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A Case Study on Weaving Capacity under Heterogeneous Traffic Condition of ONGC and Visat Roundabout, Ahmedabad by IRC Method

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Abstract - *Growth in traffic and subsequent congestion on road is a major issue in urban areas. As a result, cities are not able to provide better transportation system as well as accommodate the growing population. It also leads to negative consequences such as road accidents, delay in travel time and traffic management and operation problems etc. Ahmedabad is one of the populous city in India which is facing the crisis of urban transportation. In heterogeneous traffic condition of India, roundabout capacity is described by vehicle and driver characteristics which are different from traffic conditions in homogeneous conditions. Roundabouts of Ahmedabad are less efficient, and their efficiency is decreasing by time. Therefore, it is expected that growing traffic is one of the major problems of the city. Our research focuses on estimating weaving capacity of two roundabout i.e. ONGC and Visat roundabout situated in Chandkheda, Ahmedabad by the IRC (Indian Road Congress) Method. The results were analysed for suitability according to the traffic trends and conditions of the area.*

Key Words: Weaving Capacity, ONGC Roundabout, Visat Roundabout, IRC Method

1. INTRODUCTION

Different capacity formulas under steady-state conditions are being developed for different countries such as Highway Capacity Manual (HCM) method for US, German method and IRC method for India. Roundabouts have many advantages compared to other regular signalized intersections. The most important advantages are traffic safety, operational performance, the environment factors, pedestrian safety and aesthetics. It is essential to understand the operational performance of the roundabout. Methods have been developed to estimate empirical capacity values with different approaches, and comparative analysis of the different models can also be done using flows and delays. Capacity is a parameter which helps in defining the operational performance, the traffic scenario and level of service. In contrast to the traffic flow in developed countries, Indian traffic situation is completely different. Aside from the different driver classes, vehicles with different performances and dimensional characteristics (usually traffic is occupied by small vehicles such as motorcycle two-wheelers and auto-rickshaws), non-lane discipline, and creep behaviour are fully characterized complex traffic environment. It requires special attention and modelling of traffic flow behaviour. As a result of weaving of traffic, traffic in a weaving area is subjected to turbulence in excess of that normally present on the basic highway sections. The turbulence created by the "weaving" of vehicles often presents operational problems and special design requirements.

1.2 OBJECTIVE

- To find out the weaving capacity of two different roundabout i.e. ONGC and Visat roundabout situated in Chandkheda, Ahmedabad by IRC method.
- To investigate the effect of weaving traffic on the stretch.
- To study the compatibility of the IRC method with the observed values.
- To analyse nature of the traffic flow.

2. AREA OF STUDY

2.1 Location:

For proper and sufficient study of the traffic behaviour, we have considered the Koba-Visat Highway stretch as our study area which comprises of five roundabouts i.e. the GIFT Roundabout, Koba Roundabout, Tapovan Roundabout, ONGC Roundabout and the Visat Roundabout which is situated in the junction between the twin city, Ahmedabad and Gandhinagar. For the purpose of data collection, it is required that the data comprises of peak hour traffic volume. The roundabouts need to be working at capacity conditions for proper data-set. The peak hour at the site can be known by its location in the city. For example, the one located at office area or school area would have peak hours twice a day during starting and finishing time of office hours or school hours, respectively. All these factors considered together had been used to select the sites for data collection. Subsequently, after detailed emphasis on parameters such as peak hour traffic volume, location of the site in the city and traffic composition in the site, we have selected ONGC Roundabout and the Visat Roundabout as our location for the data collection.

Table -1: Details of data collected

SURVEY LOCATION	VISAT			ONGC		
DATE	30-03-2019	31-03-2019	01-04-2019	30-03-2019	31-03-2019	01-04-2019
DAY	Saturday	Sunday	Monday	Saturday	Sunday	Monday
COUNTING PERIOD	9 to 10 AM	9 to 10 AM	9 to 10 AM	9 to 10 AM	9 to 10 AM	9 to 10 AM
	6 to 7 PM	6 to 7 PM	6 to 7 PM	6 to 7 PM	6 to 7 PM	6 to 7 PM
OBSERVATION	Traffic count					
METHOD	Videography method					
EQUIPMENTS	CAMERA Model: D750, 24.0 Megapixel, Full-Frame Image Sensor (36mm)					

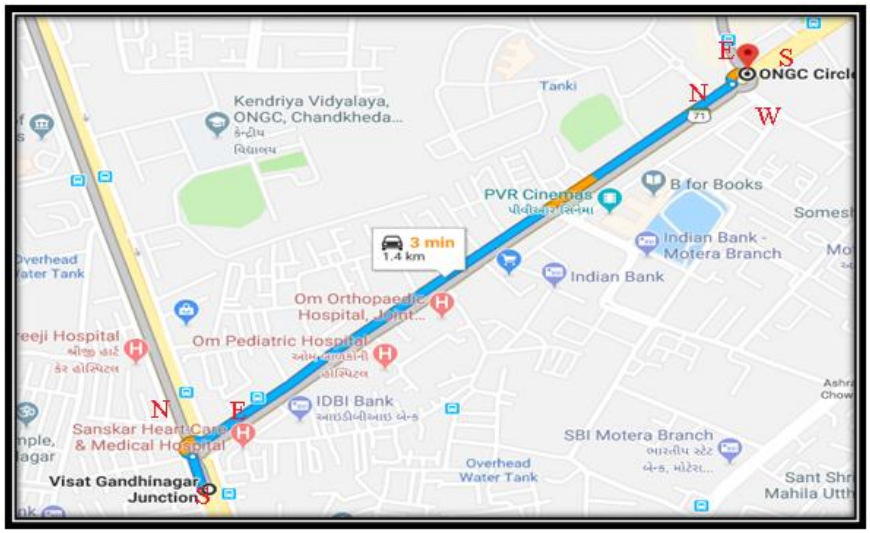

Fig -1: Study Area

Fig -2: ONGC Circle

Fig -3: Visat Circle

3. DATA COLLECTION

3.1 Methodology

The data was collected by Indirect Method through Videography Method.

The video camera was placed in such a position so as to give convenient view to collect the data. Tripods were used to place the camera in a perfect position to record the data in clear way. For our study, we have set our camera on the top of two selected buildings located near the roundabouts (ONGC and Visat Roundabouts) and took the video recording of 1 hour each in the morning and the evening.

3.2 Geometric Design

All parameters are calculated and measured as per HCM 2010. They are all measured in meters. Above measurable parameters are measured with the help of metric tape

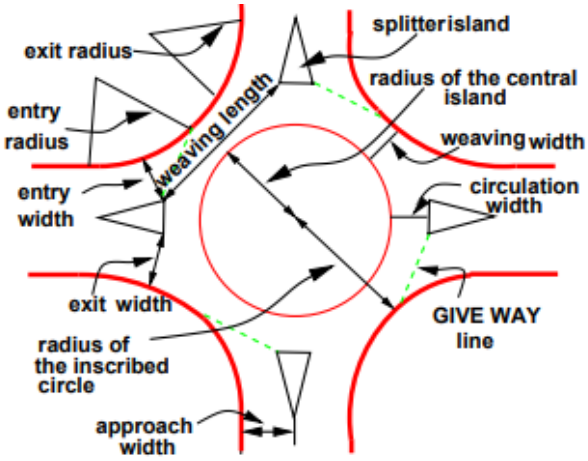

Fig -4: Typical Diagram of a Rotary Circle

Table -1: Specifications of Rotary Geometric Design

No.	Rotary Geometric Parameters	Values
1.	Entry Radius	35 m
2.	Entry Width	10 m
3.	Exit Width	10 m
4.	Weaving Length	54 m
5.	Weaving Width	13.5 m
6.	Radius of Central Island	For ONGC, R=24.39 m For Visat, R= 46.65 m

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

$$Q_w \text{ - Capacity of Rotary} = \frac{280w\left[1+\frac{e}{w}\right]\left[1-\frac{P}{3}\right]}{\left[1+\frac{W}{l}\right]}$$

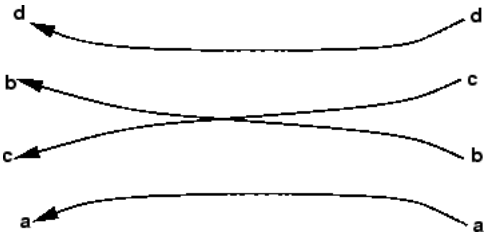

Fig -5: Traffic Flow Directions

P - Proportion of volume of weaving traffic to total traffic in that direction.

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

where e is the average entry and exit width, i.e., $\frac{e_1 + e_2}{2}$, w is the weaving width, l is the length of weaving, and p is the proportion of weaving traffic to the non-weaving traffic. Figure 1 shows four types of movements at a weaving section, a and d are the non-weaving traffic and b and c are the weaving traffic.

3.2 Data Collection and Formulations:

From the field, the geometric data was taken for each rotary. Rest of the unknowns are calculated as per IRC which is shown below: -

For ONGC Rotary,

e_1= Entry Width = 10 m

e_2= Exit Width = 10 m

e = the average entry and exit width = $\left(\frac{e_1 + e_2}{2}\right)$ = 10 m

Width of Weaving Section (w) = $\left(\frac{e_1 + e_2}{2}\right)$ + 3.5 m

= 10 + 3.5 = 13.5 m

Minimum Length of weaving section (l_{min})

= 4*w = 4*13.5 = 54 m

Similarly, For Visat rotary,

e_1= Entry Width = 10 m

e_2= Exit Width = 10 m

e = the average entry and exit width = $\left(\frac{e_1 + e_2}{2}\right)$ = 10 m

Width of Weaving Section (w) = $\left(\frac{e_1 + e_2}{2}\right)$ + 3.5 m

= 10 + 3.5 = 13.5 m

Minimum Length of weaving section (l_{min}) = 4*w

= 4*13.5 = 54 m

After the calculation of all unknowns, by using empirical formula of IRC, Q_w (Weaving Capacity) is calculated for each rotary for each day in both morning and evening sessions. All calculated data is tabulated which is given in further pages.

ONGC (Saturday, 9-10 am)

Directions	(P)	(Q_w)
N-E	0.76	3929 PCU/hr
E-S	0.79	3876 PCU/hr
S-W	0.81	3841 PCU/hr
W-N	0.73	3981 PCU/hr

ONGC (Sunday, 9-10 am)

Directions	(P)	(Q_w)
N-E	0.83	3785 PCU/hr
E-S	0.81	3841 PCU/hr
S-W	0.834	3799 PCU/hr
W-N	0.63	4157 PCU/hr

ONGC (Monday, 9-10 am)

Directions	(P)	(Q_w)
N-E	0.78	3894 PCU/hr
E-S	0.782	3885 PCU/hr
S-W	0.83	3810 PCU/hr
W-N	0.74	3973 PCU/hr

ONGC (Saturday, 6-7 pm)

Directions	(P)	(Q_w)
N-E	0.70	3999 PCU/hr
E-S	0.75	3941 PCU/hr
S-W	0.78	3894 PCU/hr
W-N	0.73	3978 PCU/hr

ONGC (Sunday, 6-7 pm)

Directions	(P)	(Q_w)
N-E	0.71	4010 PCU/hr
E-S	0.74	3952 PCU/hr
S-W	0.75	4926 PCU/hr
W-N	0.73	3978 PCU/hr

ONGC (Monday, 6-7 pm)

Directions	(P)	(Q_w)
N-E	0.70	4015 PCU/hr
E-S	0.74	3957 PCU/hr
S-W	0.76	3920 PCU/hr
W-N	0.71	4009 PCU/hr

Visat (Saturday 9-10 am)

Directions	(P)	(Q_w)
N-E	0.84	4744 PCU/hr
E-S	0.95	3594 PCU/hr
S-N	0.48	4416 PCU/hr

Visat (Sunday 9-10 am)

Directions	(P)	(Q_w)
N-E	0.90	3678 PCU/hr
E-S	0.93	3625 PCU/hr
S-N	0.48	4418 PCU/hr

Visat (Monday 9-10 am)

Directions	(P)	(Q_w)
N-E	0.90	3669 PCU/hr
E-S	0.94	3608 PCU/hr
S-N	0.47	4426 PCU/hr

Visat (Saturday 6-7 pm)

Directions	(P)	(Q_w)
N-E	0.89	3685 PCU/hr
E-S	0.81	3838 PCU/hr
S-N	0.70	4034 PCU/hr

Visat (Sunday 6-7 pm)

Directions	(P)	(Q_w)
N-E	0.86	3752 PCU/hr
E-S	0.80	3859 PCU/hr
S-N	0.34	4665 PCU/hr

Visat (Monday 6-7 pm)

Directions	(P)	(Q_w)
N-E	0.87	3829 PCU/hr
E-S	0.81	3841 PCU/hr
S-N	0.40	4555 PCU/hr

3. RESULTS

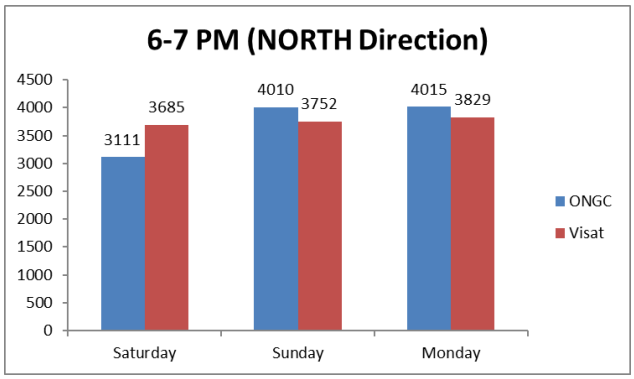

Fig -6: Maximum Weaving Capacity in North Direction

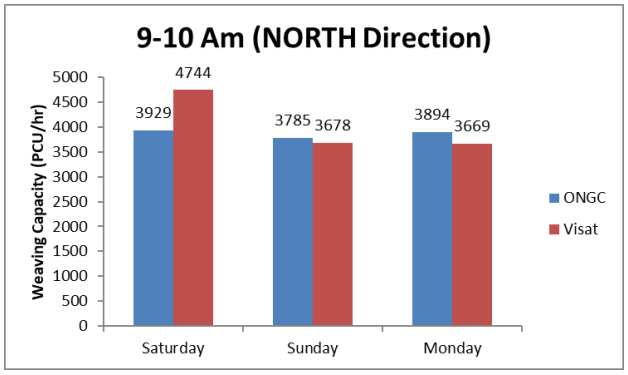

Fig -7: Maximum Weaving Capacity in North Direction

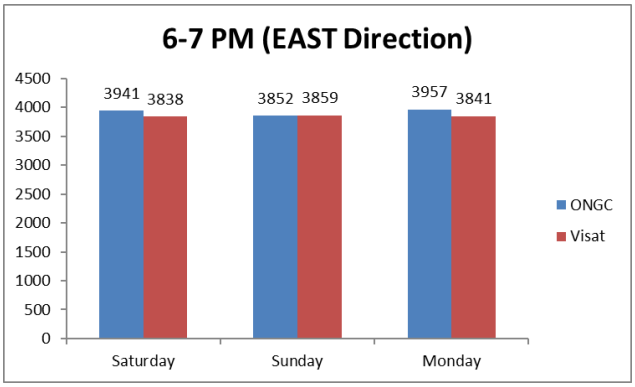

Fig -8: Maximum Weaving Capacity in East Direction

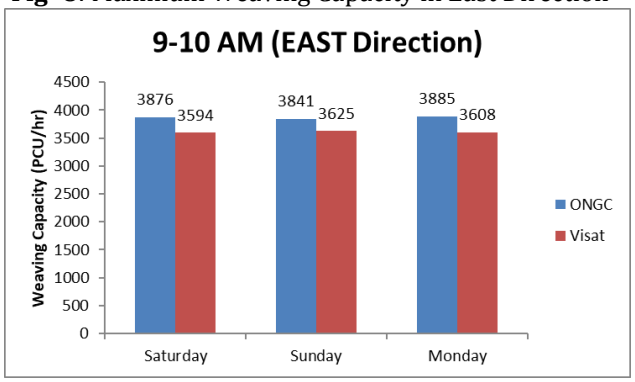

Fig -2: Maximum Weaving Capacity in East Direction

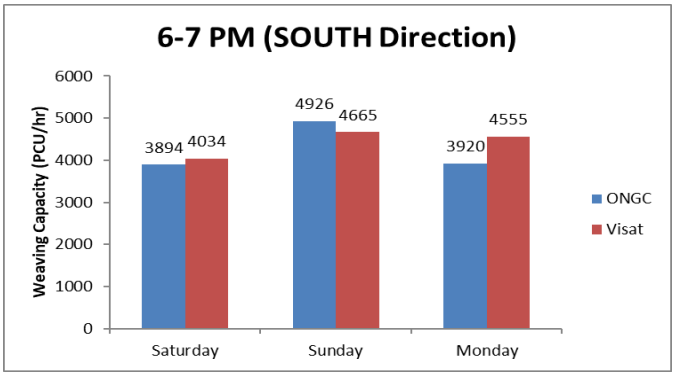

Fig -2: Maximum Weaving Capacity in South Direction

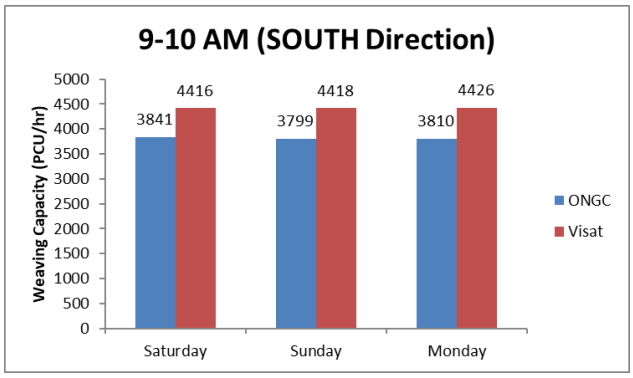

Fig -2: Maximum Weaving Capacity in South Direction

After calculating the capacities of both the roundabouts by IRC Method We found that

•Weaving capacity of the Visat Roundabout and ONGC roundabout is almost same although the latter is a 3-arm roundabout and ONGC Roundabout is 4-armed.

•It is observed that the vehicle volume of the South bound direction is much more than that of the North and East direction in the Visat Roundabout for almost all of the three days analysed in both the morning and evening sessions.

•The composition of public transport vehicle such as bus was very low in comparison to other vehicles such as cars, autos and two-wheelers.

•The number of two wheelers composition was found to be the maximum in comparison to other vehicles such as cars and autos.

•The IRC method was designed for the ideal traffic condition. Therefore, it is observed that the calculated weaving capacity overestimates the limiting value of 3000 PCU/hr as defined by the IRC specifications.

3. CONCLUSIONS

The primary objective of the study is to study the weaving capacity of the selected study area i.e. ONGC – Visat Roundabouts and to investigate the effect of weaving traffic.

The following conclusions are drawn after analysing the traffic data and calculating the capacities of both the roundabouts by IRC Method.

After calculating the capacities of both the roundabouts by IRC Method. We found that

- Weaving capacity of the Visat Roundabout and ONGC roundabout is almost same although the latter is a 3-arm roundabout and ONGC Roundabout is 4-armed.
- It is observed that the vehicle volume of the South bound direction is much more than that of the North and East direction in the Visat Roundabout for almost all of the three days analysed in both the morning and evening sessions.
- The composition of public transport vehicle such as bus was very low in comparison to other vehicles such as cars, autos and two-wheelers.
- The number of two wheelers composition was found to be the maximum in comparison to other vehicles such as cars and autos.

The IRC method was designed for the ideal traffic condition. Therefore, it is observed that the calculated weaving capacity overestimates the limiting value of 3000 PCU/hr as defined by the IRC specifications.

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