EVALUATION OF CAPACITY AND LEVEL OF SERVICE OF URBAN ROADS

Ebin Nirmal Joseph[1] and Dr.M.S.Nagakumar[2]
1. Student, Department. of Civil Engineering, R. V .College of Engineering , Bangalore.
2. Professor, Department of Civil Engineering, R. V. College of Engineering, Bangalore.

Abstract
Traffic congestion has become a serious problem in metropolitan cities like Bangalore. This enormous traffic congestion is due to huge explosion in job opportunities created by these cities. Traffic congestion has now become a very serious problem particularly in metropolitan cities because cities have expanded dynamically without any planning and control. Such rapid development has increased the number of vehicles in Bangalore city which is creating a huge increase in traffic congestion thereby increasing the delay time in each midblock. This traffic congestion is causing pollution due to idling of vehicles for a long time.
The present study is an attempt to study different parameters such as capacity, level of service, vehicle to capacity ratio, average journey time, average delay in each midblock, peak hour traffic and to provide necessary improvement measures in this midblock. For the present study 6 mid-blocks were selected in Koramangala area of Bangalore city. Traffic volume count was conducted on all these 6 stretches from morning 6 AM to 10 PM. Speed and delay studies were conducted three times during peak and non-peak hour and the average journey time was determined. Average delay of all these mid-blocks were also determined using speed and delay studies. Road inventory survey was done to determine the width of the road, median, footpath. Capacity calculation was done on the basis of spot speed studies. Level of service was found out based on the average speed among each mid-block.
The traffic data collected from the field shows that the mid blocks are congested during peak hours. The vehicle to capacity ratio during peak hour was found to be exceeding 1. The level of service of the entire stretch was found to F during the entire survey. The average time required to travel the entire 3.8km stretch during peak hour was found to be 17min and the average travel speed was below 13kmph. Improvement measures should be done in Sony signal junction where maximum delay is occurring.

Keywords- *Capacity, Level of Service, Average Journey Time, Average Travel Speed, Peak Hour Volume, Volume to Capacity Ratio*

1. INTRODUCTION

Traffic congestion has been one of major issues that most metropolises are facing and thus, many measures have been taken in order to mitigate congestion. It is believed that identification of congestion characteristics is the first step for such efforts since it is an essential guidance for selecting appropriate measures. Congestion both in perception and in reality impacts the movement of people and freight and is deeply tied to the history of high levels of accessibility and mobility. Traffic congestion causes waste of time and energy, thereby causes pollution and stress, decreases productivity and imposes costs on society.
There are two principal categories of causes of congestion, and they are; (a) micro-level factors (e.g. relate to traffic on the road) and macro-level factors that relate to overall demand for road use. Congestion is "triggered" at the "micro" level (e.g. on the road), and "driven" at the "macro" level by factors that contribute to the incidence of congestion and its severity. The micro level factors are, for example, many people and freight want to move at the same time, too many vehicles for limited road space. Many trips may be delayed by events that are irregular, but frequent: accidents, vehicle breakdowns, poorly timed traffic signals, special events like mass social gatherings, political rallies, bad weather conditions, etc. which present factors that cause a variety of traffic congestion problems. On the other side, macro level factors e.g. land-use patterns, employment patterns, income levels, car ownership trends, infrastructure investment, regional economic dynamics, etc. also may lead to congestion.

2. LITERATURE REVIEW

This research paper analysed the effects of the characteristics of urban roads, specially the side friction, in reducing the capacity and speed. It is then compared the results to the capacity and speed predicted by Indonesian HCM. It is also compared the actual speed-flow relationship and that predicted by Indonesian HCM. It is found that the capacity and speed predicted by Indonesian HCM are too high. The effects of side frictions, e.g.: on street parking, city bus stopping anywhere on the roadway (there is no specific bus stop for city bus), exit/entry vehicles and U-turn vehicles are higher than those predicted by Indonesian HCM. It is concluded that, when the side friction is too high, there is a significant different between the actual speed/capacity and that predicted by Indonesian HCM.
This paper investigated the behaviour of mixed traffic stream speed and flow rate on an access controlled urban Arterial Street in Surat city in Gujarat. Field surveys were carried out to find classified volume count and speed data was obtained manually and also through video graphic method. Mutli regime speed flow relation is developed based on data extracted from the field. Based on volume to capacity ratio level of service are established by cluster analysis approach. The results are very useful for evaluation of traffic quality for access controlled urban arterials in mixed traffic conditions.

3. OBJECTIVES

1. Determination of peak hour volume in each mid-block.
2. Determination of peak hour traffic.
3. To find the composition of vehicle in each stretch.
4. To determine the present capacity of the road and thereby determining the volume to capacity ratio in each mid-block.
5. To determine the average journey time to cover the entire stretch and each stretch.
6. To find the level of service of the entire roadway

4. METHODOLOGY

1. Reconnaissance survey.
2. Classified traffic volume count was conducted in each mid-block: Traffic volume studies are conducted to determine the number, movements, and classifications of roadway vehicles at a given location. These data can help identify critical flow time periods, determine the influence of large vehicles or pedestrians on vehicular traffic flow, or document traffic volume trends.
3. Spot speed studies were conducted in all mid blocks: Spot speed studies were done at different times to identify the speed of vehicles in each midblock. The instrument used for spot speed study is RADAR gun which gives as instantaneous speed of each vehicle.
4. Speed and delay was done by floating car method: Speed and delay studies were conducted during peak hour and non-peak hour on each midblock by floating car method. Here the time required to cover the entire road stretch is noted down and also delay caused due to different factors in noted.
5. Road inventory survey: Road inventory survey is conducted on each mid block and the following are recorded Road way width, Shoulder width, and Median width, Distance of each mid-block, Footpath width and Car parking areas.

5. EVALUATION OF CAPACITY AND LEVEL OF SERVICE

5.1 Evaluation of Capacity

Table 5.2.1

NGV to SONY SIGNAL			
TIME	CAPACITY	CYCLE TIME	g/c
6:00 to 7:00	794	75	0.43
7:00 to 8:00	743	265	0.42
8:00 to 11:00	725	215	0.43
11:00 to 17:00	743	265	0.42
17:00 to 21:00	794	205	0.46
21:00 to 22:00	812	105	0.47

The above table shows capacity calculation based on signal timing. Capacity of the road changes when the effective green time changes. Similarly ir is calculated for all mid blocks

5.2Hourly Variation of Traffic

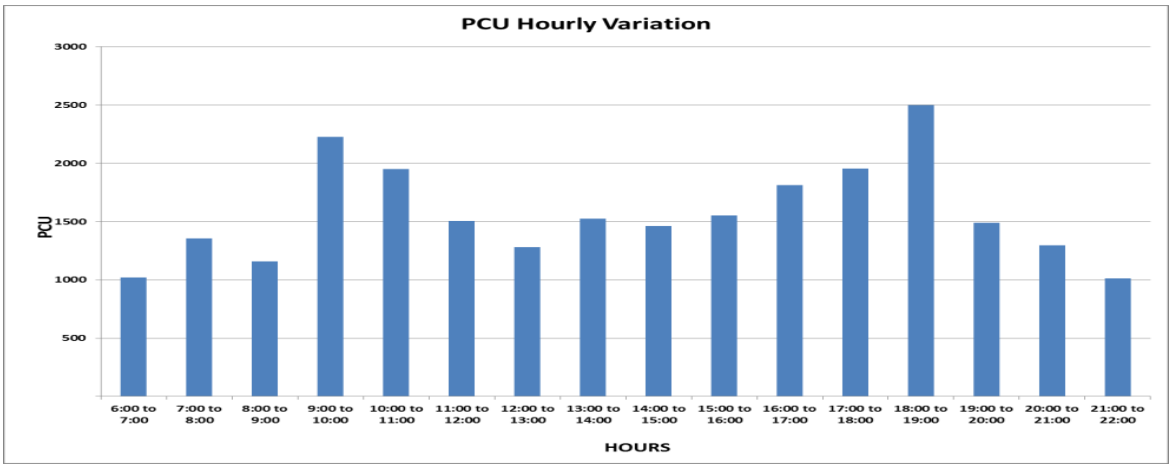

Figure 1: Hourly Variations

Hourly variation is required to find the peak hour traffic which helps in improvement measures of a midblock. Classified volume count of vehicles are performed on the field and PCU calculation is done according to IRC 106:1990

5.3 Speed and Delay Analysis

Table 1 Speed and Delay Analysis

From Forum To Sarjapur Road										
From 3.8 KM To 0 KM									No. of Trip: 1	
Date: 24/3/2014									Time: 8am	
Sl No.	Distance		Control Points	First Stop Watch Journey Time		Second Stop Watch Delay Time		Cause of Delay	No of Vehicles Overtaking the Test Vehicle	No of Vehicles Overtaken by the Test Vehicle
	KM	M		Min	Sec	Min	Sec			
1	0	0	Forum	0	0	0	0	Starting point	68	41
2	0	400	Jyothinivas college	0	42	0	14	Crossing		
3	0	900	Bethany High School	2	15	0	8	Crossing		
4	1	700	N.G.V	4	52	1	46	Signal		
5	2	200	Sony world	7	56	2	20	Signal		
6	2	700	Tanishq	11	53	1	32	Signal		
7	3	300	Wipro park	15	4	0	**22**	Signal		
8	3	800	Sarjapur Road	17	16			Stop point		
Summary										
Travel time	Delay Time		Running Time	Running Speed		Journey Speed		LOS		
Min	Min		Min	KMPH		KMPH				
17.266	6.366		10.9	20.917		13.02		F		

Speed and delay studies are conducted for finding the LOS based on IRC codes. Speed and delay are conducted during peak and non peak hours. It will help in finding the total time required for travel and for analysing each midblock

5.3. Spot Speed Analysis

Table 2: spot speed Analysis for all Study mid blocks

From Forum To Sarjapur Road						
From 3.8 KM To 0 KM						
PEAK HOUR SPOT SPEED						
MID BLOCK SECTION	METRES	2W	3W	4W	TRUCK/BUS	AVERAGE
Forum to Jyothi Nivas	400	38	35	42	33	37
Jyothi Nivas to Bethany	500	44	34	38	28	36
Bethany to NGV	800	42	37	37	33	37
NGV to Sony Signal	500	34	27	27	27	29
Sony Signal to Tanishq	500	34	36	32	31	33
Tanishq to Wipro Park	600	36	35	37	33	35
Wipro Park to Sarjapur	500	33	32	34	32	33

Spot speed studies are done to find vehicle speed cursing through individual midblock

5.5 V/C ratio

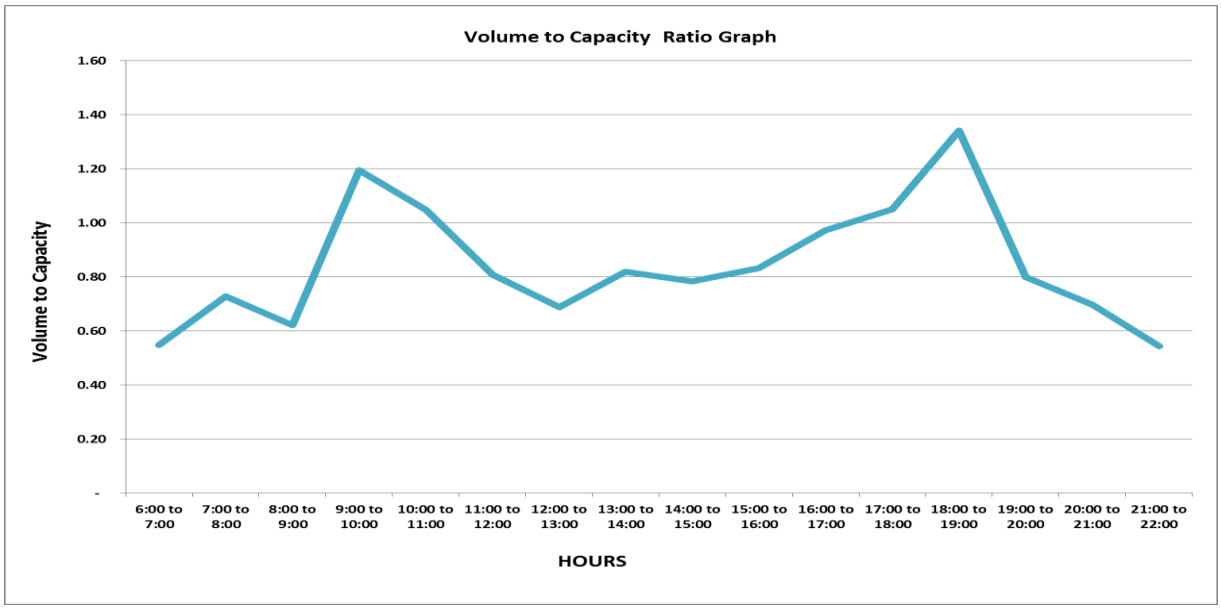

Fig. 2 Volume to Capacity Ratio

Volume to capacity ratio determines how congested the present road is. The above graph shows the variation in v/c ratio hourly. V/C ratio greater than one is considered as a congested road and LOS based on V/C ratio is given as F

5.4. Level of Service

Table 4: Level of service of each Midblock

From Forum To Sarjapur Road			
From 3.8 KM To 0 KM			
Date: 24/3/2014			
PEAK HOUR			
MID BLOCK SECTION	METRES	MIDBLOCK SPEED	LOS
Forum to Jyothi Nivas	400	25KMPH	C
Jyothi Nivas to Bethany	500	18KMPH	D
Bethany to NGV	800	21KMPH	C
NGV to Sony Signal	500	12KMPH	F
Sony Signal to Tanishq	500	6KMPH	F
Tanishq to Wipro Park	600	12.5KMPH	F
Wipro Park to Sarjapur	500	11.6KMPH	F

The above table shows level of service of individual midblock.

6. IMPROVEMENT MEASURES

1 Lane discipline: Lane discipline plays a major role in improving the roadway capacity. Because of poor lane discipline the road capacity will reduce. Usually in Bangalore city free left turn are usually hindered by other vehicles moving straight or right thereby causing congestion in the roadway. So thereby there should be a proper traffic rules to make drivers follow lane discipline thereby decreasing congestion and improving the traffic conditions.

2 Flyover constructions in Sony signal: The figure below shows the turning volume moment of Sony signal. Here the total turning volume in this intersection is 13294 PCU's during peak hour. Here if we construct a flyover in the direction Indiranagar to Koramangala BDA complex, the total turning volume in the intersection will be decreased to 7370 PCU's which is almost a 40 percent reduction.

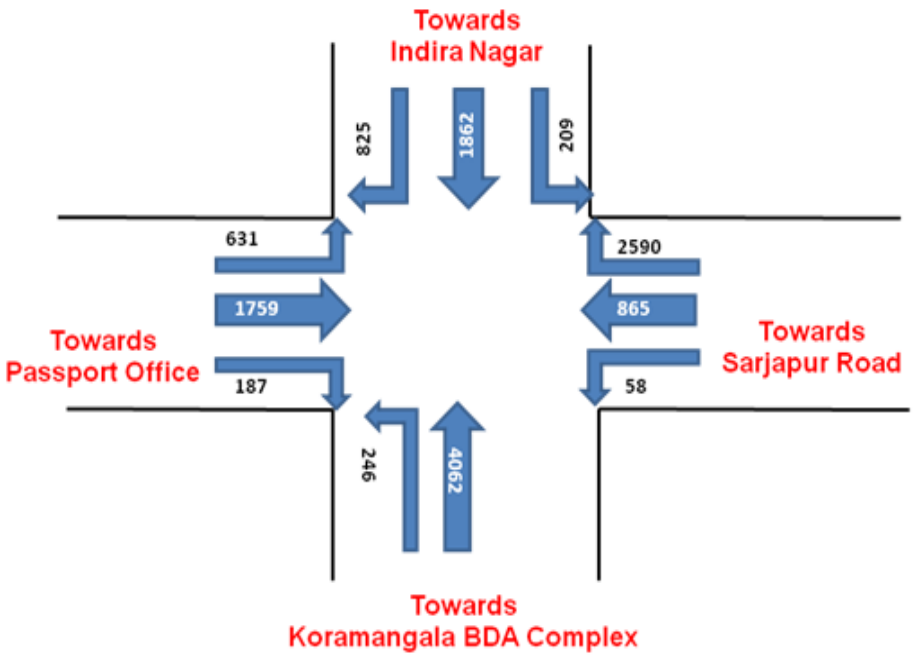

Fig. 3 Traffic volume at Sony world junction

3 Parking Improvement : The stretch considered for the study has parking issue on the entire stretch especially on the stretch starting from Wipro park junction to Sarjapur road. The above figure shows that the vehicles are parked on the road causing hindrance to traffic in this midblock thereby reducing the capacity of the midblock. The road inventory survey has found that the footpath and drainage area has a width of 6 meters. The figures shown below is drawn exactly to the same scale for identifying the provision for extra parking thereby increasing the capacity of the road and hence

reducing the traffic congestion in the area. The vehicles parked here are mainly the vehicles of employees who work in Wipro park in the area.

Fig. 4 Parking at mid block

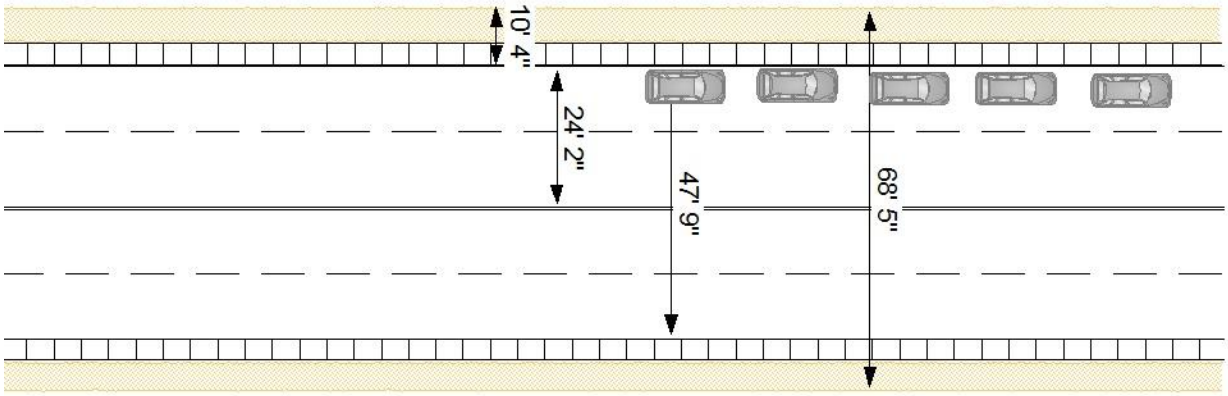

Fig. 5 Present parking condition in the area

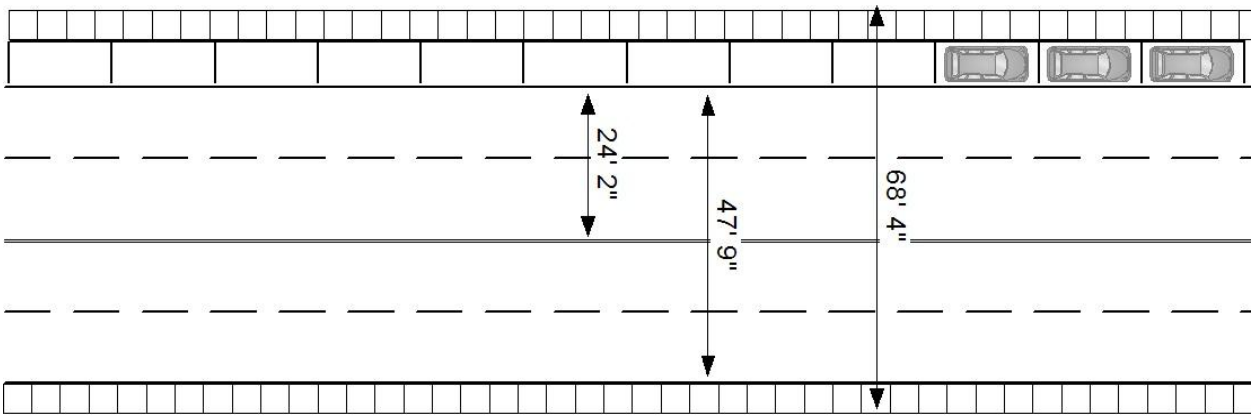

Fig. 6 Parking condition after improvement

The above figures show the parking before and after improvement in the area. A total of 64 car parking can be created by this.

7. CONCLUSIONS

The following conclusions were obtained from the present traffic conditions

1. Vehicle composition of the traffic shows that more than 50% of the vehicle composition consists of two wheelers and three wheelers.
2. The hourly variation of the traffic shows that most the midblock has peak hour traffic between 9AM to 11AM and 6PM to 8PM.
3. The volume to capacity ratio of each midblock exceeds 1 during the peak hour traffic.
4. The speed and delay studies shows that the average journey speed for the entire stretch is 12.83kmph from Forum to Sarjapur road and 13.95 kmph from Sarjapur road to Forum during the peak hours.
5. The average delay during the peak hours in the entire stretch is found out to be 6.75 min in the stretch from Forum to Sarjapur road and 5.76 min in the stretch from Sarjapur Road to Forum. The maximum delay occurs in stretch Sony Signal to NGV 2min 12sec and Sony Signal to Tanishq 2min 38sec.
6. The most congested traffic was found in the stretch starting from NGV- Sony Singal-Tanishq and The level of service of the entire stretch at peak and non peak hour was found to be F.
7.

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