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A STUDY OF VEHICULAR CONGESTION AND PLATOON DISPERSION BEHAVIOUR AT SELECTED LOCATION OF AHMEDABAD

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ABSTRACT - ***Traffic congestion is one of the major issues that most metropolises cities are facing. As the number of vehicles is increasing the problem of congestion is also increasing simultaneously. In the present study we have discussed about platoon dispersion. Platoon of road traffic can be defined as a set of vehicles or pedestrians travelling together as a group, either freely or compulsorily, because of signal control, road geometry or other factors. Once released from a signalised stop-line, vehicles normally proceed to the next intersection in bunches. While moving along a corridor, vehicle platoons disperses and therefore, the pattern of vehicle arrivals at a signal is different from the pattern of discharge from its upstream signal. Modelling of dispersion of vehicle platoon is an important consideration for coordinated operation of closely spaced traffic signals. This analysis is based on video photographic data collected at signalized intersection. The study of platoon dispersion is to a certain extent associated to driver manners and car following is one key component of driver behaviour. In this study, field investigation is made by means of videotapes which record traffic flows at several locations. After collection of video data extraction by any platoon dispersion software. This is used to accurate data collection from any intersections.***

Keywords: *Platoon, Platoon dispersion, Platoon ratio, Passenger car unit, Congestion*

I. INTRODUCTION

Traffic congestion is a condition on transport networks that occurs as use increases, and is characterized by slower speeds, longer trip times, and increases vehicular queuing. Traffic congestion wastes time, energy and causes pollution. There are broadly two factors, which effect the congestion; micro-level factors 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. The micro level factors are, for example, many people want to move at the same time, too many vehicles for limited road space. On the other side, macro level factors are e.g. land-use patterns, car ownership trends, regional economic dynamics, etc.

The traffic movement in India and in other developing countries is more complex due to heterogeneous characteristics of the traffic stream. Traffic consists of both motorized and non-motorized vehicles with lack of lane discipline. "Platoon of road traffic can be defined as a set of vehicles or pedestrians travelling together as a group, either freely or compulsorily, because of signal control, road geometry or other factors". In the Highway Capacity Manual (HCM), a vehicle platoon is defined as a group of vehicles travelling together.

Platoon dispersions the occurrence in which vehicular traffic free from, for example, an upstream signal, will get segregated, as they move over the distance towards the downstream signal. It is common, on urban roads, that the timing of successive traffic signals (when these are closely located) are planned in such a way that the main traffic stream gets the green when arriving at the downstream signal, thus, avoiding stopped delay for the stream of traffic. The study of platoon dispersion is to a certain extent associated to driver manners and car following is one key component of driver behaviour. In this study, field investigation is made by means of videotapes which record traffic flows at several locations.

The aim of this study is to investigate the nature of queue discharge headways, which may provide better information, and, reduce vehicle congestion at selected location of Ahmedabad.

The specific objectives of this research were to,

[1] To study the traffic flow characteristics at selected signalized intersections.

[2] To Approximation the passenger car equivalent unit values of different categories of vehicles at signalized intersections.

[3] To study the influence of platoon dispersion at signalized intersections and to compare with any platoon dispersion model.
[4] To find progression quality of platoon with help of platoon ratio.

II. LITERATURE REVIEW

This chapter assessments the literature concerning the work, which has been carried-out on the Platoon dispersion behaviour of vehicular traffic. Estimation of correct saturation flow rate for specific condition is very important for the calculation of capacity, delays and LOS at signalized intersections. Platoon dispersion models simulate the dispersion of traffic as they move from upstream to downstream. They estimate the downstream flow on the basis of the upstream vehicle departure profile and the average travel time in the link. Devangi hattimare used videographic method for data collection. They were selected pallav cross road, in shastry nagar Ahmedabad as study area. The passenger car units (PCUs) values was derived for different types of vehicles in the traffic stream by different approaches. They find the actual dispersion on that site, compare it with the dispersion given by Robertson's model and thus evaluate model for heterogeneous traffic condition.

Jijo Mathew was take a 1.3 km section of an urban arterial in Chennai for his study area. Digital video cameras were placed at three control points along the study section. The observations were carried out for five days in May 2013. The video data were collected for a period of two hours during the morning peak. The data collected was processed in order to extract the required data on the vehicle passing time at each control point. The vehicles were classified into four classes Two-wheelers (2W), Three-wheelers (3W), LMV and HMV. The extraction was carried out manually by recording a macro in Excel which gave the vehicle class along with the timestamp, as the vehicle passed the point. The timestamp had a least count of millisecond, thus giving more precision. The process was carried out for the 2 hour data from all the three control points. The main aim of that study was to find the actual dispersion in that site, compare it with the dispersion given by Robertson model and evaluate for heterogeneous condition.

Priya rai was worked on Saturation Flow Modelling and Level of Service Analysis of Signalized Intersections at Kolkata. That study proposes a new PCU values for different classes of vehicles for the heterogeneous traffic condition of Kolkata. The analysis is based on video photographic data collected at three selected intersections of the city. Firstly dynamic PCU values for each vehicle at the study approaches are obtained and then saturation flow for each survey approach is calculated using the average PCU values.

FENG WAN Analysis of platoon impacts on left-turn delay at signalized intersections. That research aims to develop a methodology for analyzing the platoon impacts on major-street left-turn (MSLT) delay at two-way stop-controlled (TWSC) intersections. The effects of platoons generated from the upstream signal intersection on MSLT delay are investigated in that research. VISSIM simulation was selected as the platform for research and field data was used to calibrate VISSIM simulation.

III. STUDY AREA

The study area identified was a 2.2 km section of a Sarkhej – Gandhinagar highway in Ahmedabad, from kargil petrol pump intersection to cambay circle intersection. The Sarkhej–Gandhinagar Highway colloquially the S.G. Road or S.G. Highway, connects the city of Ahmedabad with Gandhinagar, the capital of the state of Gujarat, India. It forms the major part of NH8C that connects Sarkhej with Chiloda near Gandhinagar. The length of Sarkhej–Gandhinagar Highway is 44.5 km (27.7 mi). It is a major artery road for commercial and public transport and is witnessing a major construction boom along its route towards Gandhinagar.

In this study area two intersection consider i.e. kargil petrol pump intersection and cambay intersection. The intersections are attractive to many traffic users and very high motorcycle volume. Both intersection traffic movement is more complex and heterogeneous. Traffic consists of both motorized and non motorized vehicles with lack of discipline. Both intersection having huge traffic on peak hour and it is one of the busy route of the Ahmedabad because that route also link the Ahmedabad and Gandhinagar. In study area, there are many approach ways are there which provides huge number of traffic and the public transportation and high number of traffic of two-wheeler. When the traffic is low, signalized control system is operated as pre-time control, otherwise police are controlled the traffic by themselves. Due to the great fluctuation in traffic flow, the signalized intersections based on the scope of work are selected in which,

I) Advantage location for conducting survey,
ii) Large motorcycle volume and
iii) Little interference from other factors such as pedestrians, left and right turning and bus stops, etc.

Fig: 2 Kargil petrol pump intersection to cambay intersection

Fig: 3 Kargil petrol pump intersection

IV. METHODOLOGY FLOW CHART

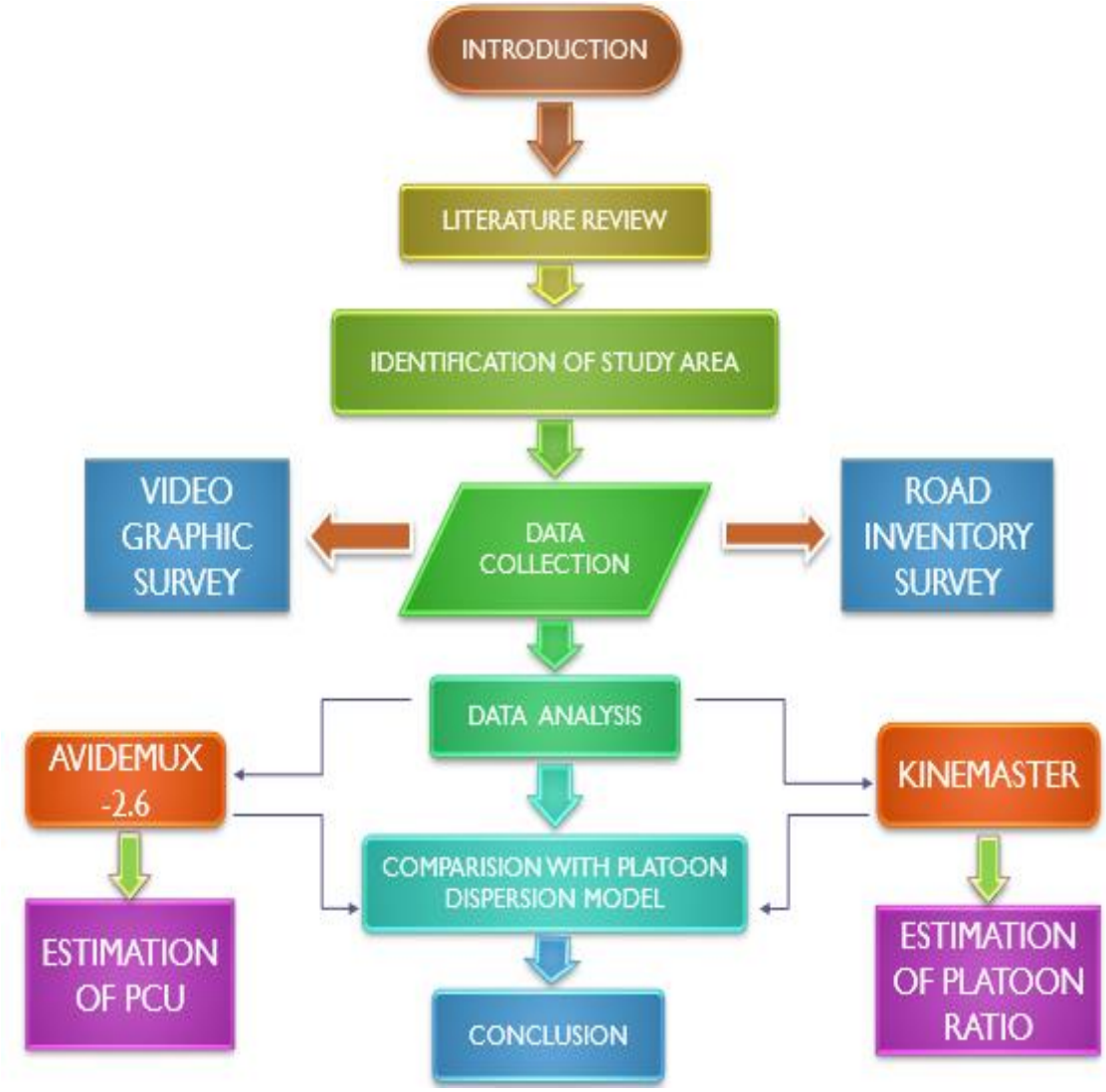

Fig: 4 Methodology flow chart

V. DATA COLLECTION

Data was collected on a typical weekday covering peak hours. During morning peak hours, substantial queue formation was observed due to which there was a considerable delay to traffic streams. This aspect was focused to get data on traffic operation at intersection over varying traffic conditions. Kargil petrol pump intersection to cambay intersection having huge traffic on peak hour and it is one of the busy route of the Ahmedabad because that route also link Ahmedabad and Gandhinagar. In study area, there are many approach ways are there which provides huge number of traffic and the public transportation and high number of traffic of two-wheeler. Data collection was carried out during peak periods from 9:30 am to 10:30 am on 15th February 2018 at satyamev - 2 complex opposite kargil petrol pump. The traffic flow at inner and middle lanes, which is mixed traffic of passenger car, bus, and motorcycle, is taken into consideration.

TABLE: 1 IDENTIFICATION OF SIGNALIZED INTERSECTION

SR NO	LOCATION	GPS COORDINATE	TIME OF VIDEOGRAPHIC SURVEY	DURATION
1	Kargil petrol pump intersection(satyamev-2 complex)	23.0769’ N 72.5248’ E	9:30 am to 10:30 am	1 hour (morning) 15th Feb 2018

Fig: 5 camera set up at satyamev – 2 complex

Fig: 6 footpath width measuring at study area

VI. DATA ANALYSIS

After collection of video graphic data extraction by Kinemaster and Avidemux – 2.6 software. For the present study, straight movement count was carried out manually by observing the recorded video and playing it repeatedly for various times. When vehicles move from upstream to downstream, disperse to some extent mostly due to the difference in the desired speed of different drivers in the platoon. This dispersion was captured by analysing the same platoons at

upstream and downstream points. After extraction of video graphic data around 48 platoons in morning are analyzed. From the video films, vehicle types and passing time are captured later by interpreting in the traffic.

For the traffic survey, the different types of vehicles in the traffic stream are classified into different groups as follows:

1. Motorcycles, scooters
2. Passenger cars, vans, Auto rickshaw
3. Buses (AMTS, BRTS, GSRTC)
4. LCV (Tempo, Tractor, Chota-hathi)
5. HCV (Truck, Water tanker)

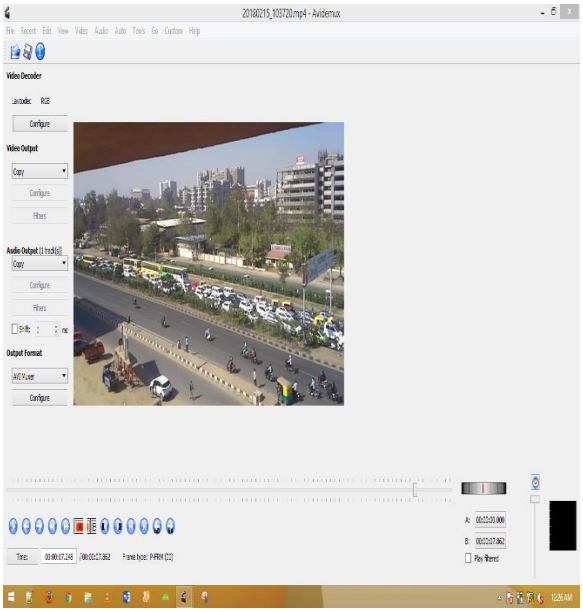

Fig: 7 screenshot of vehicle movement in Avidemux-2.6

Fig: 8 screenshot of vehicle movement in Kinemaster

CHART: 1 COMPOSITION OF VEHICLES

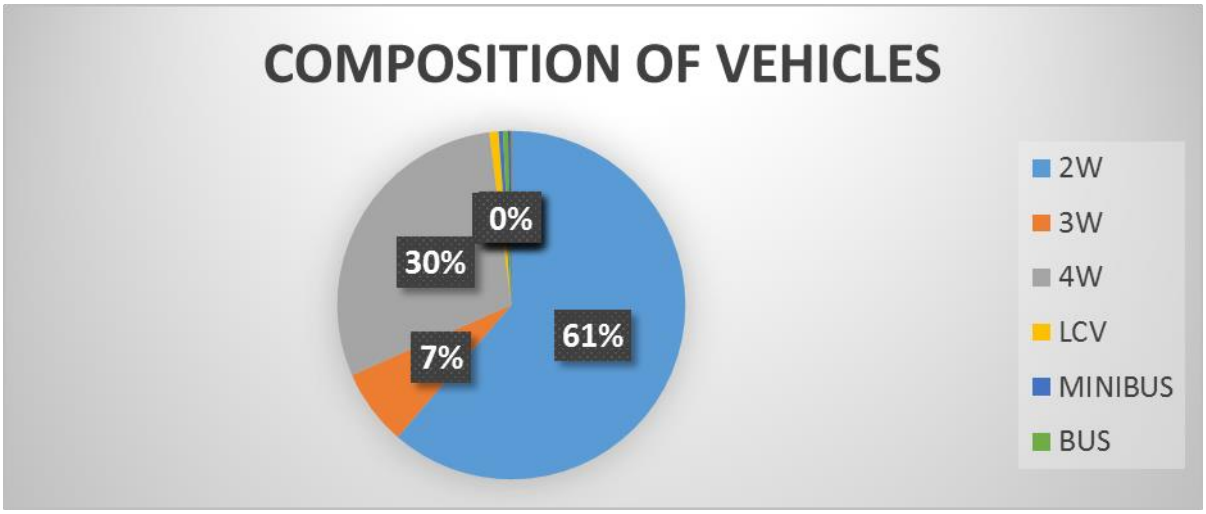

Table: 2 Vehicle compositions each category vice Analysis

PLATOON N0	PLATOON SIZE	2W	3W	4W(CAR)	LCV	MINI BUS	BUS	HCV	CYCLE
1	246	165	18	59	3	1	0	0	0
2	139	82	10	45	0	0	0	2	0
3	213	132	17	63	1	0	0	0	0
4	111	53	13	43	2	0	0	0	0
5	147	112	6	26	0	0	0	0	3
6	132	60	11	57	2	0	1	0	1
7	158	94	15	44	2	1	2	0	0
8	157	87	13	53	1	2	1	0	0
9	158	104	17	32	3	0	1	1	0
10	133	57	10	62	2	1	0	1	0
11	151	98	13	38	0	1	0	1	0
12	133	70	9	53	0	0	1	0	0
13	159	113	7	37	1	1	0	0	0
14	150	76	15	56	0	1	1	0	1
15	192	113	17	58	2	1	0	1	0
16	156	88	13	51	3	0	1	0	0
17	206	151	7	47	1	0	0	0	0
18	140	70	15	53	0	1	1	0	0
19	159	112	9	36	1	1	0	0	0
20	158	97	13	48	0	0	0	0	0
21	166	98	8	56	2	0	1	1	0
22	147	77	7	59	3	1	0	0	0
23	142	87	13	39	2	0	0	1	0
24	173	113	6	51	0	0	2	1	0
25	234	156	13	61	3	0	1	0	0
26	142	73	16	48	3	0	1	0	1
27	228	148	12	64	2	1	1	0	0
28	225	138	12	69	3	0	3	0	0
29	130	78	8	38	2	1	2	0	1
30	189	114	17	54	1	2	1	0	0
31	144	89	12	39	3	0	0	1	0
32	216	137	13	63	1	2	0	0	0
33	194	117	15	58	1	2	1	0	0
34	186	127	12	41	0	2	1	3	0
35	171	98	17	53	0	2	1	0	0
36	176	111	8	50	2	2	3	0	0
37	144	89	11	38	3	0	3	0	0
38	176	101	9	64	0	1	1	0	0
39	166	107	8	49	1	1	0	0	0
40	198	139	15	38	3	0	3	0	0
41	176	103	9	63	1	0	0	0	0

PLATOON N0	PLATOON SIZE	2W	3W	4W(CAR)	LCV	MINI BUS	BUS	HCV	CYCLE
42	141	89	11	39	0	1	1	0	0
43	185	127	8	48	1	1	0	0	0
44	147	94	13	38	0	2	0	0	0
45	154	81	9	60	2	0	1	1	0
46	153	101	11	37	3	1	0	0	0
47	167	98	17	49	2	0	0	1	0
48	180	111	13	53	0	0	2	1	0
TOTAL	8048	4935	571	2380	68	33	38	16	7
PCU FACTOR	-	0.5	1	1	1.5	3	3	4.5	0.5
PCU	**5809**	**2467.5**	**571**	**2380**	**102**	**99**	**114**	**72**	**3.5**
COMPOSITION OF VEHICLES	**100%**	**61.32 %**	**7.09 %**	**29.57%**	**0.84 %**	**0.41%**	**0.47 %**	**0.20 %**	**0.09%**

Field surveys were done in order to collect the following parameters:

Table: 3 ROAD INVENTORY DATA COLLECTION

COMPONENT	KARGIL PETROL PUMP	CAMBAY CIRCLE
Vehicle direction	Two way	Two way
Lane	Six lane	Six lane
Carriage way condition	Good	Good
Width of carriage way	9 m	9 m
Shoulder width	1.5 m	1.5 m
Median available	Yes	Yes
Median type	Raised	Raised
Width of median	3.50 m	3.50 m
Footpath condition	Good	Good
Footpath width	2 m	2 m
Type of intersection	Four leg intersection	Four leg intersection
Intersection	Signalized	Signalized
Service road	Available	Available
Width of service road	6 m	6 m
Zebra crossing	Available	Available

VII. PLATOON RATIO

The platoon ratio denoted as Rp, is a numerical value used to quantify the quality of progression on an approach. The platoon ratio represents the ratio of the number of vehicles arriving during the green phase to the proportion of the green interval of the total cycle. This is given by,

$$Rp = P*(C/g)$$

P = Proportion of vehicles arriving on green,

g/C = Proportion of green time available,

C = Cycle length

Its value ranges from 0.5 to 2.0. It is used in the calculation of delays, capacity of an approach. The arrival types range from 1 (worst platoon condition) to 6 (the best platoon condition). The platoon ratio approximates the arrival type and the progression quality. For example HCM (2000) has suggested the following relationship between platoon ratio and arrival which is as shown in Table

Table: 6 Platoon Ratio Calculations

TOTAL VEHICLES IN THE MORNING = 8048							
PLATOON NO	**PLATOON SIZE**	**P = PROPOSITION OF VEHICLES %**	**C=CYCLE TIME**	**G = GREEN TIME**	**Rp=P*(C/g)**	**RANGE OF PLATOON RATIO**	**PROGRESSION QUALITY**
1	246	5	160	100	8	> 2	Exceptional
2	139				8	> 2	Exceptional
3	213	4	160	100	6.4	> 2	Exceptional
4	111				6.4	> 2	Exceptional
5	147	4	120	100	4.8	> 2	Exceptional
6	132				4.8	> 2	Exceptional
7	158	4	135	90	6	> 2	Exceptional
8	157				6	> 2	Exceptional
9	158	4	205	115	7.1	> 2	Exceptional
10	133				7.1	> 2	Exceptional
11	151	4	205	115	7.1	> 2	Exceptional
12	133				7.1	> 2	Exceptional
13	159	4	210	120	7	> 2	Exceptional
14	150				7	> 2	Exceptional
15	192	5	185	120	7.7	> 2	Exceptional
16	156				7.7	> 2	Exceptional
17	206	5	185	100	9.25	> 2	Exceptional
18	140				9.25	> 2	Exceptional
19	159				9.25	> 2	Exceptional
20	158	6	155	70	13.28	> 2	Exceptional
21	166				13.28	> 2	Exceptional
22	147				13.28	> 2	Exceptional
23	142	4	175	105	6.66	> 2	Exceptional
24	173				6.66	> 2	Exceptional

PLATOON NO	PLATOON SIZE	P = PROPOSITION OF VEHICLES %	C=CYCLE TIME	G = GREEN TIME	Rp=P*(C/g)	RANGE OF PLATOON RATIO	PROGRESSION QUALITY
25	234	6	190	95	12	> 2	Exceptional
26	142				12	> 2	Exceptional
27	228				12	> 2	Exceptional
28	225	6	163	100	9.78	> 2	Exceptional
29	130				9.78	> 2	Exceptional
30	189				9.78	> 2	Exceptional
31	144	5	174	87	10	> 2	Exceptional
32	216				10	> 2	Exceptional
33	194	5	193	70	13.78	> 2	Exceptional
34	186				13.78	> 2	Exceptional
35	171	4	215	120	7.16	> 2	Exceptional
36	176				7.16	> 2	Exceptional
37	144	6	309	120	15.45	> 2	Exceptional
38	176				15.45	> 2	Exceptional
39	166				15.45	> 2	Exceptional
40	198	5	241	130	9.26	> 2	Exceptional
41	176				9.26	> 2	Exceptional
42	141	4	253	125	8.096	> 2	Exceptional
43	185				8.096	> 2	Exceptional
44	147	6	202	110	11.01	> 2	Exceptional
45	154				11.01	> 2	Exceptional
46	153				11.01	> 2	Exceptional
47	167	4	200	110	7.27	> 2	Exceptional
48	180				7.27	> 2	Exceptional

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