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Efficiency and Capacity of Traffic Rotaries at the Intersection

Foram Chaudhari¹, Prof. V. G. Yadav²

¹BE Student, Civil engineering department, GEC Surat, Gujarat, India

²Professor V. G. Yadav, Civil engineering department, GEC Surat, Gujarat, India

Abstract: For the movement of the vehicle and the safety of the road users at the intersection where two or more road networks are meets, rotary or roundabout is constructed. Rotary intersection control the different traffic congestion efficiency and it is important to evaluate rotary intersection capacity and its efficiency. The rotary intersection assessment is directly related to several parameters of traffic and motorists such as service of level, travel time delay, accidents, operating costs, environmental factors, pedestrian safety, etc.

Keywords: Efficiency, Capacity, Pedestrian Safety, Accidents.

I. INTRODUCTION

A rotary intersection is an enlarged intersection where all converging vehicles are forced to move around a large island in one direction before they weave out of traffic flow into their respective direction radiating from the central island. It is enlarged intersection of roads where vehicles cross the road or change their direction without stopping. The main objects of providing a rotary are to eliminate the necessity of complete stopping even for crossing streams of vehicles and reduce the area of conflict.

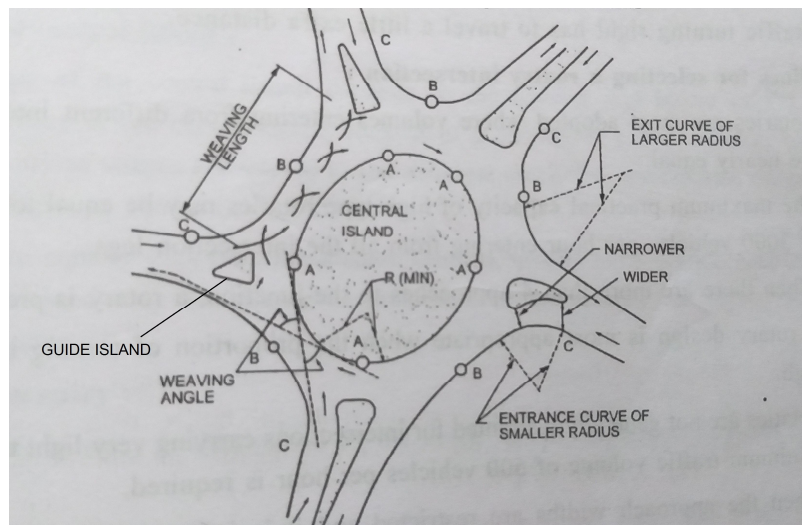


Fig.1: Rotary intersection

II. THEORY

A. Criteria Of Suitability Of A Rotary At The Intersection

- 1) Rotaries are most adopted where volumes entering from different intersection legs are nearly equal.
- 2) The maximum practical capacity of high rotaries may be equal to total volume of 3000 vehicle per hour entering from all the intersection legs.
- 3) When there are more than 4 approaches to the junction, a rotary is preferred.
- 4) A rotary design is most appropriate when the proportion of turning traffic is very high.
- 5) Rotaries are not generally warranted for intersection carrying very light traffic volume. Minimum traffic volume of 500 vehicles per hour is required.
- 6) When the approach widths are restricted and it is impossible to provide separate lanes for through traffic, a rotary may be desirable.

B. Various Design Factors To Be Considered In A Traffic Rotary Are

1) Design Speed

a) In rural areas – 40 km/h

b) In urban areas – 30 km/h

2) **Shape of Central Island:** The various shapes considered to suit different conditions are circular, elliptical, turbine and tangent shape.

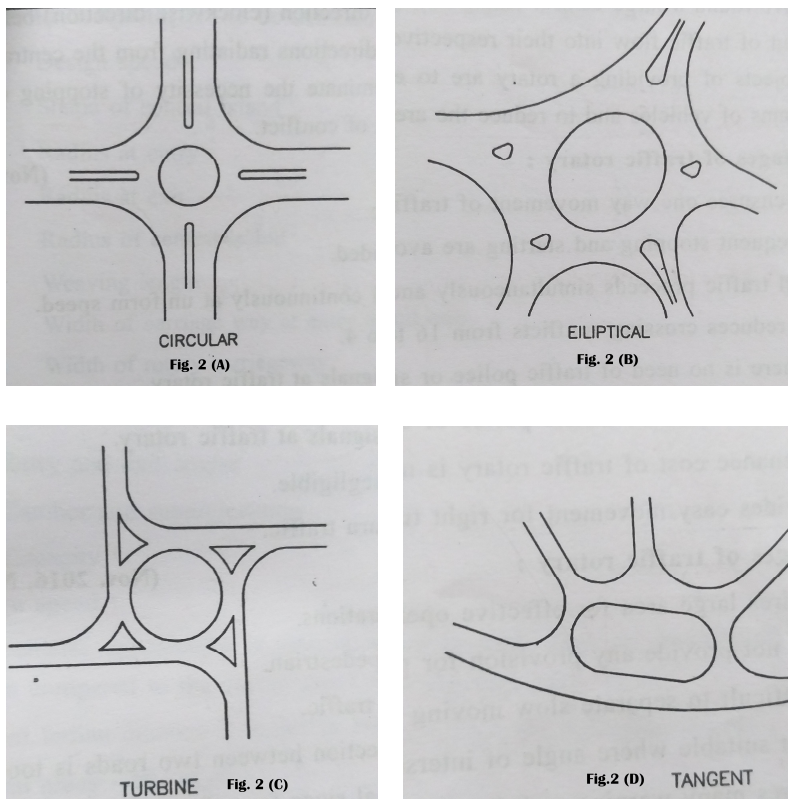


Fig. 2 : Shapes of rotary intersection

3) **Radius at Entry:** The radius at entry is determined by the design speed, super elevation and coefficient of friction
 \therefore allowable radius of the curve,

$$R = \frac{v^2}{127f}$$

IRC has suggested the radius of entry curve as:

Table - 1

Radius of entry curve	Design speed
20 – 30 m	40 km/h
15 – 25 m	30 km/h

4) **Radius at Exit:** The general practice is to keep the radius of exit curves 1.5 to 2 times the radius of the entry curves (Refer Fig. 1). In case of large pedestrian traffic cross the exit road, the radius of exit curve may be taken equal to the radius of entry curve to keep the exit speed reasonable.

5) **Radius of Central Island:** The radius of central island may be kept slightly larger than the radius of the entry curve. The recommended mini radii of central island are 1.33 times the radius of entry curve.

- 6) *Weaving Length*: For smooth traffic flow the weaving angle should be small but not less than 12°. The minimum weaving length as per IRC – 65 are:

Table - 2

Design speed (km/h)	Minimum wearing length (m)
40	45
30	30

- 7) *Width of Carriage way at Entry and Exit*: A minimum width of carriage way at entry and exit is 5.0 m. The minimum width of carriage way at entry and exit as per current Indian practice is given below:

Table – 3

Carriage way width of approach road	Radius at entry	Width of carriage way at entry & exit
7 m (2 lanes) 10.5 m (3 lanes) 14 m (4 lanes)	25 – 35 m	6.5 m 7.0 m 8.0 m

- 8) *Width of Rotary Carriage Way*: The width of weaving section (w) should be one traffic lane (3.5 m) wider than the entry width.

$$\therefore w = \frac{e_1 + e_2}{2} + 3.5 \text{ metre}$$

Where,

e1 = width at entry

e2 = width of non-weaving section

- 9) *Entry and Exit Angle*: Entry angles should be larger than exit angle. It is desirable the entry angles should be about 60°, and exit angles should be small.
- 10) *Camber and Super Elevation*: The rotary curvature being opposite to that of entry and exit, the super elevation in the two portion will be opposite to each other. To cause the least discomfort, the algebraic difference in the cross-slopes should be limited to about 0.07. The camber's inward slope acts as a super elevation for traffic round the central island and camber's exterior slope enable vehicles to turn left toward the radiating road's exit curve.
- 11) *Capacity*: The transport and road research (U.K.) has recommended the following formula for practical capacity of the weaving section.

$$Q_p = \frac{280w \left(1 + \frac{e}{w}\right) \left(1 - \frac{p}{3}\right)}{1 + \frac{w}{L}}$$

Where,

Qp = practical capacity of the weaving section (PCU/hour)

W = width of wearing section (6 to 18 m)

E = avg. Entry width (m)

L = length of wearing section between ends of channelizing islands (m)

P = proportion of weaving traffic

III. LITERATURE REVIEW

- A. Shrirame and Nagoshe (2017) describes that traffic rotary at road intersection is special form of grade change of lanes to channelize movement of vehicles in the one direction around a central island. With rapid growth of traffic it was experienced by than widening of roads and providing flyovers have become imperative to overcome major conflicts at intersections. 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.
- B. Bhatt (2017) describes that increasing trends of traffic density in urban area is a major concern in all the cities in India. The heterogeneous traffic are more diverse in nature due to lane changing and lack of lane discipline characteristics of drivers in India. The rotary intersection are of the most vital components of urban roadway network. Intersection is one when either three or more road meets or intersect each other.
- C. Taylor and Knight (2012) provide evaluation criteria for metropolitan grade separation crossing priorities. This includes standard financial, social and environmental policies, as well as a "Strategic fit" criteria reflecting the comparative significance of different roads to the general transport network. In perspective of the above literature, traffic was discovered in this job.
- D. Jing and et al. (2010) university of hong kong, pokfulam road, hong kong, china 'capacity evaluation of multi-lane roundabout' used the HCM (Highway Capacity Manual) and kimber models to analyse the capacity of multi-lane roundabout and discovered that both the turning proportion and the use of roundabout drivers had a significant effect on roundabout capability.
- E. As a function of traffic and geometric variables, Al-Omari et al. (2004) proposed a model for estimating roundabout delay. A total of twenty hours of field traffic and geometric information from fourteen rotaries across jordan have been gathered. Data were collected on sunny days from locations with good pavement conditions and need to be recorded during the field observation.
- F. Al-Masaaid and faddah (1997) developed an empirical model to estimate entry ability as a function of traffic circulation and geometric properties. Ten roundabouts have been researched across Jordan. Regression analysis was used to create the entry capacity model and its performance was then compared to German, Danish and French capability model outcome.

IV. CONCLUSION

From the reviews of the traffic rotary, it is seen that if rotary is provided at the road intersection the number of accidents can be decreased and road users can change their direction without difficulties. There is need to conduct more research on the traffic rotary at the intersection for the safety of all road users. In India, there is need to enforce traffic rules and regulation, which should be earnestly followed by the traffic road users for the safety as in other foreign countries.

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