Efficiency of Shaheed Bhagat Singh Rotary Intersection Greater Noida, India

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Abstract— Rotary intersections or roundabouts are special form of channelized intersections at same grade laid out for the movement of traffic in one direction around a central traffic island. Basically all the major conflict at an intersection namely the collision between through and right-turn movements are converted into milder conflict namely merging and diverging. The vehicles entering the rotary are gently forced to move in a clockwise direction in orderly fashion. They weave out of the rotary to the desired direction. In one sense, Rotary intersections can be considered as a form of channelized intersection in which vehicles are guided onto a one-way roadway and required to move in a clockwise direction about a central island. At one time, the rotary intersection was considered to be the answer for all the problems associated with intersections. In fact, the rotary intersections have particular advantages and disadvantages, and the decision as to whether a rotary should be used at any individual location requires an understanding of these. Where roundabouts are properly used and designed, the efficient flow of traffic is promoted by the orderly movement of vehicles about the central island. There is only minor delay to traffic due to speed reductions and no delay, at all, due to stopping.

Key words: IRC, PCU, Traffic Volume, Capacity, Rotary Intersection

I. INTRODUCTION

Traffic congestion on major roads consequent upon existing bottlenecks at intersections is a major problem especially in metropolitan areas. Intersections are the most critical points from capacity, congestion and safety viewpoints for the operation of an urban road network and have implications on the socio economic workings of a city. A rotary is an alternative form of intersection traffic control. Rotaries are generally circular in shape, characterized by yield on entry and circulation around a central island. Rotaries are appropriate for many intersections including locations experiencing high number of crashes, long traffic delays, and approaches with relatively balanced traffic flows. Rotary have the potential to resolve various traffic flow problems.

Current research work on rotary models mostly concentrates on determining the capacity of an approach based on the entering and circulating flows. Approach capacity is calculated as a mathematical function of critical headway and follow-up headway. This method is not sensitive to rotary geometric parameters such as inscribed circle diameter, entry angle, etc.

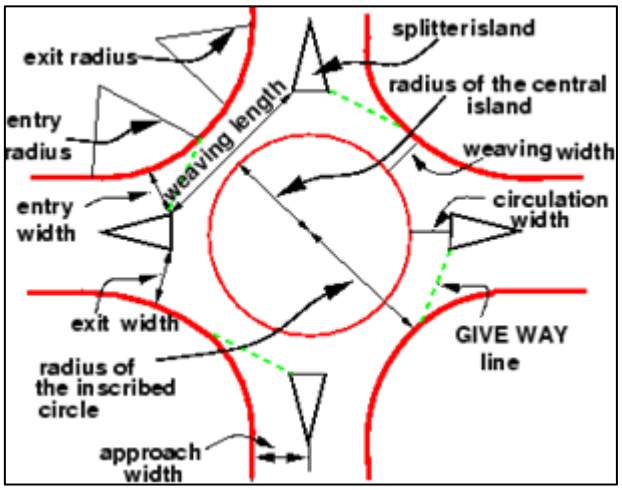

Fig. 1: Layout of General Rotary Intersection

II. OBJECTIVES

Since 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 according to IRC 65.

So our main objectives are as under

1) To find out the capacity of Rotary Intersection and check its efficiency.
2) Suggest effective modification of rotary intersection if required.

III. METHODOLOGY

A. Rotary Intersection

A rotary intersection or Traffic rotary is an enlarged road intersection where all converging vehicles are forced to move around a large central island in one direction (clock wise direction) before they can weave out of traffic flow into their respective direction radiating from the central island.

The main objective of providing a rotary is to eliminate the necessity of stopping vehicle even for cross streams of vehicle and to reduce the area of conflict. Traffic rotaries can handle traffic volume from 500 PCU/hour to 3000 PCU.

B. Design Considerations

- Design speed
- Radius at entry and exit
- Radius of Central Island
- Weaving length and width
- Entry and exit with
- Friction coefficient
- Sight distance

1) Design Constraints as per IRC

1) Design Speed:- 30 and 40 kmph for urban and rural areas respectively.

2) Radius at Entry:- 15 and 20 meters is ideal for an urban and rural design respectively.
3) Radius at Exit:- The exit radius as 1.5 to 2 times the entry radius.
4) Radius of Central Island:- The radius of the central island is 1.3 times entry curve.
5) Weaving Length:- For the design speed of 40 kmph and 30 kmph are 45m and 30m respectively.
6) Width of rotary carriageway:- The width of weaving section (w) should be one traffic lane (3.5) wider than the mean entry width.
7) Entry and Exit Angles:- Entry angles should be larger than exit angle, it should be should be about 60^0.

C. Current Situation of Shaheed Bhagat Singh Rotary Design

Design speed	30 KMPH
Radius of central island	30 m
Friction factor	0.43
Weaving length	44 m
Weaving width	11 m
Entry radius	20 m
Exit radius	26 m
Minimum sight distance	30-45 m
Super-elevation	Minimum

D. Data Collection

Per hour traffic data at Shaheed Bhagat Singh Greater Noida rotary intersection.

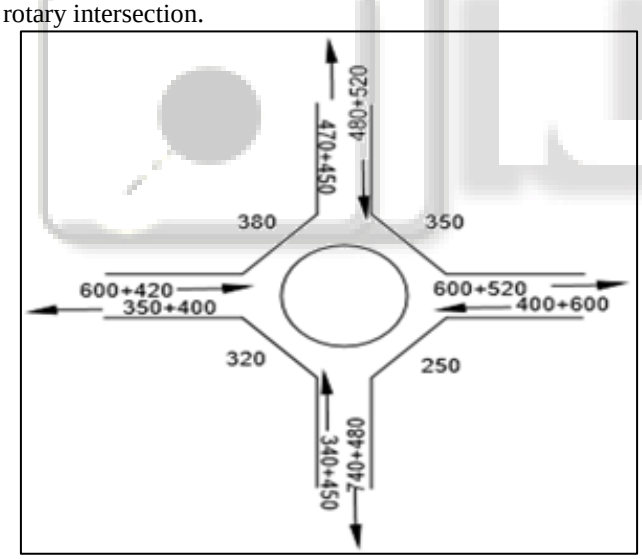

Fig. 2: proportion of traffic weaving ratio

1) Proportion of weaving ratio:

$$P = \frac{b+c}{a+b+c+d}$$

$$P_{NE} = \frac{480+520+600+520}{350+480+520+600+520+740} = 0.6504$$

$$P_{ES} = \frac{400+600+740+480}{250+400+600+740+480+350} = 0.7801$$

$$P_{SW} = \frac{340+450+350+400}{320+340+450+350+400+470} = 0.6623$$

$$P_{WN} = \frac{600+420+450+470}{380+600+420+450+470+520} = 0.6890$$

Fig. 3: Aerial view of Shaheed Bhagat singh rotary intersection

2) Weaving Ratio:

The practical capacity of the rotary is dependent on the minimum capacity of the individual weaving section the capacity is calculated from the formula:

P= 0.78

a) Width of weaving section:

$$w = \frac{e1+e2}{2} + 3.5$$

$$W = \frac{7.5+7.5}{2} + 3.5 = 11\text{m}$$

3) Length of weaving section:

L = 4W

L= 4×11 = 44 m

4) Capacity of the rotary

$$Q_P = \frac{280W\left(1+\frac{e}{w}\right)\left(1-\frac{P}{3}\right)}{\left(1+\frac{W}{l}\right)}$$

$$Q_P = \frac{280\times 11\left(1+\frac{7.5}{11}\right)\left(1-\frac{0.78}{3}\right)}{\left(1+\frac{11}{44}\right)}$$

$[Q_P]_{ES}$ = 3066.56 vehicle/hour in East South direction

where,

Qp = practical capacity of the weaving section in PCU/ hr.

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

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

e = avg. width of entry e_1 and width non weaving section e_2

L = length of weaving section between the ends of channel island in meter

p = proportion of weaving traffic given by

$p = (b+c) /(a+b+c+d)$

a = left turning traffic moving along left extreme lane

d = right turning traffic moving along right extreme lane

b = crossing/weaving traffic turning toward right while entering the rotary

c = crossing/weaving traffic turning toward left while leaving the rotary.

IV. CONCLUSION

According to IRC 65 traffic rotaries can handle traffic volume from 500 PCU/hour to 3000 PCU/hour. Here capacity of traffic rotary is 3066 PCU per hour in east south direction at

Shaheed Bhagat Singh rotary intersection as per present traffic condition which is almost under satisfied condition for urban rotary intersection. But current rate of traffic growth is very high in Greater Noida due to high rate of development in this area so we recommend installation of traffic signal at this rotary in future for efficient movement at intersection.
As per our research we found that Shaheed Bhagat Singh Rotary intersection Greater Noida is found satisfactory intersection presently.

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