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Efficiency of Rotary Intersection at Authority Chowk Greater Noida

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ABSTRACT: Greater Noida is satellite city for Delhi, capital of India, higher rate of urbanization and decentralization of Delhi are the major reason for fast growing vehicular traffic. Rate of decentralization is very high due to more aesthetic and pollution free environment in Greater Noida. Greater Noida is an urbanised town and most of intersections are designed as Rotary intersection as per previous medium traffic flow in past years as per economic consideration. Rotary intersection became inefficient in peak hour traffic and resulted as a major point of traffic congestion near intersection area and increase travel time, discomfort as well as noise and air pollution. First step in my research work is to collect traffic volume study in different approaches by manual method in PCU per hour and with help of other field data such as existing weaving length, width, angle, road width etc., evaluate the present capacity of weaving section. The practical capacity of rotary intersection is depended on the minimum capacity of the individual weaving section. We know that a rotary can handle a maximum traffic volume of 3000 PCU/hour as IRC 65 guidelines. So if I found more than 3000 PCU/hour traffic at Authority Chowk rotary intersection even in peak hours, it creates traffic congestion some time traffic jam at rotary. Signals are provided at existing rotary to efficiently handle the increased traffic. Signal is designed by approximate method in my research work.

KEYWORDS: PCU, Traffic Congestion, Rotary Intersection

I. INTRODUCTION

The Increase within the traffic is turning into sever downside. And this downside is inbound as a result of owning of private automobiles. To effectively dominant of this increasing traffic on road some control measures square measure used on road i.e. traffic rotary, traffic light, direction of road etc. An intersection is the area where two or more streets join or cross at-grade. Channelized intersections use pavement markings or raised islands to designate the meant vehicle methods the foremost frequent use is for right turns, notably once in the course of associate auxiliary right-turn lane. The roundabout may be a channelized intersection with unidirectional traffic flow current around a central island. All traffic through further as turning enters this unidirectional flow though sometimes circular form, the central island of a roundabout may be oval or on an irregular basis formed. Traffic flow is regulated to in one direction of movement, thus eliminating severe conflicts point between crossing movement. Rotaries do not need practically any control by police or traffic signals.

Fig 1 Elevated view of rotary intersection at authority

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Signals are recommended in my research work to reduce traffic congestion at rotary**.** Traffic signals are automatic traffic control devices which could alternately direct the traffic to stop and proceed at intersections using red and green traffic light signals. The main requirements of traffic signal are to draw attention, provide meaning and time to respond and to have minimum waste of time.There are four general signal design methods of co-ordination of signals for road network, as listed below:

a) Trial cycle method
b) Approximate method
c) Webster method
d) IRC method

Approximate design procedure for signaling is suggested for the simple design of a two phase signal unit at cross roads, along with pedestrian signal as my research work. Complete removal of rotary islands and convert it into signaling system is not economic method. So my research work is concern with implementation of automatic signaling system at rotary intersection without removal of Rotary Island proved as an economic solution to make rotary intersection efficient.

II. LITRATURE REVIEW

I have reviewed various literatures related to my research. Some of literatures which are very similar to my project and important to know previous work related to my research work are as followings:

Chhalotre R. K. & Dr. Joshi Y. P., described that traffic congestion is a major problem at an intersection in urban areas. Continuous increase in the growth of vehicular traffic load on the existing rotary intersections were increased and resulted as Jam condition for movement of vehicles. The traffic in Bhopal city was increasing with continuous traffic growth and the condition was then reached to upgrade the intersection. This paper is very important for my research work as my problem of traffic congestion is similar to his paper work. During peak hour flow at Authority Chowk Rotary Intersection at weekends, jam condition develop due to Kadamba market. At that time the rotary intersection is inefficient for the movement of traffic. In my project work I am finding the efficiency of the rotary intersection and if the rotary is inefficient I am providing a proper signaling system to solve the congestion problem and make the movement of traffic efficient without any collision.

Prof. Shrirame V. B. and Prof. Nagoshe S. R.et. al., describes that Traffic Rotary at road intersections is 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 was experienced by them 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.

By studying the paper of Shrirame V.B and Nagoshe S.R it is clear that 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. His paper work also explain us that the traffic operations at a rotary are three; diverging, merging and weaving. All the other conflicts are converted into these three less severe conflicts.

Prof. Bhatt K. describes that increasing trends of traffic 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 driver's in India. The rotary intersections are of the most vital components of urban roadway network. Intersection is one when either three or more road meets or intersects each other.

Arora R and Dr. Gupta P.K., describe that Rapid urbanization and industrialization has led to substantial increase in urban traffic. Thus congestion on urban road is a common phenomenon in cities. India is also facing the problem. Chandigarh, a Union Territory of India was planned by Le Corbusier's and the city also known for its beautiful roundabouts. But these roundabouts become place of slow moving traffic during peak hours. Traffic flow occurs at these intersections especially during the peak hours. This heavy traffic leads to congestion at both these intersections and also the flow of traffic is not smooth between these two intersections.

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III. OBJECTIVE

The overall objective of this study is to investigate the current efficiency of authority Chowk rotary intersection in Greater Noida, Uttar Pradesh by the formula of capacity of rotary intersection as per IRC 65 guide lines. If the rotary is not efficient then provide proper signalling system and also provide a suitable change in the dimension of rotary intersection to make the rotary efficient.

IV. SURVEY AT SITE LOCATION

This study is concerned with determine the PCU values of vehicles in under mixed nature traffic flow at on congested Authority Rotary. It is channelized intersection at-grade circular rotary system is available. Traffic volume is medium. Traffic volume increases because population of Greater Noida increases. Rotary intersections or round about are special form of at-grade intersections.

Fig 2 Data collection at Authority rotary intersection

Location: Authority Chowk, Greater Noida, India
Station: In front of Authority water tank
Date: 13th to 20th March 2018
Time: Time of data collection 5:00 pm to 6:00 pm
Weather Condition: Sunny
Observation: Classified Vehicle Counts, Central Island Radius, Weaving Width.
Method: Direct Manual Method
Equipment: Stop watch, Pencils, Eraser, Tape, Data sheet

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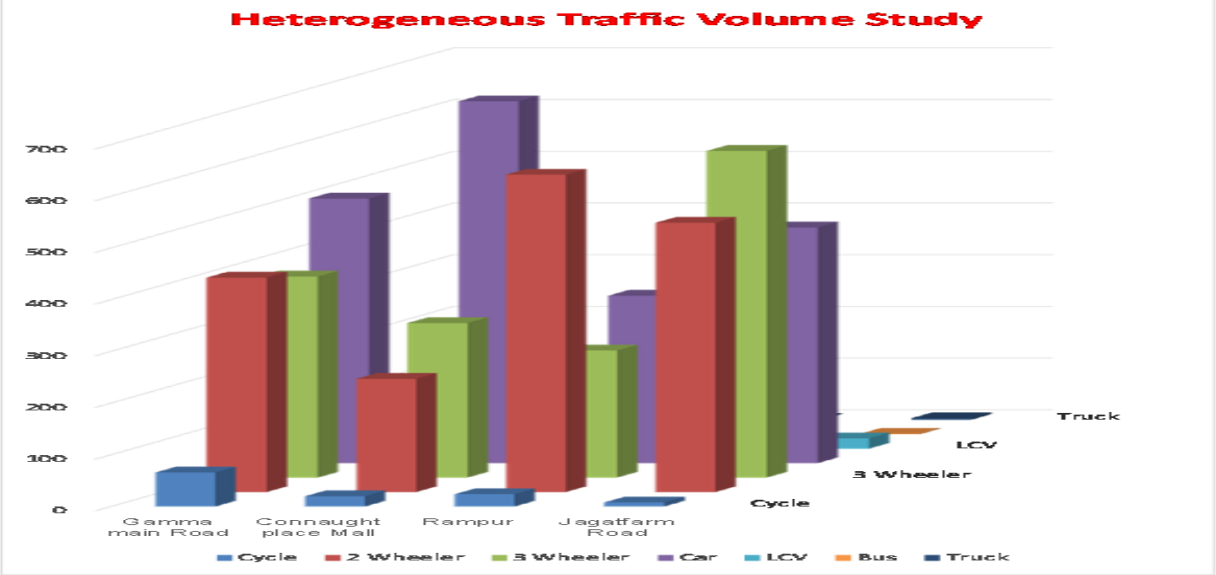

Fig 3 Bar chart of heterogeneous traffic volume

V. METHODOLOGY

First of all I have to collect and analyze the present data of Authority rotary intersection. Then by calculating the traffic volume and converting it into PCU we can calculate Practical Capacity of rotary intersection.

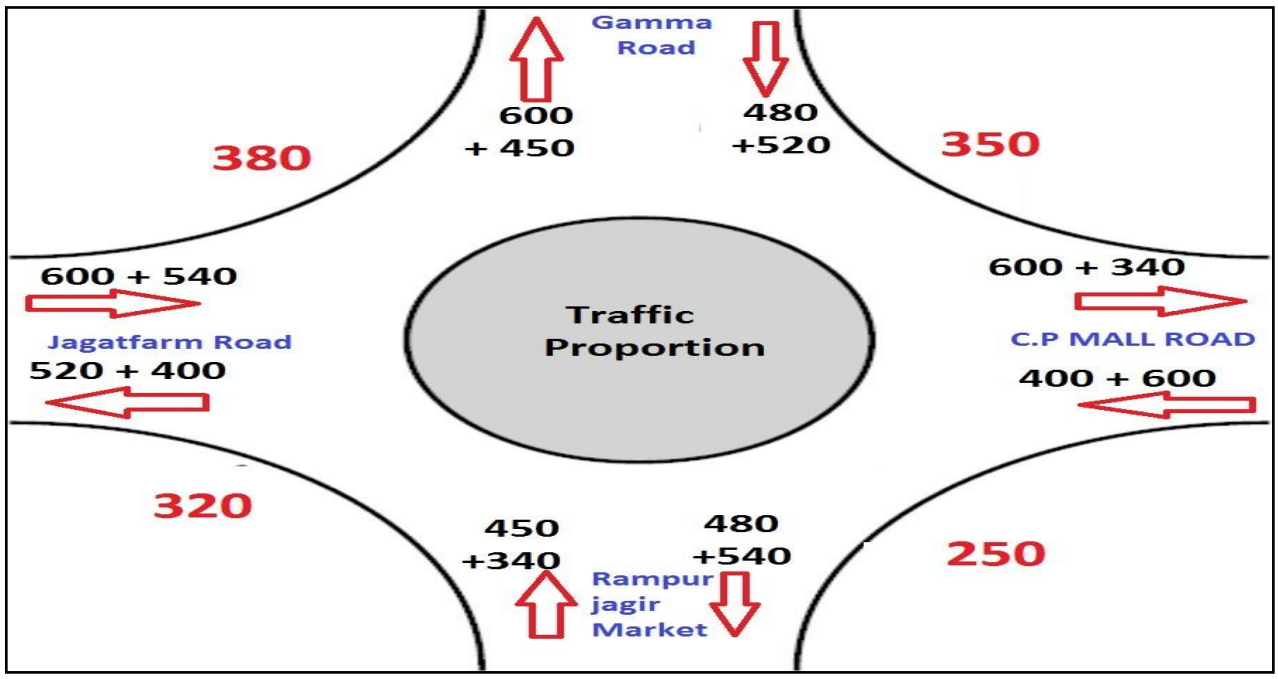

Fig 4 Proportion of traffic

Methodology of my research work is completed in different steps which are as under:
IRC- 65 Guidelines for Design of rotary intersection of roads.
Traffic volume study.

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Calculation of Capacity of Rotary.
Result Evaluation & Analysis.
Traffic Signal
Design of traffic signal
Where,
Q_D = capacity of rotary intersection in vehicle per hour
W = width of weaving section in meter
e = average width of entry and width of non-weaving section

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

e_1 = width of weaving section at entrance in meter
e_2 = width of weaving section at exit in meter
L = weaving length in meter
p = proportion of weaving traffic
a = left turning traffic moving along left extreme lane
b = weaving traffic turning toward right while entering the rotary intersection
c = weaving traffic turning toward left while leaving the rotary intersection

Calculation of Capacity of Rotary

e_1=7.8 meter & e_2=8.4 meter
e = 8.1 m
W = 11.6 m
L= 4 ×W = 46.4 m

Gamma road to Connaught place mall (N-E)

P_{NE}=0.6855
$Q_{(NE)}$ = 3404.32 PCU/hour

C.P mall to Rampur jagir market (E-S)

P_{ES}=0.7240
$Q_{(ES)}$ = 3347.40 PCU/hour

Rampur jagir market to Jagat form road (S-W)

P_{SW} = 0.6501
$Q_{(SW)}$ = 3456.40 PCU/hou

Jagat farm road to Gamma road (W-N)

P_{WN} = 0.7525
$Q_{(WN)}$ = 3305.77 PCU/hour

Now it is clear that the minimum capacity of the rotary intersection is 3306 PCU/hour. The capacity of rotary is the minimum of the capacity of all the weaving section. Now it is seen from the above result that the maximum capacity of the rotary is 3306 PCU/hour. And the total traffic entering the intersection is 5230 PCU/hour. Hence in this case the **Signalized Rotary** can be provided which is suggested in this case.

Introduction of Traffic Signal at Authority Rotary by Approximate method

Traffic signals are one of the most effective and active control systems of traffic and are widely used in several cities worldwide. The traffic arriving from different direction is separated by time, segregation. Traffic signals are the control devices which could alternately direct the traffic to stop and proceed at intersection using red and green traffic light signals automatically.

In my project, I am designing 2-phase simple traffic signal with pedestrian signal by approximate method:

Step 1: Minimum time required by pedestrian to cross any road
Clearance interval (CI) = w/1.2
Minimum green time for pedestrian to cross any road by adding 7 sec for initial
G_{PA} (Green time for pedestrian to cross road A) =w/1.2+7.0 sec
$R_A=G_B+A_B$
$R_B=G_A+A_A$
Calculate G_A and G_B

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Step-2: Cycle length $C = G_A+A_A+G_B+A_B$
Step-3: Do not walk (DNW)
$DNW_A=G_A+A_A=R_B$
$DNW_B=GB+G_B=R_A$
Design of traffic signals at authority rotary intersection with heaviest volume per hour for each lane of road A and B are 500 and 570, respectively. Width of the road is 17m for both the roads.
Step-1:
(i) Based on the approach speed, amber periods:
For road A with 40kmph, amber period $A_A=3$sec
For road B with 30kmph, amber period
$A_B=2$ sec$\frac{17}{1.2}+7.0$
$G_{PA}=21.16$sec $G_{PB}=21.16$ sec
$G_{PA}=G_B+A_B$
$G_B=G_{PA}-A_B=21.16-2=19.16$
$G_B=19.16$ sec
Similarly,
$G_A=G_{PB}-A_A=21.16-3=18.16$
$G_A=18.16$ sec
Step-2:
If $G_A=18.16$ sec
$G_B=20.70$ sec
Similarly,
If $G_B=19.16$ sec
$G_B=19.16$
$G_A=16.80$ sec
Step-3:
Cycle length $C=G_A+A_A+R_A$
$C = G_A+A_A+G_B+A_B= 16.80+3+20.70+2$
C=42.50 sec ~ 45 sec
Hence adopt cycle length of 45 secs.
Adjustment
$X_A= 1.168$
$X_B = 2.5 -1.168 = 1.332$ sec
Adjusted signal time
$G_A= 16.80+ 1.168= 17.968$ sec
$G_B= 20.70+ 1.332= 22.032$ sec
$A_A= 3$sec
$A_B= 2$ sec
Now total cycle length= $G_A+A_A+G_B+A_B= 17.968+3+22.032+2=45$sec
Step-4:
Do not walk (DNW) period of pedestrian signal at road A is red period of traffic signal at B.
$DNW_A= R_B=20.968$ sec
Similarly,
Do not walk (DNW) period of pedestrian signal at road B is red period of traffic signal at A.
$DNW_B= R_A=24.031$ sec
Pedestrian clearance interval (CI) = 14.16
$CI_A=CI_B=14.166$ sec
Now, walk time (W) is calculated from total cycle length.
Walk time for pedestrian for road A,
$WP_A=45-(20.968+14.166) = 9.865$
$WP_A=9.865$ sec
Similarly,
Walk time for pedestrian for road B,

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WP_B=45-(24.031+14.166) = 6.803
WP_B=6.803 sec

VI. EXPERIMENTAL RESULTS

Fig 5 Phase diagram time of Traffic Signal light

Traffic signals are the control devices which could alternately direct the traffic to stop and proceed at intersection using red and green traffic light signals automatically.

G_A	**A_A**	**R_A**		Traffic Signal Road A
17.968	**3**	**24.032**		45 second
R_B		**G_B**	**A_B**	Traffic Signal Road B
20.968		**22.032**	**2**	45 second
DNW_A		**CI_A**	**WP_A**	Pedestrian Signal Road A
20.968		**14.166**	**9.865**	45 second
CI_B	**WP_B**	**DNW_B**		Pedestrian Signal Road B
14.166	**6.803**	**24.032**		45 second

VII. CONCLUSION AND FUTURE WORK

After the estimation has been completed following points will present the conclusion of our research

- Present capacity of Authority rotary intersection is calculated as 3306 PCU per hour which is less than 5230 PCU/hour weaving traffic.
- So we provided signal at existing rotary intersection by approximate method.
- Efficiency of my research work is positive as input is much than its output in different manner such as pollution control, less fuel wastage and less travel time.

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