

An Evaluation of the Capacity of two Roundabouts: A Case Study of Agartala, Tripura

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Abstract— Roundabouts are one of the biggest areas in road intersection. The special form of at-grade intersection is roundabout which is laid out for the movement of traffic in one direction. In urban area, total quantity of vehicles increase very sharply. Quantities of vehicles are also increasing at the intersection of post office chowmuhani area as well as circuit house area in Agartala, Tripura. With this increasing rate of vehicles may cause congestion, delay and accident in intersection. The study shows that the Post office chowmuhani and in Circuit House chowmuhani roundabouts the total traffic capacity is 3599 PCU/hour and 2970 PCU/hour respectively. Hence, as per the study it expected that the Circuit House chowmuhani roundabout will be collapsed by the year 2022.

Index Terms— Agartala, Circuit house roundabout, India, Passenger Car Unit, Post office chowmuhani Roundabout, Traffic Movement, Tripura, Wardrop formula.

1 INTRODUCTION

THE second largest city in North-East India after Guwahati is Agartala. It is also the capital of Tripura. Agartala city is one of oldest city developed in 1844 AD. Agartala city is connected with Bangladesh by Akhaura Road. Agartala city is connecting by the road to other part of state and the high possibility of establishing of business corridor in Agartala. Traffic congesting is frequently observed in major intersection of Agartala.

Roundabouts 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. Roundabouts are suitable when there are more approaches and no separate lanes are available for right-turn traffic thus making intersection geometrically complex. The traffic operations at a roundabouts are three; diverging, merging and weaving [1].

Roundabouts have been widely accepted and used in countries for decades. A roundabout is a form of intersection design and control that accommodates traffic flow in one direction around a central island. Compared to uncontrolled intersection, roundabout can reduce speed as well as number of conflict points because of the geometrical design. The overall delay will probably be less than that for signalized intersection. Therefore, it is necessary to evaluate the feasibility of roundabouts as an intersection control alternative in the city of Agartala [2].

Significant study has been done to develop methodologies to evaluate the functional performance of roundabouts.

Significance of this study is to evaluate the capacity of roundabout as an intersection control alternative in Agartala. Roundabouts can be a good replacement for all-way stop control where traffic volume are high, because priority is assigned to circulating traffic and yield-at-entry control allows vehicles to enter without stopping when gaps are available. Capacity models for the weaving sections using interweave theory model Wardrop (1973) formula is considered to be a typical representative of this model gap technique is applied in this paper. Capacity is a useful indicators used by most countries to assess roundabout performance [2].

Indian cities are facing the crisis of urban transportation. Despite of investments in road infrastructure and plans for transport development, users face the problem of congestion, accidents and pollution. Accident is a major problem, especially at the intersection, as the vehicles on the intersection move at very high speed. Also due to traffic jam, lot of time is wasted. Pedestrians face troubles in crossing the road. Due to congestion, pollution increases and it causes harmful effects on human health living adjacent to the area. At any intersection delay and improper management as well as poor control over the flow of traffic increases rapidly. At intersection of Hari Ganga Basak road and VIP road, above problems frequently occurs due to heavy traffic flow [3].

2 SITE DESCRIPTION

The site has been so selected that within a stipulated time frame the maximum variety of data can be collected for the utilization in the study. Site could be selected in such a place where video graphic survey is to be conducted. In present study, two very important congestion areas had been selected near in Agartala. One has been selected in Post Office Chowmuhani and another one is selected in Circuit House Chowmuhani in Agartala.

3 METHODOLOGY

Interweave theory model, gap acceptance theory model and regression analysis theory are the fundamental three method-

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ologies can be used to assess the capacity of roundabouts. The typical representative for the interweave theory model is Wardrop (1973) formula. Based on the weaving theory, the model of capacity on weaving segment is established to reflect the capacity of roundabouts. A total of 2(Two) roundabouts were selected in Agartala city for data collection. The selected roundabouts should satisfy the following conditions in the selection of candidates.

A total of 2(Two) roundabouts were selected in Agartala city for data collection. The selected roundabouts should satisfy the following conditions in the selection of candidates. First, there should be an area where a digital video camera can be mounted to tape the entire roundabout and the weaving section. Second, the selected roundabouts should meet the demand of large and heavy traffic, but with no congestion or any incident occurring at the roundabout.

4 RESULTS AND DISCUSIONS

The entry flow and the circulating flow of rotary intersection can be determined by using the radar gun. In Circuit house roundabout, the relationship between the speed of entry flow and circulating flow are illustrated below in fig. 1. It is evident that at weaving sections when the paths of two or more traffic streams cross in the same general direction, conflict and interference increase rapidly. This situation results in a reduction of speed. By conducting significance test, the difference between the speed of entry flow and circulating flow is statistically significant. Therefore, it is necessary to study the weaving sections.

Circuit house roundabout having 4(Four) approach, One approach is towards Radha nagar, another three are towards airport Road, Krishna Nagar Road and G.B Road. Among them Radha nagar approach is one of the busiest one. The vehicles data collected from circuit house roundabout are tabulated in fig 2.

Present vehicle data like total vehicles, three wheeler, two wheeler, jeep, trucks in Agartala city has been collected from transport information center in Agartala. The collected data is used in regression analysis to develop suitable equation. Using this equations vehicles growth percentage is determined. It was observed that for two wheeler, three wheeler and for four wheeler the growth percentage will be 96%, 88 % and 107 % respectively at 2022. The maximum capacity of Roundabout at Circuit House in 2022 by Wardrop formula is calculated as 3009 PCU/hour.

Similar procedure is followed in Post office chowmuhani Roundabout and it is observed that its traffic capacity 3599 PCU/hour at present. Fig. 6 shows the PCU value in various directions at Post office chowmuhani Roundabout. Fig. 7 and Fig. 8 show the signal design at Post office chowmuhani Roundabout.

5 EQUATIONS

The capacity of Roundabout at Circuit House as well as post office chowmuhani is calculated by Wardrop formula,

$$QP= (280w (1+e/w) (1-p/3))/ ((1+w/l))..... (1)$$

The capacity of rotary is directly determined by the capacity of each weaving section. The capacity of a weaving section is determined by the geometric layout, including entrances and exits, and the percentage of weaving traffic. The Transport and Road Research Laboratory (U.K.) which has pioneered research on this aspect, recommends the following formula, which is a modification of the well-known Wardrop formula (Equation 1).

6 FIGURES AND TABLES

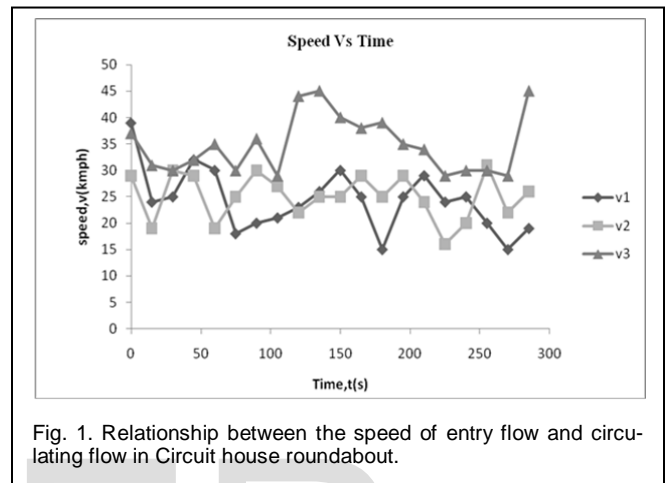


Fig. 1. Relationship between the speed of entry flow and circulating flow in Circuit house roundabout.

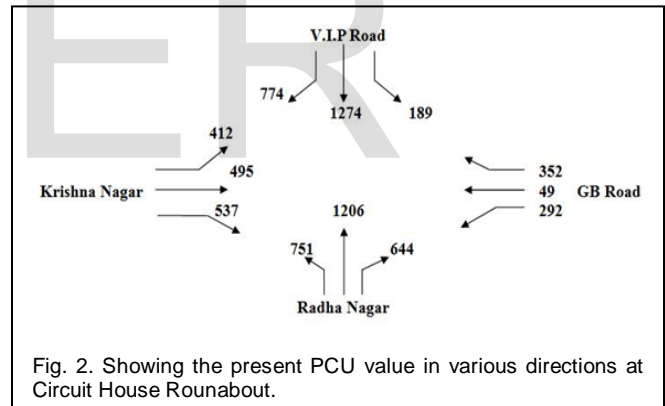


Fig. 2. Showing the present PCU value in various directions at Circuit House Roundabout.

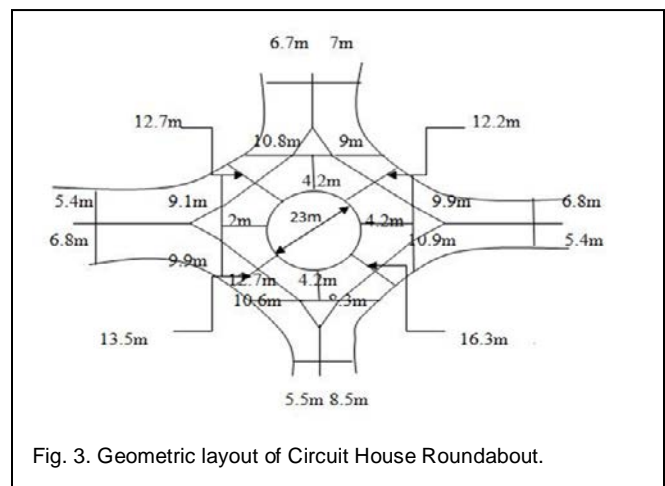


Fig. 3. Geometric layout of Circuit House Roundabout.

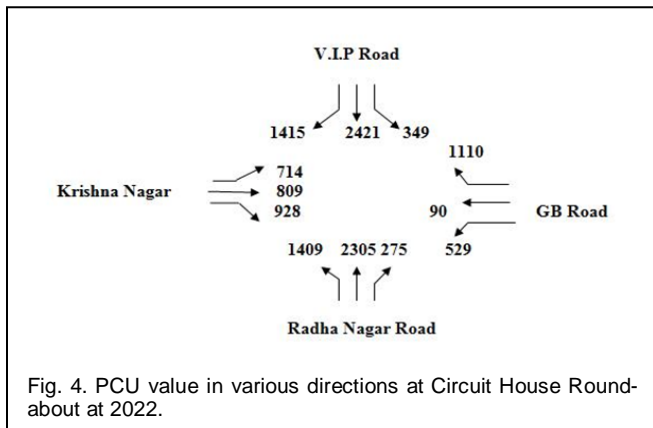


Fig. 4. PCU value in various directions at Circuit House Roundabout at 2022.

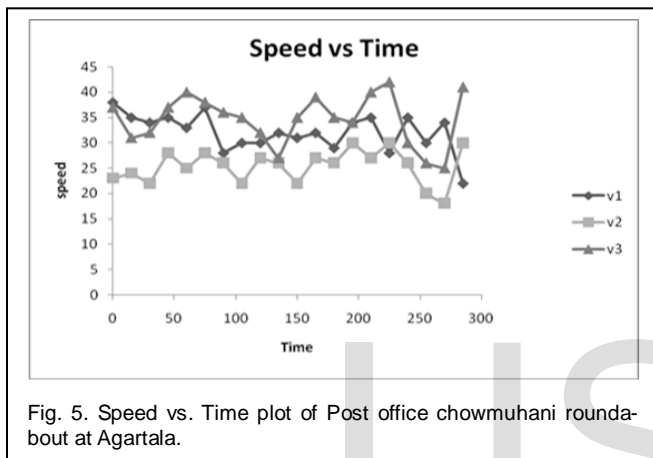


Fig. 5. Speed vs. Time plot of Post office chowmuhani roundabout at Agartala.

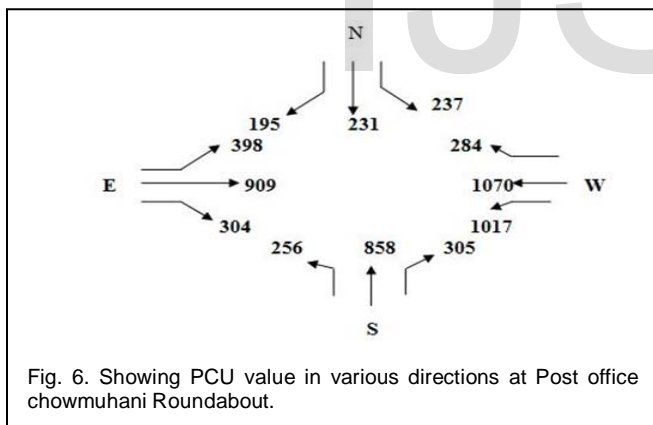


Fig. 6. Showing PCU value in various directions at Post office chowmuhani Roundabout.

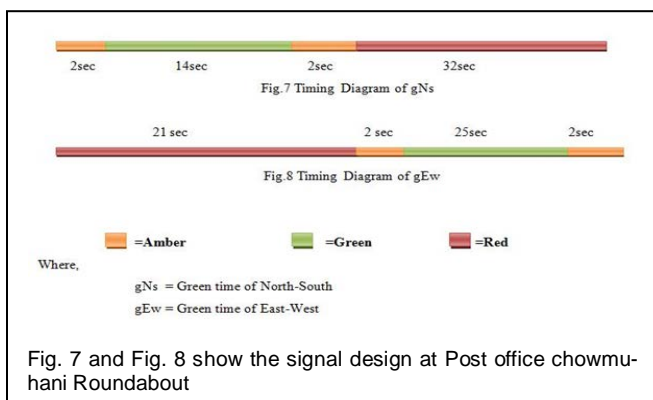


Fig. 7 and Fig. 8 show the signal design at Post office chowmuhani Roundabout

Where,

V1= the speed of vehicles which enter into the circulating flow, Km/hour.

V2= the speed of vehicles which drive out of the circulating flow, km/hour.

V3= the speed of entry flow, km/hour.

Qp= Practical Capacity of the weaving section of the roundabout in PCUs per hour

w= width of the weaving section in meters.

e= average entry width of the roundabout in meters

l= Length of weaving section between the ends of the channelizing island in meters

P=Proportion of weaving traffic.

4 CONCLUSION

Roundabouts 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 are the lower limit as per IRC. Hence, Circuit house Roundabout is suitable for present condition, but as the study shows that it exceeds the upper value in the year 2022 and the Roundabout will be collapsed by that time.

In case of Post office chowmuhani Roundabout the total traffic at the junction is 3599 PCU/hour which is much more than the limit of 3000 PCU/hour specified by IRC. So, it can be concluded that the present condition is not sufficient for controlling traffic operations at that Roundabout. For that most convenient way to design the traffic is signal design which is given a tried over here. In future scope of work it needs to be adopt other alternatives to accommodate the traffic.

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