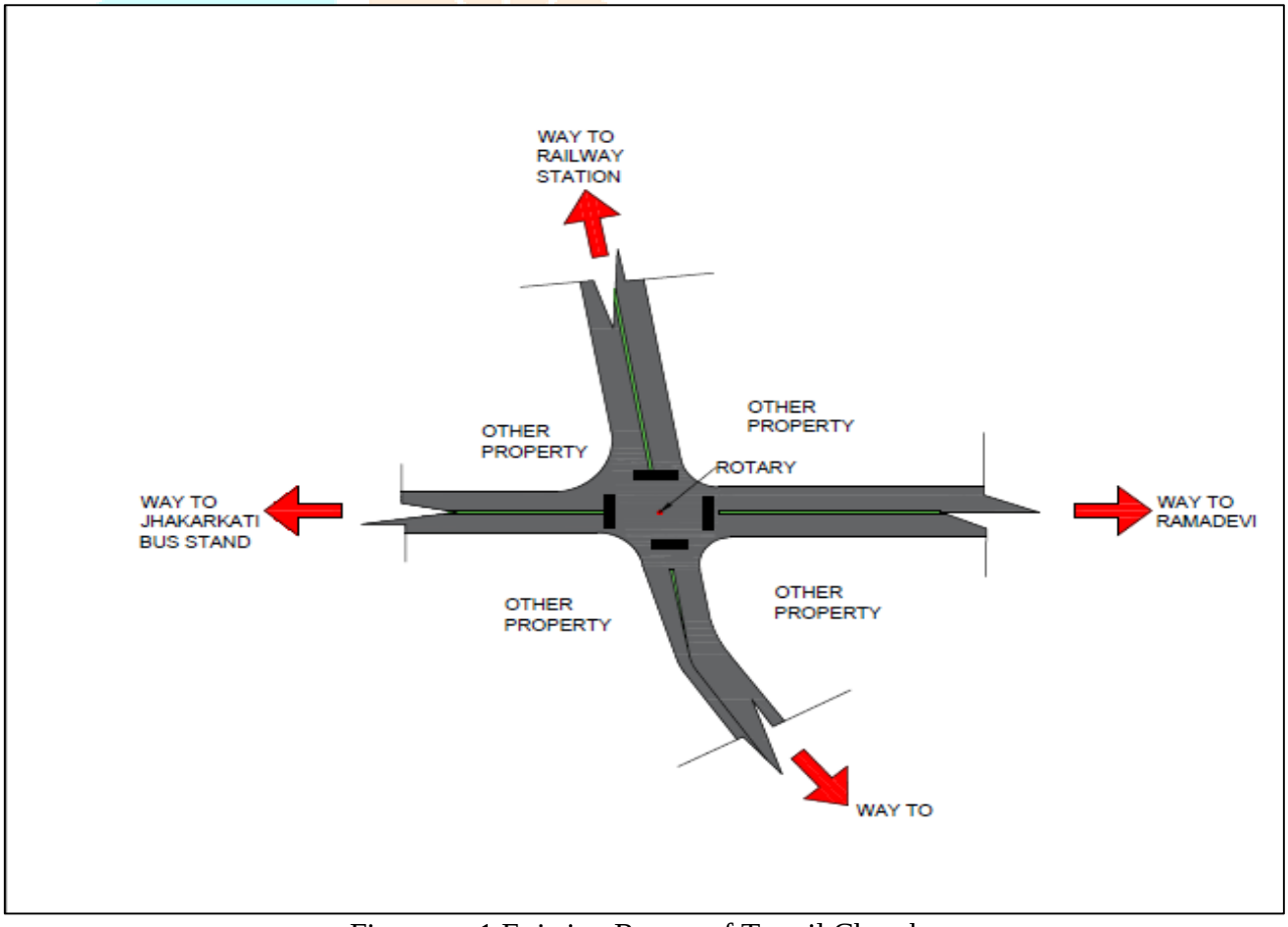

Figure no.1 Existing Rotary of Tatmil Churaha

2. DESIGN ELEMENT OF ROTARY INTERSECTION

In the rotary intersection, design elements includes: -

1. Design speed
2. Radius of entry curve
3. Radius of exit curve
4. Entry and Exit width
5. Capacity Of a Rotary intersection
6. Width of the Rotary
7. Weaving Length

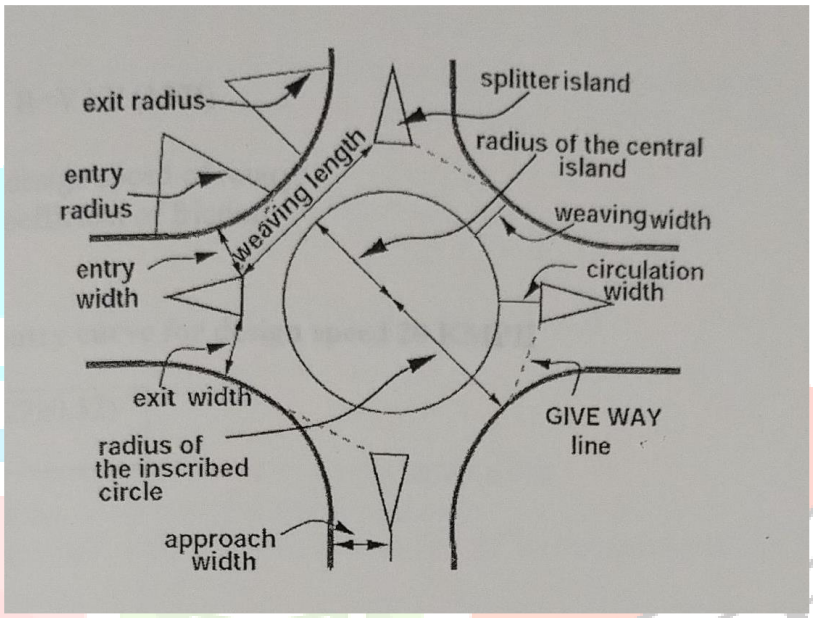

Figure no. 2

2.1 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.

2.2 Radius of entry curve

The radius at the entry depends on various factors like design speed, super- elevation, and 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 determine 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 40 KMPH

R=40^2/(127x0.52)

R=24.22m

2.3 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 is to keep the exit radius as 1.5 to 2 times the entry radius.

2.4 Entry and Exit width

The entry width and exit width of the rotary is governed by the traffic entering and leaving the intersection and the width of the approaching road. The width of the carriageway at entry and exit will be lower than the width of the carriageway at the approaches to enable reduction of speed.IRC suggests that a two lane road of 7 m width should be kept as 7 m for urban roads and 6.5 m for rural roads. Further, a three-lane road of 10.5 m is to be reduced to 7 m and 7.5 m respectively for urban and rural roads The width of the weaving section 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,

$$\textbf{Weaving (p) =(e1+e2/2)+3.5m}$$

Where,

e1= is the width of the carriageway at the entry

e2=is the carriageway width at exit

Weaving length determines how smoothly the traffic can merge and diverge.

- 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

2.5 Capacity of a Rotary intersection

The capacity of rotary is determined by the capacity of each weaving section. Transportation road research lab (TRL) proposed the following empirical formula to find the capacity of the weaving section.

$$\textbf{Qp=280w(1+e/w) (1-P/3)/(1+ w/l)}$$

Where,

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

w=is the weaving width, l =is the length of weaving

P= is the proportion of weaving traffic to the non-weaving

Traffic,

Four types of movements at a weaving section a, and d, are the non-weaving traffic and band c are the weaving traffic. Therefore,

$$\textbf{[p=(b+c)/(a+b+c+d)]}$$

This capacity formula is valid only if the following conditions are satisfied.

- Weaving width at the rotary is in between 6 and 18 meters.

- The ratio of average width of the carriage way at entry and exit to the weaving width is in the range of 0.4 to 1.3.
- The ratio of weaving width to weaving length of the roundabout is in between 0.12 and 0.4.
- The proportion of weaving traffic to non-weaving traffic in the rotary is in the range of 0.4 and 1.5.
- The weaving length available at the intersection is in between 18 and 90.

2.6 Width of the Rotary

The diameter of the inlet and the width of the rotary exit are controlled by the traffic in and out orthe 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 .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 analysing 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,

$$W = \text{weaving} = (e1+e2)/2 + 3.5$$

Where, e**1** is the width of the carriageway at the entry and e**2** 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.

2.7 Weaving Length

The weaving length determines the ease with which the vehicle can manoeuvre through the weaving section and thus determines the capacity of the rotary. The weaving length is decided based on 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.

3. OBJECTIVES OF THE PROPOSED STUDY

- To flow Traffic flow, it must 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 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 ail other intersections at grade.

4. RESEARCH METHODOLOGY

4.1 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.

4.2 Area calculation

Width of pavement (Tatmil towards Ramadevi) — 72 feet
Width of pavement (Tatmil towards Kidwai nagar) — 66 feet
Width of pavement (Tatmil towards Bus-stand) - 72 feet
Width of pavement (Tatmil towards Railway Station) — 66 feet

Area= 72ft* 66ft

4.3 Traffic volume

Traffic/ Time	December 2024 11:15pm to 12:20am	December 2024 9:30am to 12:30pm	December 2024 5:00pm to 9:00pm
Days	Thursday	Monday	Friday
Car	215	1546	2978
Motorcycle	297	3940	7984
Bicycle	50	305	707
Van/auto rickshaw	100	1019	1947
Small lorry	32	1100	1024
Articulated lorry	26	28	09
Bus	43	197	841
Construction vehicle	05	05	01
Farm vehicle	13	09	04
E-rickshaw	102	413	929
Tanga	08	24	29

4.4 Traffic volume data collected from the site

To examine that, our site TATMIL CHAURAHA is favourable 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-

SIGN OF ROAD ROUTE	⇦	⇨		TIME
	Left	Right	straight	
	Ramadevi to Kidwai nagar	Ramadevi to Ghantaghar	Ramadevi to bus-stand	morning
Car	187	198	168	9:30am to 10:30am
Motorcycle	577	433	375	9:30am to 10:30am
Bicycle	93	130	96	9:30am to 10:30am
Van/auto rickshaw	173	225	241	9:30am to 10:30am
Small lorry	25	20	25	9:30am to 10:30am
Articulated lorry	01	00	00	9:30am to 10:30am
Bus	09	35	40	9:30am to 10:30am
Construction vehicle	02	01		9:30am to 10:30am
Farm vehicle	00	00	00	9:30am to 10:30am
E-rickshaw	127	129	139	9:30am to 10:30am

Table No. 02 Total Traffic count of Tatmil Chauraha

5. FUTURE SCOPE OF STUDY

- Getting broad and more realistic view regarding results on rotary intersection to of study area, the survey carried out which should cover every season of year that is summer season, winter season, monsoon season and festival, that means January to October or November i.e. up to the end of Diwali. Particularly the problem of traffic jams seems high on intersection in festival season. For the above period perform automatic traffic count which works on sensors that detect load of the vehicle Also there should extended survey area before Bajaj square intersection road. Such a broad survey helps to make the exact traffic volume count.

- Also, design can do with AutoCAD Civil 3D design this process in a comfortable manner within time and it conserves a lot of time and effort.

- As the capacity of rotary increased above 3000 PCU/hr. with the development of new technologies adding Signaling System.

6. CONCLUSION

Traffic rotaries reduce the complexity of Crossing traffic by forcing them in to weaving operations. The shape and size of the rotary are determined by the traffic volume and share of turning movements. Capacity assessment of a Rotary is done Analyzing the section having the greatest Proportion of weaving traffic.

An engineer Needs desion methods based on the basic relationship between geometry, Strength, and safety that will enable him to move from the Proposed geometry to actual Scale of the working

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