

The Effect on Variation in Categories of Vehicles on Urban Arterial Road Capacity

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ABSTRACT: Highway traffic flow phenomena involve several complex and stochastic variables with high interdependencies. In this study the variations in roadway, traffic and environmental factors influence the traffic flow quality significantly. Capacity analysis of road sections under different traffic and geometric conditions need to quantify the vehicles of widely varying characteristics to a common and universally acceptable unit. The variations in roadway, traffic and environmental factors influence the traffic flow quality significantly. By the traffic volume study we can decide the priority for improvement and expansion, and we can do analysis of traffic patterns. This paper analyze the variation in categories of vehicles on outer ring road (Sarakki to Mysore road junction) of Bengaluru, Karnataka.

I. INTRODUCTION

India is a land of diversity in every aspect. Traffic in India is not an exception to this diverse behavior. The main function of an arterial road is to supply traffic from collector roads to arterial roads, and between urban centers at the highest level of service possible. India is urbanizing at rapid pace with urban population rising much faster than its total population. Level of urbanization has increased from 17.29% in 1951 to 31.6% in 2011. In this study the variations in roadway, traffic and environmental factors influence the traffic flow

quality significantly. Capacity is a central concept in design of roadway and traffic control facilities. Capacity analysis predicts the maximum hourly rate of traversal of vehicles or persons in a lane or road segment in uniform traffic, roadway under controlled conditions. The present study is about speed flow behavior under traffic, evaluate the capacity of road.

II. OBJECTIVES

- To study the effect of slow moving on mixed traffic flow on urban arterial roads.
- To study the conflicts between vehicles caused due to slow moving vehicles on arterial road.
- To evaluate the capacity based on speed flow behavior under mixed traffic.
- To study the impact of public transport vehicles on capacity.

III. METHODOLOGY

To determine the effect on variation in categories of vehicles on urban arterial road capacity based on objectives.

1. Site selection
2. Speed study
3. Volume study

1. SITE SELECTION



For this project we selected outer ring road (Sarakki to Mysore road junction) of Bengaluru, Karnataka. This arterial road is busy normally. For collecting volume and speed data we choose 3 locations (junctions):

1. Sarakkijunction
2. Devewogda petrol bunk
3. PesitUniversity

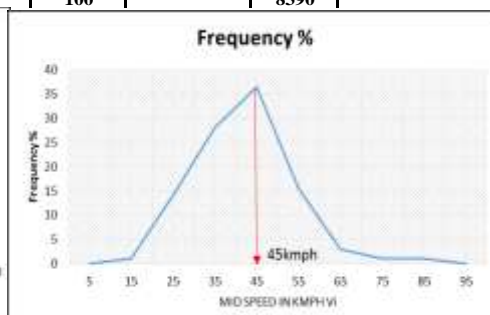
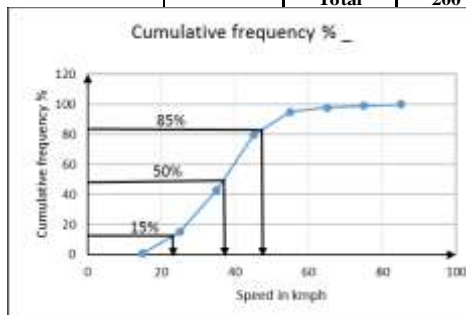
2. SPEED STUDY

- Spot speed study by Direct Timing or stop watch method
- Data collected for both carriage way of the arterial road selected.
- Distance taken for study is 30m.
- Data collection and presentation

Example:

Tabular column : No. of vehicles									
Speed in kmph	2W	2W	3W- Passenger	3W-Goods	4W	LCV- Small	LCV- Regular	Bus/Truck	TOTAL
0-10	-	-	-	-	-	-	-	-	-
10-20.	-	-	-	-	-	-	1	1	2
20-30	-	1	1	5	2	8	3	8	28
30-40	2	4	7	11	6	6	12	8	56
40-50	12	8	10	7	12	11	6	7	73
50-60	8	9	5	2	3	-	3	1	31
60-70	2	2	1	-	1	-	-	-	6
70-80	-	1	-	-	1	-	-	-	2
80-90	-	-	1	-	-	-	-	-	2

Tabular column : Frequency distribution					
Speed in kmph	Mid speed in kmph	Frequency fi	Frequency %	Cumulative frequency %	fi*Vi
0-10	5	-	-	-	-
10-20.	15	2	1	1	30
20-30	25	28	14	15	700
30-40	35	56	28	43	1960
40-50	45	73	36.5	79.5	3285
50-60	55	31	15.5	95	1705
60-70	65	6	3	98	390
70-80	75	2	1	99	150
80-90	85	2	1	100	170
90-100	95	-	-	-	-
Total		200	100		8390



Frequency Distribution Chart Modal Speed

1. Lower speed limit (15th percentile) = 25kmph
2. Average speed limit (50th percentile) = 37kmph
3. Upper speed limit (85th percentile) = 48kmph

4. Mean speed = 41.95kmph
5. Modal speed = 45kmph

Like this we collected data for all locations and also for individual types of vehicle.

Below table shows the abstract of speed study data

Carriage way- 1

JUNCTIONS	MODAL SPEED	LOWER SPEED LIMIT	AVERAGE SPEED LIMIT	UPPER SPEED LIMIT
SARAKKI	45	25	37	48
DEVEGOWDA PETROL BUNK	45	30	39	50
PESIT	45	32	43	54
VEHICLES	MODAL SPEED	LOWER SPEED LIMIT	AVERAGE SPEED LIMIT	UPPER SPEED LIMIT
2W(GEARED)	55	37	46	58
2W(UNGEARED)	55	37	45	55
3W(PASSENGER)	45	32	39	50
3W(GOODS)	35	27	34	43
4W(CARS)	45	34	44	51
LCV(SMALL)	45	25	37	47
LCV(BIG)	35	28	35	44
BUS/TRUCKS	45	24	34	41

Carriage way- 2

JUNCTIONS	MODAL SPEED	LOWER SPEED LIMIT	AVERAGE SPEED LIMIT	UPPER SPEED LIMIT
SARAKKI	35	25	35	48
DEVEGOWDA PETROL BUNK	45	31	41	51
PESIT	45	30	40	53
VEHICLES	MODAL SPEED	LOWER SPEED LIMIT	AVERAGE SPEED LIMIT	UPPER SPEED LIMIT
2W(GEARED)	55	37	50	62
2W(UNGEARED)	53	33	45	53
3W(PASSENGER)	45	33	40	49
3W(GOODS)	35	27	35	44
4W(CARS)	45	32	42	53
LCV(SMALL)	45	28	39	51
LCV(BIG)	35	26	33	42
BUS/TRUCKS	45	24	33	42

3. VOLUME STUDY

Volume data is collected manually. While collecting data we considered the type of vehicles, number of vehicles and direction of vehicles.

Counting of traffic volume by Short term (for one or two hours) at peak hours of morning and evening for 2 days at each locations. And collected data's are converted into PCU factor.

Example:

DATE:16/03/21								SESSION:MORNING	
LOCATION : SARAKI SIGNAL									
Types of vehicle	8:30-9:00	PCU	9:00-9:30	PCU	9:30-10	PCU	10:00-10:30	PCU	
2W	1033	774.75	1073	804.75	1928	1446	1523	1142.25	
3W(Passenger)	105	210	205	410	344	688	218	436	
3W(Goods)	8	8	9	9	17	17	7	7	
4W	193	193	212	212	337	337	289	289	
LCV	13	26	30	60	53	106	78	156	
Bus/Truck	8	29.6	4	14.8	14	51.8	9	33.3	
Slow moving	1	0.5	3	1.5	3	1.5	9	4.5	
TOTAL		1241.85		1512.05		2647.3		2068.05	

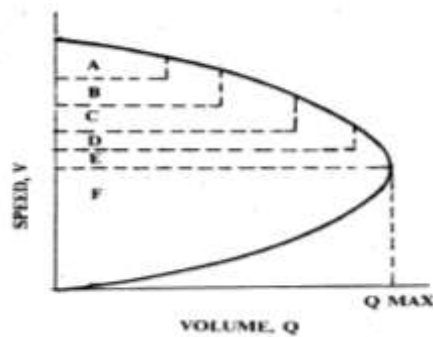
							SESSION: EVENING	
Types of vehicle	4:00-4:30	PCU	4:30-5:00	PCU	5:00-5:30	PCU	5:30-6:00	PCU
2W	420	315	629	471.75	884	663	1307	980.25
3W(Passenger)	117	234	140	280	187	374	183	366
3W(Goods)	2	2	13	13	24	24	12	12
4W	132	132	137	137	250	250	248	248
LCV	13	26	20	40	78	156	73	146
Bus/Truck	6	22.2	7	25.9	24	88.8	13	48.1
Slow moving	3	1.5	1	0.5		0	5	2.5
TOTAL		732.7		968.15		1555.8		1802.85

IV. DATA ANALYSIS

1. Speed study

Level of service (LOS)

As per, IRC 106-1990 below chart shows the various level of service in the form of indicative volume-flow relationship for urban condition



The average speed limit of all locations in

Carriage way- 1 is 39.66 kmph

Carriage way- 2 is 38.66 kmph

By analyzing the obtained speed data, the LOS of selected arterial road is **level of service E**.

2. Volume study

As per IRC 106, PCU factors for various types of vehicles on urban roads are converted

Carriage way-1

LOCATION	DATE	SESSION	8:30-9:30/4:00-5:00	9:00-10:00/4:30-5:30	9:30-10:30/5:00-6:00
SARAKI SIGNAL	16/03/21	MORNING	5489.15	5690.9	5429.8
		EVENING	3465	3292.1	3165.95
	17/03/21	MORNING	4698	4364	4188.3
		EVENING	3533	3528.5	3461.95
DEVEGOWDA PETROL BUNK	18/03/21	MORNING	4515.65	5314.65	5172
		EVENING	3413.8	3690.4	4164.5
	19/03/21	MORNING	4133	4276.4	4274.35
		EVENING	3387.5	3916.8	4276.55
PESIT	23/03/21	MORNING	4501.6	4854.2	5349
		EVENING	3102.4	3612.5	4367.7
	24/03/21	MORNING	4513.95	4918.65	5599.9
		EVENING	3388.2	3905.2	4569.4

Carriage way-2

LOCATION	DATE	SESSION	8:30-9:30/4:00-5:00	9:00-10:00/4:30-5:30	9:30-10:30/5:00-6:00
SARAKI SIGNAL	16/03/21	MORNING	2726.9	4159.35	4715.35
		EVENING	1700.85	2523.95	3358.65
	17/03/21	MORNING	4413.05	4365.65	3929.9
		EVENING	1547.3	2322.9	3317.2
DEVEGOWDA PETROL BUNK	18/03/21	MORNING	3301	4550.45	5082.7
		EVENING	3874.35	4182.7	4112.45
	19/03/21	MORNING	3108.5	3808.3	3934.7
		EVENING	3779.7	4157.4	4049.4
PESIT	23/03/21	MORNING	3334.35	3951.25	3864.55
		EVENING	3433.1	4032.6	3766.95
	24/03/21	MORNING	3651.6	4128.6	4708.95
		EVENING	3367.65	4088.4	3084.65

From the above tables we analyzed peak hour values

LOCATION		MORNING	EVENING
SARAKI SIGNAL 1	Peak hour	9:30-10:30	5:00-6:00
	Peak value	4715.35	3358.65
2	Peak hour	8:30-9:30	5:00-6:00
	Peak value	4413.05	3317.2
DEVEGOWDA PETROL BUNK 1	Peak hour	9:30-10:30	4:30-5:30
	Peak value	5082.7	4182.7
2	Peak hour	9:30-10:30	4:30-5:30
	Peak value	3934.7	4157.4
PESIT 1	Peak hour	9:00-10:00	4:30-5:30
	Peak value	3951.25	4032.6
2	Peak hour	9:30-10:30	4:30-5:30
	Peak value	4708.95	4088.4
LOCATION		MORNING	EVENING
SARAKI SIGNAL 1	Peak hour	9:00-10:00	4:00-5:00
	Peak value	5690.9	3465
2	Peak hour	8:30-9:30	4:00-5:00
	Peak value	4698	3533
DEVEGOWDA PETROL BUNK 1	Peak hour	9:00-10:00	5:00-6:00
	Peak value	5314.65	4164.5
2	Peak hour	9:00-10:00	5:00-6:00
	Peak value	4276.4	4276.55
PESIT 1	Peak hour	9:30-10:30	5:00-6:00
	Peak value	5349	4367.7
2	Peak hour	9:30-10:30	5:00-6:00
	Peak value	5599.9	4569.4

According to irc 106, the design service volume for selected arterial road is 3600 PCU's per hour. But, in the obtained data PCU is more than 3600PCU per hour.

3. Percentage of types of vehicle at peak hour

Carraige way-1

Location 1

Types of vehicle	9:30-10:30AM
2W	2588.25
3W(Passenger)	1124
3W(Goods)	24
4W	626
LCV	262
Bus/Truck	85.1
Slow moving	6

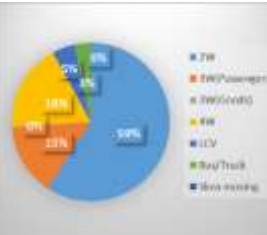


Types of vehicle	5:00-6:00PM
2W	1643.25
3W(Passenger)	740
3W(Goods)	36
4W	498
LCV	302
Bus/Truck	136.9
Slow moving	2.5



Location 2

Types of vehicle	9:30-10:30AM
2W	3007.5
3W(Passenger)	746
3W(Goods)	16
4W	907
LCV	234
Bus/Truck	170.2
Slow moving	2

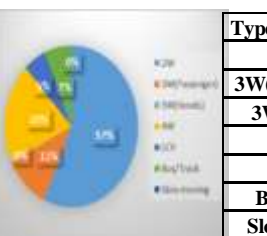


Types of vehicle	4:30-5:30PM
2W	2125.5
3W(Passenger)	696
3W(Goods)	25
4W	738
LCV	314
Bus/Truck	281.2
Slow moving	3



Location-3

Types of vehicle	9:00-10:00AM
2W	2243.25
3W(Passenger)	422
3W(Goods)	17
4W	792
LCV	218
Bus/Truck	259
Slow moving	0



Types of vehicle	4:30-5:30PM
2W	1876.5
3W(Passenger)	540
3W(Goods)	31
4W	882
LCV	450
Bus/Truck	251.6
Slow moving	1.5



Carriage way-2

Location-1

Types of vehicle	9:00-10:00AM
2W	3394.5
3W(Passenger)	1096
3W(Goods)	24
4W	858
LCV	180
Bus/Truck	136.9
Slow moving	1.5



Types of vehicle	4:00-5:00PM
2W	1593
3W(Passenger)	785
3W(Goods)	64
4W	600
LCV	178
Bus/Truck	240.5
Slow moving	4.5



Location-2

Types of vehicle	9:00-10:00AM
2W	3102.75
3W(Passenger)	882
3W(Goods)	16
4W	786
LCV	164
Bus/Truck	358.9
Slow moving	5



Types of vehicle	5:00-6:00PM
2W	1801.5
3W(Passenger)	822
3W(Goods)	28
4W	802
LCV	248
Bus/Truck	460.5
Slow moving	2.5



Location-3

Types of vehicle	9:30-10:30AM
2W	2760
3W(Passenger)	904
3W(Goods)	37
4W	872
LCV	274
Bus/Truck	499.5
Slow moving	2.5



Types of vehicle	5:00-6:00PM
2W	1782
3W(Passenger)	772
3W(Goods)	29
4W	1039
LCV	278
Bus/Truck	466.2
Slow moving	1.5



In this analysis compare to other types of vehicle, 2 wheelers (geared and ungeared) are greater in percentage. It almost acquires 50%.

V. RESULTS AND DISCUSSION

This survey does not represent actual data since 30-40% of traffic is reduced due to COVID-19. Even though traffic is high.

The average speed limit of that road i.e., carriage way- 1 is 39.66 kmph, carriage way- 2 is 38.66 kmph

According to IRC 106, the average speed limit of 40kmph represents level of service E.

Level of service E, this is a zone where the speed are reduced to a low. Operations at this level are usually unstable, because minor disturbances within the traffic stream will cause breakdowns.

Comfort and convenience are extremely poor and driver frustration is generally high.

According to IRC 106 the PCU per hour for 4 lane divided (two way) is 3600 PCU.

But in this road PCU per hour exceeding the design service volume at the desired level of service, the operating conditions will deteriorate and level of service goes down beyond E. So, capacities can be improved through application of traffic engineering techniques.

VI. CONCLUSIONS

From speed and volume studies it has been observed that the level of service gone down beyond E since high volume of traffic.

To improve free flow and avoid congestion:

1. Add multiple lanes like 6 lanes. But it is not possible because adjacent lands are commercialized and it is very expensive to expand.
2. Exclusive or dedicated bus lanes with better public transportation system. It will reduce the travelling time by 60%.

In exclusive or dedicated bus lanes, lanes are separate for buses only and restricted to private vehicles.

Bus stops at every 1 km for easy access for the public.

Availability of bus at every 10 minutes.

Encouraging the public to use public transportation and promote 2 wheelers and others to switch over public transportation by installing air conditioners, playing music and informational videos.

Use of public transport is an acknowledged way to reduce congestion and reduce pollution and it will be greater benefits to environment.

This project requires co-operation between BMTC, BBMP and traffic police for successful implementation.

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