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Optimising U-turn vehicle movement and signal phasing using VISSIM

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***Abstract*---**In the developed countries traffic congestion in the urban area is becoming the part of our daily life, as well as in the most of the developing countries, traditional methodology to manage congestion are not fulfilling the requirement, a new method of capacity analysis at the intersection has been developed in the study where the driver's behavior, traffic composition, level of road side activities are different from those different countries. Typical cities in the developing countries performed by the heterogeneous traffic mixed including fast-moving vehicle (motorized) and slow moving vehicle (non-motorized).This paper evaluates "optimizing U-turn vehicle movement and signal phasing by simulation method" or low cost "indirect right turn treatment" to reduce conflicts and congestion at the intersection in the urban area. A U-turning vehicle, during merging at an uncontrolled median opening creates the possibility of conflict with approaching through traffic movement and causes traffic congestion which reduces the roadway capacity. The effect of the conflicting

traffic volume on the U-turning maneuver was also investigated by collecting placement data extremely congested traffic condition. Compared with the turning movement at the intersection, Volume and travel time studies were conducted at different intersection. U-turn movements at the median opening are highly complex and risky. Normally, the speed conflicting traffic stream is relatively high and turning vehicle must wait for the acceptance gap and then turn under low speed level. Therefore, the turning vehicle needs a large gap in the conflicting stream before performing the U-turn. In fact, the little studies which contain procedures and models for estimating capacity and delay for different movement at intersection do not provide specific guidelines for estimating the capacity and delay of U-turn at median openings. For this reason an effort was made to estimating and delay model U-turn opening. The results of the approach are present in this study. A linear model was also recommended as a relationship between the average total delay of the U-turning vehicles and the conflicting traffic flow.

***Keywords*---**gap acceptance, headway, signal, U-turn.

Introduction

The first and foremost thing of the transportation system is to move people and goods efficiently and safely without any problems. With the increase in traffic on the road network the main goal and the focus of transportation project has shifted to improve operational efficiency of existing network. Safety and performance indicators provide input to methodology for ranking the system analytically, all the rules and regulations required to change the operational efficiency are to be checked before implementation, due to several limitation of the methodologies suggested by the highway capacity manual(HCM). Because of the new procedure and installation, transportation professionals are unfamiliar with the many alternatives intersection and interchange form furthermore, at the national level, well-documented and substantive resources needed for the planning, analysis, design and the public outreach and education were limited.

In order to reduce the traffic any other alternatives solution are to be made by taking traffic congestion into account by limited financial resource and restricted right of way in urban area, for developing countries financial support is major concern . This project is mainly based on to evaluation on in-direct right turn to reduce the conflict and congestion in both signalised and un-signalised intersection. The stimulation of U-turn is currently of the great interest to many transportation professionals because of wide spread use of indirect left turn treatment. In this study, a detailed procedure was proposed to help the transportation professional's model U-turn movement at signalised /un-signalised intersection in the traffic stimulation programme VISSIM.

The behavioural feature of the U-turning vehicle such as priority rules, lane section, and turning speed were determining by the data collection from different location. Vissim stimulation model is calibrated and validated by the procedure

called genetic algorithm. The stimulation results of the calibrated vissim model are then compared with the field capacity and capacity estimation is done by using gap acceptance. For the better traffic operation the capacity of the U-turn movement is to be estimated to facilitate the level of service. The U-turn vehicle is to wait at the bay area until there is an acceptance headway gap in the traffic stream; the gap acceptance behaviour is calibrated using actual traffic data. The left turning vehicle from driveway was selected as the measure of the effectiveness for the model calibration and validation. Field data is collected at different intersection where indirect right turn treatment were implemented. The major purpose of modelling U-turn median opening is to develop useful relationship between capacity and the set of traffic and geometric characteristics, under different traffic condition the developed model should be easy for the practical application.

In order to improve the traffic management operation some traffic movement are not permitted at some location, especially along divided arterial. In most of the case, such minor movement are accommodated at separated U-turn median opening that is compared with turning movement at intersection, U-turn movement at the median opening are highly complex and risky. Normally the speed of conflicting traffic stream is relatively high and there turning vehicle must wait for acceptance gap and turn under low speed level. Therefore before performing U-turn vehicle need a large gap to turn the vehicle into the conflicting stream in fact, the little studies which contain procedures and model for estimating the capacity and delay for U-turning movement at median opening for this reason effect are made to estimate capacity and delay at the U-turn median opening.

Study Area

The study area identified in this project is certain stretch mekhri circle (near cavery theatre). The important of this junction the road is connected between different areas of the city to kempegowda international airport. In this stretch (mekri circle junction) access different categories of vehicle, so congestion will create at the U-turn junction so the signal is installed at the beginning of the intersection (mekhri circle) so important goal at this junction is to make un-signalised into signalised intersection, so that delay and travel reduced certain extent. Signal is provide with mutual co-ordination with vehicle coming from the underpass, that mean the vehicle moving in the underpass should not get effect by vehicle moving towards hebbal.

Figure 1 location of the study area

Research methodology

- Identifying Study Area,
- Traffic volume count both manually and by video graphic
- Collecting geometric details of particular stretch
- Delay and queue length calculation by HCM manual 2000
- Creating the base model of selected stretch using VISSIM software
- Analyze the obtained result after simulation
- Validation of the results
- Results and Conclusion

Data Collection Traffic Volume Study

A number of vehicles pass on the road per unit time at any selected period at the selected stretch is known as traffic volume. Traffic flow is measured in terms of traffic flow. Complete traffic volume study includes the classified volume study by recording the volume of various type and class of traffic, the headway distribution by the direction and the turning movement and the distribution on the different lane per unit time.

Queue length

1. Queue length is noted down at the selected stretch when the signal turns into red, say 250m or 300m at the selected stretch.
2. The length of the queue is noted down and used for comparison through the delay
3. By marking on the road at the selected stretch, queue length at the junction is noted.
4. Analysis of the same junction and while simulating in the VISSIM software.

Figure 1 indicates the graphical representation of the vehicles crossing mekhri circle near cauvery theater and the route is majestic to hebbal done on date: 27/11/2021, Saturday 8:00am to 9:00am (morning)

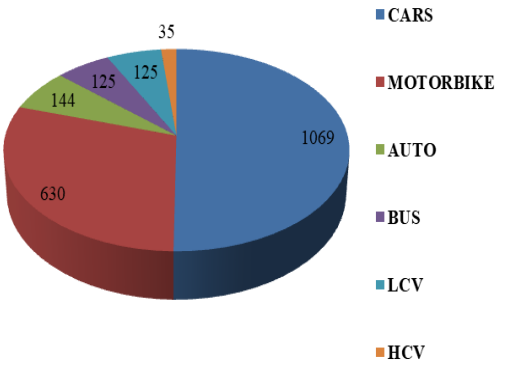

Figure 2 vehicles crossing in mekhri circle

Vehicle Count From Majestic To Yelhanka

Table No 1 indicates the Classified Traffic Volume Count from majestic to yelahanka in morning and evening peak hour (8:00 am to 10:00 am and 4:00pm to 6:00pm) on Saturday (27/11/2021)

Table 1 classified traffic volume count(morning)

Time (AM)	2-Wheleer	Autos	Cars	Bus	LCV	HCV	Total
8- 8:15	316	161	31	21	29	06	564
8:15- 8:30	370	152	34	38	21	08	623
8:30- 8:45	333	164	41	40	34	11	623
8:45-9:00	348	153	38	26	41	10	616
9:00 9:15	338	161	41	16	38	11	605
9:15 - 9:30	340	181	42	10	31	06	610
9:30-9:45	336	161	38	16	28	12	591
9:45 -10:00	360	140	41	12	21	08	582

Table 2 classified traffic volume count (evening)

Time (PM)	2-Wheleer	Autos	Cars	Bus	LCV	HCV	Total
4:00-4:15	121	56	24	08	21	01	231
4:15- 4:30	98	62	21	15	14	02	212
4:30- 4:45	96	68	10	14	16	02	206
4:45- 5:00	111	48	15	22	07	01	204
5:00- 5:15	131	38	08	26	07	00	210
5:15 - 5:30	135	46	11	19	07	00	218
5:30- 5:45	116	53	07	29	05	00	210
5:45 - 6:00	222	48	20	20	08	01	319

Data Analysis And Results

Design of isolated fixed time signal by HCM method near mekhri circle junction:

Max vehicle count/Phase in numbers
Phase 1: 2460 vph
Phase 2: 1805 vph
Phase 3: 2520 vph
Critical lane volume for the first phase Vc1=2460vph
Critical lane volume for the second phase Vc2=1805vph
The sum of critical lane volume, Vc= Vc1+vc2
=2460+1805
=4265vph
Effective green time can be found out by the equation Tg=123-(2.5-3.5)

=124sec
Green time for the first phase, g1 can be found out from equation $g1=\frac{2460}{4265}*124$
= 87sec

Green time for the second phase can be found out from the equation g2= $\frac{1805}{4265}$ *124 =34secs

Actual green time can be found out from the equation thus actual green time for the first phase,

G1=87+2.5=89.5secs
Actual green time for the second phase, G2=34+2.5=36.5secs

Providing signal phasing in VISSIM

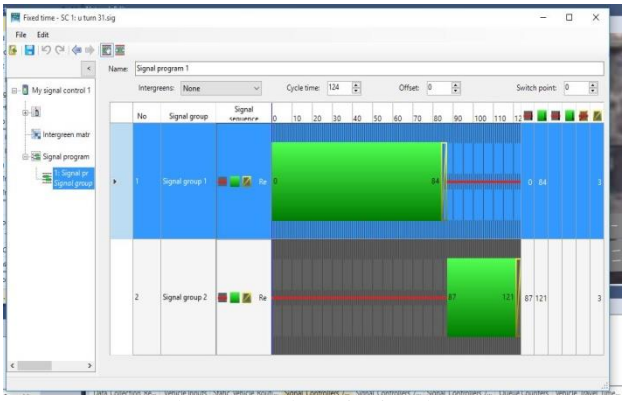

Figure 3 signal phasing

Before implementation

Queue length: 462m
Vehicle travel time: 285sec
Queue delay: 69sec
Average speed: 35kmph

After implementation

Queue length: 116m
Vehicle travel time: 192sec
Queue delay: 29.60sec
Average speed: 34kmph

Conclusion

- Based on the above results we can conclude that by providing signal at the unsignalized intersection we can reduce the delay, travel time, queue length and queue delay at the selected stretch.
- By the above results LOS can be increased at the particular stretch.
- Before introduction of signal, queue length is=462m,travel time=285sec, queue delay=69sec and speed=35kmph
- After introduction of signal in stretch queue length drops down by 116m, and travel time by 192secs and queue delay by 29 secs.

- Queue length is reduced by 40%, travel time by 67% and queue length by 42%.
- Similarly introduction of alternative route for MEKHRI circle is done it reduces queue length by 66%, travel time by 74% and queue delay by 59%.

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