Traffic Volume and Congestion Analysis at Golf Course Rotary Intersection

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ABSTRACT

Rapidly Increasing traffic in urban area is a major concern in all the cities in India. The number of vehicles on the road are gradually increasing day by day giving out a number of problems at intersections like traffic congestion, wastage of time, deterioration of engines, more consumption of fuel etc. During peak hours, traffic volume increases by 50% and situation become more intense.

The paper attempts to measure the traffic volume density at Golf Course , Noida. It is one of the most busiest areas in the region due to the presence of metro stations, shopping malls and busy infrastructure all around.

Golf course rotary intersection is taken up for capacity analysis. The capacity studies on the rotary are done from all four directions and is calculated based on the established norms of Indian road congress (IRC:65, 1976). The performance analysis of rotaries are based on various parameters such as total entry & exit traffic volume, weaving lengths & width. The resulting performance leads to a new modal development and its validation based on calculated traffic volume density by collected data of traffic volume at the particular location.

KEYWORDS: Traffic volume, Rotary, Traffic congestion

INTRODUCTION AND OBJECTIVES

A rotary intersection is a type of circular intersection or junction in which road traffic flows almost continuously in one direction around a central island. The modern form was standardized in United Kingdom.

They are generally circular in shape, characterized by yield on entry and circulation around central islands. They are designed for locations experiencing heavy traffic volume which leads to number of crashes, long queues, road blockage. Rotaries are capable of solving various traffic related problems. Evaluation of junction capacity is very important since it is directly related to delay, level of service, accident, operation cost and environmental issues. In India there are three legs, four legs, five legs and six legs rotaries but no one knows their capacities and level of services as very little attention is given to them in terms of design and capacity evaluation.

This research work on rotary models is based on the entering and Circulatory flows and was conducted at Golf Course intersection, Noida. Dresner and Stone(2006) augmented the system such that it is able to accommodate traditional human operated vehicles using existing infrastructure. Ahmed and Das(2011) presented traffic congestion and performance analysis at four different rotaries Sadarghat, NH point, Rangerkhari and Tarapur in Silchar,

Assam. The heterogeneous traffic are more diverse in nature due to lane changing and lack of lane discipline characteristics of drivers in India. Atomode(2013) examined traffic delay problems and its causes at selected road intersections in Ilorin, Nigeria. Chimdessa et al. (2013) in his paper evaluated the performance of a multi lane intersection to identify the best scheme as congestion is becoming a worldwide serious problem. Chowdhary(2015) has conducted the study with a view to inculcate the present scenario of traffic congestion at various traffic intersection points in the city of Kolkata and to assess the status of environmental pollution related to vehicular air pollution at various busy traffic points.

The main objectives of this research are:

- To conduct traffic volume survey at rotary intersection at peak hours.
- To measure the dimensions of existing rotary.
- To assess the traffic volume density and comparing with the standard prescribed limits.
- To provide corrective measures if required.

METHODOLOGY

The present study is done at Golf Course Intersection, Noida by calculating traffic volume from four different directions (Golf Course, sec-31, 36 & 37, sec-50, 51 & 52 and Noida City Centre) during day time at peak hours. Traffic volume is defined as the number of vehicles crossing a section of road per unit time at any selected period. Traffic volume studies are conducted to collect data on the number of vehicles and/or pedestrians that pass a point on a highway facility during a specified time period.

There are two methods of traffic volume measurement – Manual method and Automatic method.

- **Manual Method**- Manual counts are typically used to gather data for determination of vehicle classification, turning movements, direction of travels, pedestrian movements, or vehicle occupancy. Recording data onto tally sheets is the simplest means of conducting manual counts. The data can be recorded with a tick mark on a pre-prepared field form. A watch or stopwatch is necessary to measure desired count interval.
- **Automatic Method-** Automatic counts are typically used to gather data for determination of vehicle hourly patterns, daily or seasonal variations and growth trends, or annual traffic estimates.

Considering the cost factor and available facilities we have used manual method for calculating traffic volume count.

Readings were taken at entry and exit points to the roads going in all four directions using tally method of counting and measuring tape was used to measure dimensions like radius of rotary, entry and exit width, weaving width, weaving length etc.

Following data were recorded at the site-

- Physical details of the study location- Name of the location, Radius of central island, Radius of rotary, Entry width, Exit width, Friction, Weaving length, Weaving width, Approach width.
- Traffic volume count.

Observed data was then used to measure p_{min} & p_{max}(minimum and maximum proportioning ratio)i.e calculating proportioning ratio in all the four directions using weaving and non-weaving traffic and thus traffic volume density corresponding to the data was calculated so as to compare with the standard prescribed limits. Table 1 below gives the details of the survey locations and their distance from the intersection.

Table 1: Survey Locations

Location	Position (distance in km from rotary)
Sector-39	0.7
Sector-31	1.0
Sector-43	1.1
Sector-32	1.3
Sector-18(network area)	1.4
Sector-44	2
Sector-50	2.2
Sector-51	2.4
Sector-48	2.5
Sector-49	2.6

DATA COLLECTION AND ANALYSIS

The traffic volume data collection by manual method using hand tally is collected at Rotary Intersection of Golf Course, Noida at peak hours. The map in Fig. 1 shows survey location (also known as Shashi Chowk). The data collection of various basic elements (shown in Fig.2) of rotary are tabulated manually at entry and exit to roads in all the four directions(Golf Course, Sec- 31,36&37,Sec-50,51,52 and Noida City Centre).

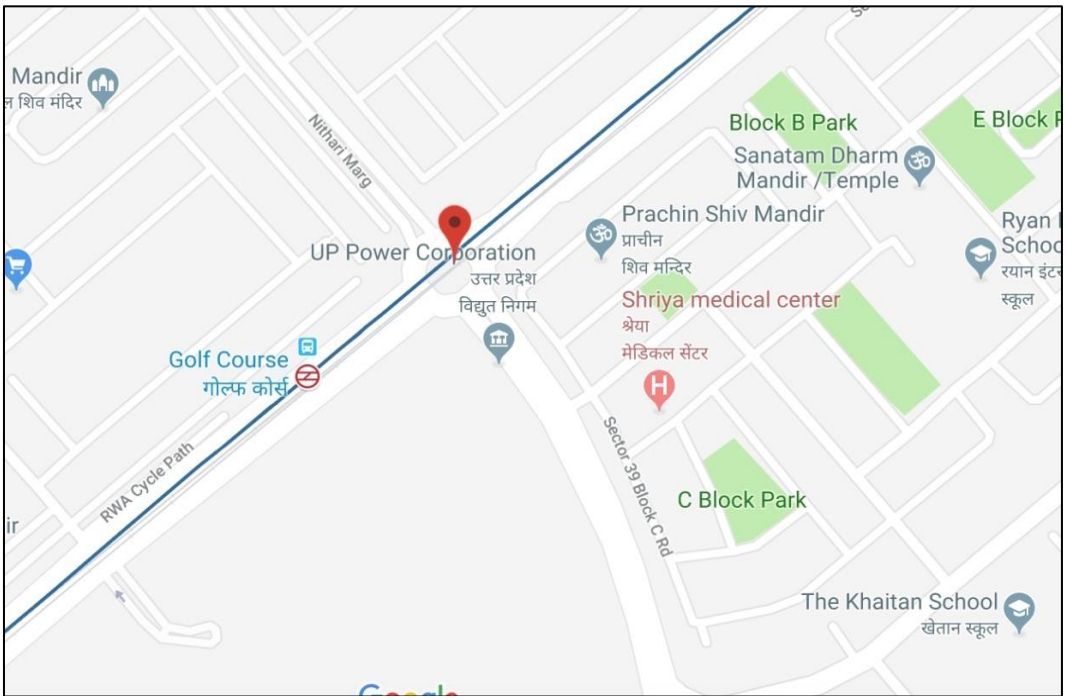

Figure 1: Map of Survey Location

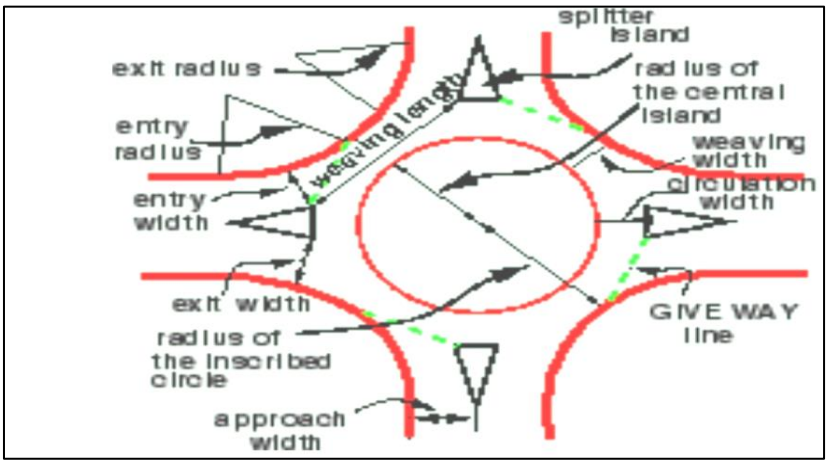

Figure 2: Design elements of rotary

Traffic volume: It is defined as the number of vehicles crossing a section of road per unit time at any selected period. Traffic volume studies are conducted to collect data on the number of vehicles and/or pedestrians that pass a point on a highway facility during a specified time period. The values are converted into PCU/hr as shown in Table 2 and then utilised to calculate traffic volume density at that particular intersection. The values are given in the table below.

Table 2: Traffic volume data in PCU/hr

FROM	TO	CAR/JEEP/VAN	BIKE/2-W	3-W/AUTO	BUS	BICYCLE	TRACTOR	RICKSHAW
GOLF COURSE	SEC-31,36,37	238	73	192	45	2	0	34
	SEC-50,51,52	317	97	216	36	3.5	0	24
	NCC	489	188	496	18	7	0	68
SEC-31,36,37	GOLF COURSE	354	130	304	15	8.5	0	36
	SEC-50,51,52	186	49	352	21	4	0	12
	NCC	456	148	196	39	15	0	60
SEC-50,51,52	GOLF COURSE	318	93.5	232	33	7	0	16
	SEC-31,36,37	187	54	136	21	2	0	18
	NCC	256	69	388	24	8	0	28
NOIDA CITY CENTRE (NCC)	GOLF COURSE	272	59	472	27	21	0	14
	SEC-50,51,52	142	34	190	15	11	0	36
	SEC-31,36,37	196	57	378	42	10	0	22

Then the design elements of Golf course Intersection are recorded manually tabulated in Table 3.

Table 3: Design elements of Golf Course Intersection

Radius Of Central Island	Radius Of Rotary	Friction(f) $R=V_2/127f$	Entry Width	Exit Width	Weaving Width(W) $(e_1+e_2)/2+3.5$	Weaving Length	Circulation Width	Approach Width
24.5m	35m	0.2025	9.5m	9.5m	13m	52m	19.5	11m

Capacity of rotary:

It is determined by the capacity of each weaving section. The various components are thus calculated and tabulated in Table 4. The empirical formula to find the capacity of the weaving section is - $Q_w = 280w([1+e/w][1-p/3]) / [1+w/1]$

Table 4: Proportioning ratio and Traffic volume count

	GOLF COURSE	SEC-31,36,37	SEC-50,51,52	NCC
Proportioning Ratio(P)	0.7528	0.604	0.67	0.676
Traffic Volume Count(Qw)	3378.32 PCU/hr	4030.28 PCU/hr	3929.52 PCU/hr	3899.29 PCU/hr

Below is the table showing the values calculated through the above mentioned formula:

Where,

- e is the average entry and exit width, i.e, (e_1+e_2) /2
- w is the weaving width
- l is the weaving length
- p is the proportion of weaving traffic to the total traffic
- And p= (b+c)/(a+b+c+d)
- Where a & b are non weaving traffic and b & c are weaving traffic

RESULTS AND CONCLUSIONS

From the traffic volume survey carried out at the rotary at Golf Course, Noida, it is observed that traffic volume density at the survey location is much more as compared to the standard recommended values as per IRC (which ranges from 500 PCU/hr to 3000 PCU/hr) for both minimum and maximum value of proportioning ratio, thus resulting in traffic congestion**.** From the study we found out that the maximum traffic volume density is 4030.28 PCU/hr and the minimum value of traffic volume density is 3378.38 PCU/hr. Whereas the maximum proportioning ratio came out to be is 0.7528 and minimum value for the same is 0.604. These values shows clearly the heavy amount of traffic which enters the rotary leading to long queues and traffic jams. The rotary must be redesigned to handle such an enormous traffic numbers. **Suggestions to make rotary efficient:**

- Introducing the signals at the Intersections so as to avoid accidents and thus making it efficient in high traffic.
- Introducing the pathways for pedestrians
- Physically changing the roundabout geometry by changing weaving width, weaving length.

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