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Signal and Rotary Intersection at Haliyal CBD Area

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***Abstract*: Traffic congestion has been one of the major issues in the rapidly growing towns in spite of measures being taken to mitigate and reduce it. In the recent past, traffic congestion has emerged as one of the main challenge for engineers and planners. There is no single, broadly accepted definition of traffic congestion. Traffic congestion can generally be defined as excess of demand for road travel. Many professionals and organizations have defined congestion in different ways based on variety of criteria. Due to the lack of an unified definition for the measurement of congestion, several metrics are in use. These include speed, travel time, delay, volume and level of service etc. The main focus of this study is aimed at understanding the recurring town congestion, its measurement and mitigation. Shivaji circle and Vanashri circle in Haliyal Town Uttara Kannada District, is chosen for the study. In this study we are going to do the traffic volume survey by manual methods and also the necessary calculations required for this study Through this study we are going to assess whether the Rotary intersection present there is sufficient or not for the present traffic volume.**

***Keywords*: signal, rotary intersection, rotary design.**

1. Introduction

A rotary intersection is a specialized form of at grade intersection laid out for traffic in one direction round a central island. These are also known as “roundabout or traffic island”. The vehicles from converging areas are forced to move around the central island in clockwise direction and weave out of rotary movement into their desired directions. The traffic circles were designed for high-speed travel, generally featuring large radius and vehicle capacity. A traffic light, traffic signal, or stop light is a signaling device positioned at a road intersection, pedestrian crossing, or other location in order to indicate when it is safe to drive, ride, or walk using a universal color code. The traffic lights for vehicles commonly have three main lights, a red light that means stop, a green light that mean go and yellow that means ready to stop. However, for the pedestrians, there have only two lights, a red light and a green light that mean go and stop respectively. The traffic lights have given many benefits to all road users. Besides reducing the number of accidents, it made the traffic flow smoothly and possibly could save people time. There is high traffic volume at the intersections that we are considering for our projects because of which there is very much interruption of continuous traffic flow, high accident probability and difficulty in crossing the road by the pedestrian and vehicles so the efficiency safety and speed is very low at the intersection and therefore cost of operation increases the capacity of road decreases. Hence, for the purpose of the fulfilment of all the above factors and for safe and comfort moment we took this project as for the improvement of the intersection and its estimation which will provide much help to the engineers and will also give the idea while the execution of the project realistically.

2. Project Locations

The rotary junction named as “Shivaji circle” includes four arms/ legs i.e. Haliyal/ Yallapur road, Dharwad road, Dandeli road and V.R.Deshpande road. Figure 1 shows the project location for rotary intersection. The traffic signal named as “Vanashri circle” includes four arms/ legs i.e. Belgaum Road, Dharwad Road, Yallapur road, and Bus-stand Road. Figure 2 shows the project location for traffic signal.

Shivaji circle:

Fig. 1.

Vanashri circle:

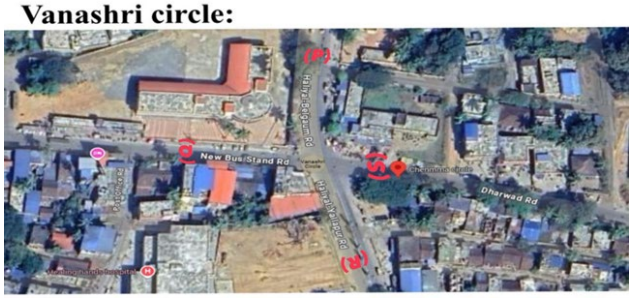

Fig. 2.

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3. Literature Review

All over the world, many studies on Rotary intersection or roundabouts have proven that the rotary intersections are most effective than signalized intersection in regulating the traffic within specified volume.

S. Vasantha Kumar, Himanshu Gulati and Shivam Arora worked on intersection in Chennai. They have found that the proposition of weaving section as 0.81, which is less than 1 and suitable to construct the rotary intersection. The observed traffic volume is 2665 PCUs/hr which is lesser than practical capacity 3020 PUCs/hr. Finally, they concluded with rotary intersection proposal for the selected intersection.

Veethika Gomasta was designed rotary intersection in Bhopal according to their design capacity of Vallabha bhawan roundabout was found to be 3017 PCUs/Hr which is greater than 3000 PCUs/Hr. Since the observed volume was greater than practical capacity, they concluded that rotary intersection is not suitable and signalized intersection to be provided.

Optimizing traffic signals to improve traffic progression relies on minimizing mobility performance measures (delays and stops). However, delay and stop minimizations do not necessarily lead to minimal sustainability measures (fuel consumption and emissions). For that reason, researchers have focused, for decades, on integrating traffic models, signal optimization models. Therefore, this paper reviews, classifies, and analyzes studies found in the literature regarding optimizing traffic signals.

Ekinhan Eriskin et al., (1995) suggested a new method for designing traffic signal timing at oversaturated intersections was expressed “the elimination pairing system”. An object function with vehicle delay and stop-start numbers has been generated. Total cost value has been calculated according to the object function. Obtained results were compared with Webster as a traditional traffic signal timing design method and Transyt 14 signal timing software. While Webster gives exaggerated results, Transit 14 and Elimination Pairing Systems provided better results. As a result of that study, the elimination pairing system could be used for optimizing the traffic signal timings.

Huajun Chai et al., (1998) captured the interaction between travelers' route choice and traffic signal control in a coherent framework. They tested their algorithm and control strategy by simulation in Om Net++ (A network communication simulator) and SUMO (Simulation of Urban Mobility) under several scenarios. The simulation results shown that with the proposed dynamic routing, the overall travel cost significantly decreases. It was also shown that the proposed adaptive signal control reduced the average delay effectively, as well as reduced the fluctuation of the average speed within the whole network.

4. Methodology

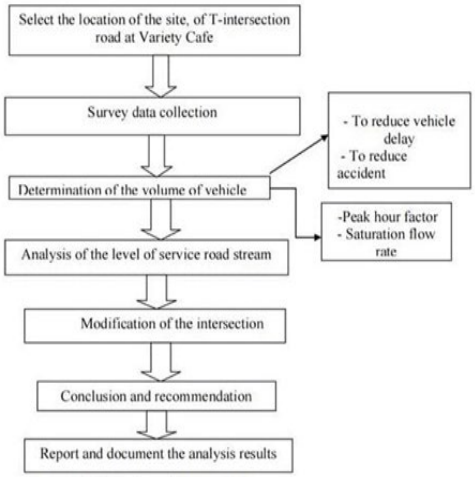

Fig. 3.

5. Peak Hour Estimation

A network level peak hour has been adopted for the project rather than junction level. This is due to the reason that with proposed road upgrades a traffic redistribution exercise has to be performed for the study area which can only be done with a network level peak hour. Peak hour factors should be applied in most capacity analyses in accordance with the Highway Capacity Manual, which selected 15-minute flow rates as the basis for most of its procedures. The peak-hour factor (PHF) is descriptive of trip generation patterns and may apply to an area or portion of a street and highway system. The PHF is typically calculated from traffic counts. It is the average volume during the peak 60-minute period V av60 divided by four times the average volume during the peak 15 minute’s period.

$$Peak\ hour\ factor = \frac{\text{Maximum volume count of 1 hour}}{4 * \text{Maximum volume count of 15 min}}$$

A. Shivaji Circle

Summary of Trips of Shivaji Circle on Tuesday.

Table 1

Summary Of Trips (Tuesday)				
Peak	**15 Min Interval**		**Total**	
PM PEAK	04:00	04:15	676	
	04:15	04:30	721	
	04:30	04:45	778	778
	04:45	05:00	752	
	05:00	05:15	735	
	05:15	05:30	763	
	05:30	05:45	724	
	05:45	06:00	661	
Summary of Trips (Tuesday)				
Peak	**1 Hour Interval**		**Total**	
PM PEAK	04:00	05:00	2927	
	04:15	05:15	2986	
	04:30	05:30	3028	3028
	04:45	05:45	2974	
	05:00	06:00	2883	

Peak hour factor (Tuesday): 0.97

Summary of Trips of Shivaji Circle on Sunday:

Table 2

Summary of Trips (Sunday)				
Peak	**15 Min Interval**		**Total**	
PM PEAK	04:00	04:15	497	
	04:15	04:30	483	
	04:30	04:45	1034	
	04:45	05:00	819	
	05:00	05:15	1193	
	05:15	05:30	1112	
	05:30	05:45	1260	
	05:45	06:00	1295	1295
Summary of Trips (Sunday)				
Peak	**1 Hour Interval**		**Total**	
PM PEAK	04:00	05:00	2833	
	04:15	05:15	3529	
	04:30	05:30	4158	
	04:45	05:45	4384	
	05:00	06:00	4860	4860

Peak hour factor (Sunday): 0.94

B. Vanashri Circle

Summary of Trips of Vanashri Circle on Tuesday

Table 3

Summary of Trips (Tuesday)				
Peak	**15 Min Interval**		**Total**	
	04:00	04:15	853	853
PM PEAK	04:15	04:30	672	
	04:30	04:45	789	
	04:45	05:00	664	
	05:00	05:15	668	
	05:15	05:30	577	
	05:30	05:45	741	
	05:45	06:00	598	
Summary of Trips (Tuesday)				
Peak	**1 Hour Interval**		**Total**	
	04:00	05:00	2978	2978
PM PEAK	04:15	05:15	2793	
	04:30	05:30	2698	
	04:45	05:45	2650	
	05:00	06:00	2584	

Peak Hour Factor (Tuesday): 0.87

Summary of Trips of Vanashri Circle on Sunday

Table 4

Summary of Trips (Sunday)				
Peak	**15 Min Interval**		**Total**	
	04:00	04:15	801	
	04:15	04:30	767	
	04:30	04:45	962	962
PM PEAK	04:45	05:00	754	
	05:00	05:15	853	
	05:15	05:30	817	
	05:30	05:45	813	
	05:45	06:00	709	
Summary of Trips (Sunday)				
Peak	**1 Hour Interval**		**Total**	
	04:00	05:00	3284	
	04:15	05:15	3336	
PM PEAK	04:30	05:30	3386	3386
	04:45	05:45	3237	
	05:00	06:00	3192	

Peak Hour Factor (Sunday): 0.88

6. Analysis Parameters

An operational analysis was carried out for the project to make sure that the junctions within the study area operate at an acceptable Level of Service (LOS) of D or better. In cases where LOS is worse than D, mitigation measures are proposed to achieve at least LOS D. Level-of-Service (LOS) for traffic signal controlled and un-signalised intersections are based on methodologies and procedures outlined in the most recent edition of the Highway Capacity Manual (HCM 2010) published by the Transportation Research Board. Level of Service definition is based on average delay (in seconds) and V/C ratio for signalised junctions and solely on delay (in seconds) for un-signalized intersections (give-way/ yield and roundabouts).

7. Analysis Tools

Following are the various software tools used to carry out the operational analysis of the project road network:

SYNCHRO software was used to analyse signalized junctions.

SIDRA software was used to analyse roundabouts and priority junctions.

8. Sidra

SIDRA Intersection is a software package that helps analyze traffic, intersections, network capacity, service levels, and performance. It's known for its traffic analysis and optimization capabilities. Here are some features of SIDRA Intersection: Highway Capacity Manual (HCM): SIDRA Intersection complements the HCM as an advanced intersection analysis tool. It includes the HCM Edition 7 roundabout capacity model for single-lane and multi-lane roundabouts. Calibration: Users can calibrate SIDRA models for local conditions. Roundabout capacity model: SIDRA Intersection offers the SIDRA Standard roundabout capacity model option.

9. Synchro

Synchro is a software that allows users to model, optimize, manage, and simulate traffic systems. It includes the following applications:

Synchro: A macroscopic analysis and optimization program

SimTraffic: A traffic micro-simulation software application

3D Viewer: A three-dimensional view of SimTraffic simulations

Synchro Studio can be used for Analyzing traffic operations, modeling complex traffic networks, supporting multiple scenarios in a single file, and providing multiple analysis methods. Synchro is easy to use and can adapt too many different scenarios. It can also combine deterministic modeling tools with microscopic simulation tools.

10. Existing Junction Analysis

Analysis results shows that, both existing junctions are working as “LOS F” during weekday and weekend, which means there is a need of mitigations/ proposed improvements to work these junctions under acceptable level of service “LOS D”.

Junction Analysis: The roundabout analysis has been carried

out for Shivaji circle and Give Way analysis for Vanashri Circle with help of SIDRA software. The existing condition layout for Shivaji circle as well as Vanashri Circle is as follows.

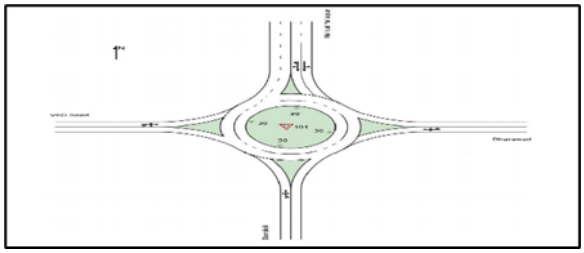

Fig. 4. Existing layout for Shivaji circle

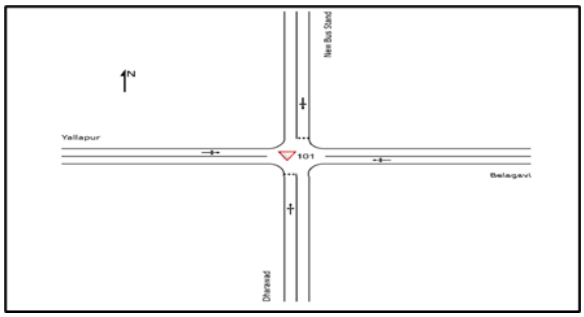

Fig. 5. Existing layout for Vanashri circle

Table 5
Existing junction analysis weekday

Time Period	Junction ID	Delay (S)	LoS
PM	Shivaji Circle	128.1	F
PM	Vanashri Circle	712.8	F

Table 6
Existing junction analysis weekend

Time Period	Junction ID	Delay (S)	Los
PM	Shivaji Circle	368.8	F
PM	Vanashri Circle	3297.1	F

11. Mitigation Measures/ Proposed Improvements

Based on the existing junction analysis results, mitigation measures is proposed as follows. Proposed improvements to Shivaji and Vanashri circle results in LOS D. FIG 1 and FIG 2shows the proposed layouts for Shivaji Circle and Vanashri Circle.

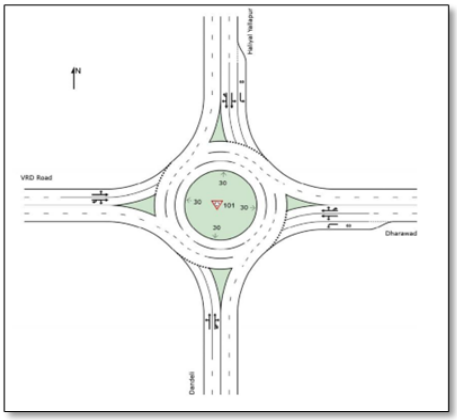

Fig. 6. Proposed layout for Shivaji circle

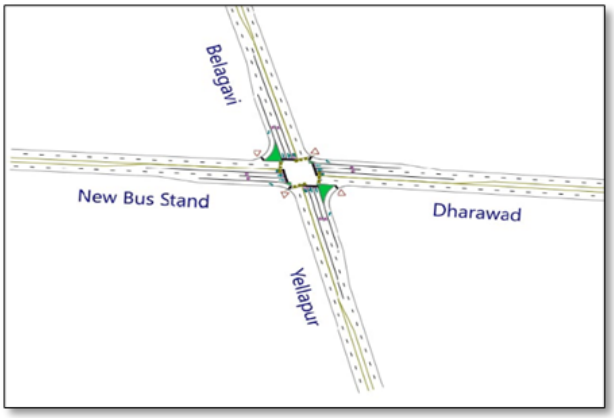

Fig. 7. Existing layout for Vanashri circle

12. Proposed Junction Analysis

Analysis results shows that, both the junctions are working at acceptable “LOS D” during weekday and weekend with proposed mitigations.

Table 7
Proposed junction analysis weekday

Time Period	Junction ID	Delay (S)	LoS
PM	Shivaji Circle	13.5	B
PM	Vanashri Circle	28.9	C

Table 8
Proposed junction analysis weekend

Time Period	Junction ID	Delay (S)	LoS
PM	Shivaji Circle	35.9	D
PM	Vanashri Circle	47.7	D

13. Conclusion

Roundabout and Signal junctions is used to enhance the operational efficiency of existing condition where traffic causes unacceptable vehicle delay and cause unacceptable queues at junctions.

Traffic surveys for the project study area were undertaken in OCTOBER 2024. The traffic survey results were used to analyses the existing conditions on junctions. Analysis also indicates that the junctions are not working under acceptable LOS for the base year.

Based on the analysis outputs, Mitigations have been provided for the failing junctions to allow smooth traffic for future years. Proposed design shows that junctions will operate at an acceptable Level of Service for the base year.

References

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