Effective Utilization of Road Space on the Selected Road Links of Ahmedabad City

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Abstract: Ahmedabad is metropolis rapid growing city of Gujarat, in many regions of Ahmedabad multi lanes road serves different purposes like vehicular traffic, pedestrians, bicycles, public transit system etc. But with uneven or non-uniform distribution of space for each activities. So, there will be a need to allocate most appropriate and sufficient space with proper utilization of road space.
In this research, the main aim of the study is effective utilization of road space throughout day without any undesirable congestion. Also suitable space allocation and designing to attain economy in capital cost as well as maintenance and operations cost of road user. This research affords to study the level of utilization of spaces allocated in urban roads of study area for different purposes and collect the information's regarding traffic volume count, speed-delay studies, pedestrian traffic survey, LOS of the existing condition. Traffic data collected on a section of a six-lane divided roadway (one-way movement only) are used to develop the speed-flow curve. It is observed that capacity is 1791 PCU/hour and 1924 PCU/hour for IIM mid-block and at Shivranjani mid-block observed capacity is 2194 PCU/hour and 2060 PCU/hour respectively. The observed capacity compared with capacity suggested by INDO-HCM 2017. At IIM mid-block the observed capacity is nearly 57.35% and 54.19% lower than the capacity suggested by INDO-HCM 2017. At Shivranjani mid-block the capacity suggested by INDO-HCM 2017 is nearly 2.28% and 5.67% higher than the observed capacity.

Key Words: **Utilization of Road Space, PCU, Capacity, LOS, Bicycle Lane, Sidewalk, Simulation.**

1. INTRODUCTION

Ahmedabad is rapid growing city, in many regions of Ahmedabad multi lanes road serves different purposes like vehicular traffic, pedestrians, bicycles, public transit system etc. Also Ahmedabad city content some of region where utilization of bicycle tracks, side walk, service lane, also some of the BRTS corridor are not utilized throughout the day this is because of lake of availability of bicycle sharing system and also due to not proper planning of BRTS system. So no utilization of such road spaces throughout day traffic congestion may occurred on main carriageways, so speed, delay, queue length of vehicle may increase day by day so flexible movement not possible in peak hours. So it is needed to study how to achieve proper utilization of road space for better use of road width without any congestion & flexible movement of vehicles.

1.1. Objectives of the study

1) To evaluate utilization of Capacity of road, cycle lanes, and sidewalks by Effective utilization of road space.
2) To study utilization pattern of allocated facilities of urban roads for a given study area for different purposes and analyse the data.

3) To Comparing Capacity of the existing situation with Indo HCM and propose advanced strategy for effective utilization of road space.
4) To Simulate existing and upgrade conditions of given road space.

2. LITERATURE STUDY

Pratik U. Mankar "Capacity Estimation of Urban roads under Mixed Traffic Condition", Here the problem of measuring flow may addressed by using Dynamic PCU values and the Capacity of urban roads is find out by green shield. They select road MSH-255 (Near IC Chowk, Nagpur) MSH-260 (Wardha Road, Nagpur) and 30m study patch is elected with consideration of no interaction. Capacity estimation was done for two roads and capacity of road is finding by speed-flow relationship. Also Capacity of road is determined by using microscopic simulation model (VISSIM) and Speed volume graphs are plotted from simulation. They observed that obtained results from Simulation software are similarly matched with traditional method, variation of theoretical volume with obtained simulated volume with plus minus 5%. The Traffic data for urban road and the dynamic PCU values are found by Dr.Satish Chandra methods used. Based on the parameters and data obtained for capacity estimation the following conclusions have been drawn. (1) The observed field capacity and simulated capacity is found to be ±5% (2) The further increase in road width the PCU values for traffic composition are increases as well as capacity of road increases.

Jinal Patel " Estimation of Level of Service through Congestion – A Case Study of Ahmedabad City " Here, 6 level of service has been defined with congestion levels of 20, 40, 60, 80, 100% distinguishing LOS (A-E) within the stable zone and LOS (F) with congestion more than 100%, indicating unstable flow. The capacity values for Gurukul to Manavmandir road (4 lane) and Income tax to Usman Pura road (6 lane) has been taken (4500 PCU/hr and 6500 PCU/hr) and then compared with IRC-1990 suggested capacity value (4200 PCU/hr and 6200 PCU/hr). Also they found out free flow speed in off peak hour (48 km/hour) for both the roads. Here they take the capacity of road C, free flow speed Sf ,operating volume pi, and traffic stream speed S, after that Coefficients a and mi of the congestion model has been calibrated after making logarithmic transformation of Eq. For Gurukul to Manavmandir they observed that the magnitude of all the coefficients, except those of cycle and 2W are found significance against a t value of 2.013. The R2 value found out to be 0.94 which is good. For Income tax to Usman Pura they observed that the magnitude of the coefficients of 2W, 3W and Bus are found to be significant against a t critical value of 1.94. The R2 value found out to be 0.89 which is fairly good then they conclude that with increase in a lane or increase in the carriageway width, there is a reduction in congestion by 30-50%.

Chetan R Patel "Capacity and LOS for urban arterial road in Indian mixed traffic condition" In this study the road model is the basis of the entire city traffic simulation system, playing an important role in binding on simulation of traffic flow, with the rapid development of the city, the original model has been insufficient for accurately describing the delicate and complex road system. This paper carefully analyzed the characteristics of road networks and the advantages of network simulation, and on the basis of the original road node-segment model analyzes the node and the new characteristics of roads, putting forward a new aggregation node model and description method of lane, which can exactly simulate the junction parameters and path form of the real world From the perspective of meeting the demand of urban road simulation, this article puts forward aggregation nodes and roadway to the basic elements of the road network description model. A macroscopic traffic analysis model is compared with the model adopted by the

network, with more accurate and detailed road network topological relations and road geometry, laying a theoretical foundation for urban traffic simulation and visualization.

Prashanth.M studies of calibrate and validate VISSIM driving behavior parameters for signalized and un-signalized intersections in Bangalore City and to fix whether the calibrated parameter of one particular intersection suits another intersection. The simulation results using default parameters conveyed only 15-20% similarity to the field condition, whereas the results obtained by sensitivity analysis matched nearly 70-80% of the field observed data. All the MOEs used for validation had a range of change of values was between 5–10% to that of field observed values.

Dr. Satish Chandra "Capacity Estimation Procedure For Two-Lane Roads Under Mixed Traffic Conditions" In this research they collected the data on more than 40 sections of two lane road in different part of country. They analyze the data on the parameters which are effecting capacity like gradient, lane width, shoulder width, traffic compositions, directional split, slow moving vehicle, pavement conditions. At the end of the study they gives systematic procedure to determine capacity of a two lane road under mixed traffic conditions.

$$Ca = Cb.fg.fw.fsnv.fs.fui$$

Where, Ca = actual capacity under prevailing roadway and traffic conditions

Cb = basic capacity PCU / Hr

Cb.fg.fw.fsnv.fs and fui are the adjustment factors for gradient, lane width, directional split, slow moving vehicles, shoulder conditions and unevenness.

3. METHODOLOGY

The detailed research methodology consists of the following tasks to reach the research objectives.

- First of all identify the problem
- Then after literature search for the prior study will be cheaked.
- Then after defining the objectives and scope of the study.
- Afterwards defining all the terms data is to be collected
- Here the Data has been categories in two part. first is geometric data for cad drawing and second one is Traffic data
- Geometric data includes inventory of site and data collection like width of carriage way, width of cycle lane, width of side-walk, and dividers widths.
- And for traffic data includes cvc, cyclist flow, pedestrian flow, spot speed of different composition of vehicle.
- After the data collection
- Compare the existing scenario with INDO-HCM then after recommend the new strategy.
- The recommended new strategy modeling in PTV VISSIM software then after compare the enhanced scenario with existing scenario.
- In last give result and conclusion.

4. DATA COLLECTION & ANALYSIS

The data collection period is a most essential task in this study work. Field information for the current investigation was gathered for chosen extends. The information gathered for the current examination are ordered volume check, various rates of vehicles, street stock information and so on The section was chosen enough away from junction or road to have consistent stream condition for field data collection. The videography was done on 22th February 2021 at IIM mid-block area and 24th February 2021 at Shivranjani mid-block segment to gather speed and volume information. A longitudinal part of 30-50 m length was made on the street (just in one heading of traffic movement) and video recording of the section was taken for 5-6.30 hours on a typical work day for morning and evening top hours. The video was subsequently replayed and information on characterized volume check was gathered. The spot speed information were likewise gathered and analyzed. Speed-stream relationship was created to assess the capacity of the chosen roadway stretches.

4.1 Primary data

Primary data includes

1. Road inventory Survey
2. Classified Volume Count
3. Spot Speed Survey
4. Cyclist Flow & Pedestrian Flow

4.1.1 Road inventory data for IIM road and Shivranjani road.

Table -1: IIM TO SHIVRANJANI (INVENTORY DATA)

Type of section	Width
Carriage way	9m
BRTS corridor	7m
Cycle lane	2.1m
Divider (Carriageway / cycle lane)	2m
Pedestrian Cross walk	2.88m

Table -2: Shivranjani to Nehru nagar & Nehrunagar to Shivranjani

Type of section	Width
Carriage way	10.75m
BRTS corridor	10.20m
Pedestrian Cross walk	3.4m

4.1.2 Classified volume count

Volume is a vital extent of traffic on a road network. Volume or flow is the amount of vehicles at a given point in the city during a picked time stretch. Since roads have a particular width and different ways, stream is continually imparted by the given width (for instance per lane or per two paths and so forth) Traffic volume checks are the markers of the need to improve the vehicle offices. It is overall used in arranging, plan and control, activity and the management analyses of the facility.

Table 3 CVC Sheet

22 FEB 2021 (IIM to Shivaranajani) 6:00 TO 8:00 PM												
SR. NO.	No of Vehicles					volume/5min	PCU / Hr	Vehicle Composition (% ge)				
	T/W	3 W	CAR	LCV	Bus &HCV			T/W	3 W	CAR	LCV	Bus &HCV
1	160	27	75	2	1	265	1683	60	10	28	1	0
2	171	23	87	3	0	284	1787	60	8	31	1	0
3	169	24	81	1	2	277	1775	61	9	29	0	1
4	165	21	86	1	0	273	1685	60	8	32	0	0
5	155	24	92	1	0	272	1761	57	9	34	0	0
6	161	21	76	2	1	261	1637	62	8	29	1	0
7	153	25	87	3	0	268	1761	57	9	32	1	0
8	163	22	84	1	1	271	1721	60	8	31	0	0
9	165	23	72	2	1	263	1619	63	9	27	1	0
10	148	23	91	2	1	265	1804	56	9	34	1	0
11	164	26	82	2	0	274	1711	60	9	30	1	0
12	153	28	85	1	1	268	1767	57	10	32	0	0
13	161	24	88	3	0	276	1784	58	9	32	1	0
14	167	23	84	3	0	277	1741	60	8	30	1	0
15	164	27	88	3	0	282	1821	58	10	31	1	0
16	158	24	91	1	0	274	1757	58	9	33	0	0
17	156	28	103	1	1	289	1991	54	10	36	0	0
18	149	25	98	1	1	274	1883	54	9	36	0	0
19	167	23	94	2	0	286	1833	58	8	33	1	0
20	162	21	89	1	1	274	1768	59	8	32	0	0
21	146	26	84	2	0	258	1690	57	10	33	1	0
22	161	22	81	1	1	266	1680	61	8	30	0	0
23	162	21	76	3	1	263	1667	62	8	29	1	0
24	147	18	71	2	1	239	1512	62	8	30	1	0

4.1.3 Non-Motorized Vehicle & Pedestrian Data Collection

In my study area at IIM road, separate bicycle lane and sidewalk facility were provided. IIM to Shivranjani, the width of the bicycle lane and sidewalk was 2.1 and 2.88 meter, Shivranjani to IIM the width of the bicycle lane and sidewalk was 2.1 and 2.3 meters respectively. The given table 29 and 30 below show the flow of bicyclists and pedestrians at a different time intervals.

In The second location of my study area Shivranjani road, where is only sidewalk facility is provided. The width of sidewalk is the same on both sides 3.4 meters. In below Table shown the flow count of bicyclists and pedestrians at a different time intervals.

Time	Bicycle flow	Pedestrian flow
Morning (7 AM to 7:45 AM)	22	11
Morning (10 AM to 12 AM)	21	18
Noon (2 PM to 3 PM)	5	13
Evening (6 PM to 8 PM)	16	19

Time	Bicycle flow	Pedestrian flow
Morning (10 AM to 12 AM)	13	227
Noon (2 PM to 3 PM)	7	119
Evening (6 PM to 8 PM)	15	219

4.2 Composition of Traffic

Following vehicle composition is observed from 5-6.5 hour survey for different selected road links. Traffic composition was presented in the form of pie chart. From the pie chart, it is clear that, major traffic is shared by two wheelers followed by car and three wheelers.

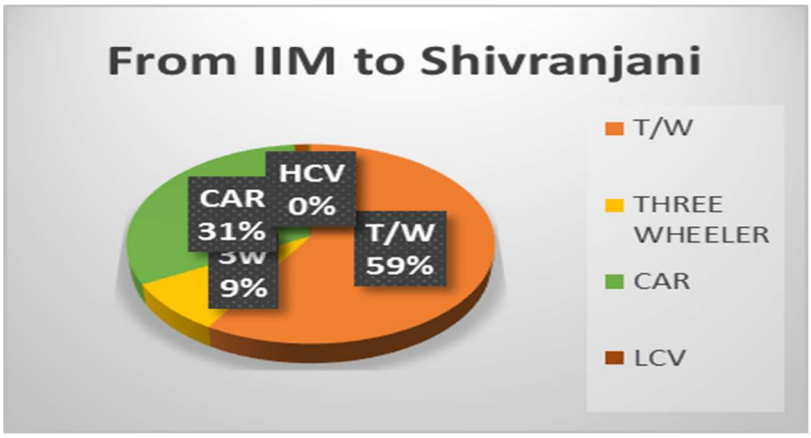

Figure 1 From IIM to Shivranjani

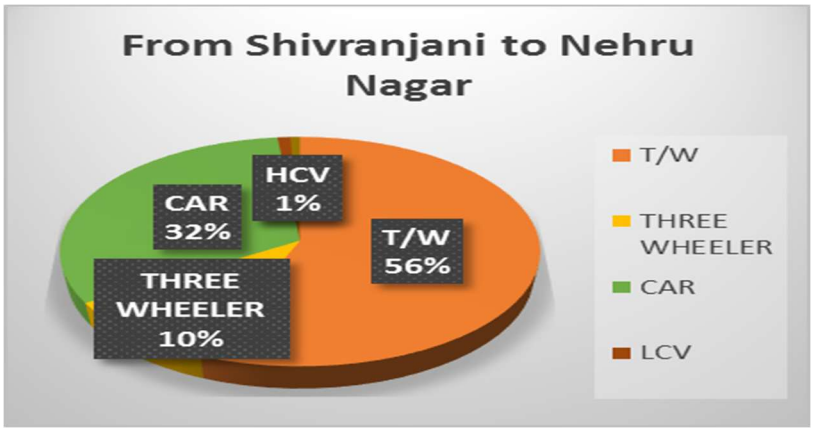

Figure 2 From Shivranjani to Nehru Nagar

4.3 Traffic Stream Speed

Speed is perhaps the most fundamental attributes of traffic stream and its estimation is additionally required in rush hour traffic studies. Speed is the rate of movement of traffic or of indicated segments of traffic and is communicated in kilo-meters per hour (kmph).

In Videography Method, the speed measured by stop watch technique and additional variable find by Videography. Two-point mark on the urban traffic road links on selected location the length of the road is taken 40-50 m as mid-block section of the road the video will be played the time taken by altered vehicles to cross that distance will be measured in seconds.

The data were collected on 22th and 26th February 2021 for morning and evening peak hours. From the well-known distance and the measured time intervals speeds were estimated from videography. For that 30 m, longitudinal section on IIM mid-block and 50 m section on Shivranjani mid-block section are created on the road links. From such data, the relation between cumulative frequency (%) and speed was established for all mid-block sections. It gives values of space mean speeds and various percentile speeds. Figure 3 to 4 are showing Cumulative speed distribution of spot speed for two wheelers, Light Commercial Vehicles (LCVs), three wheelers cars and Buses at selected road links.

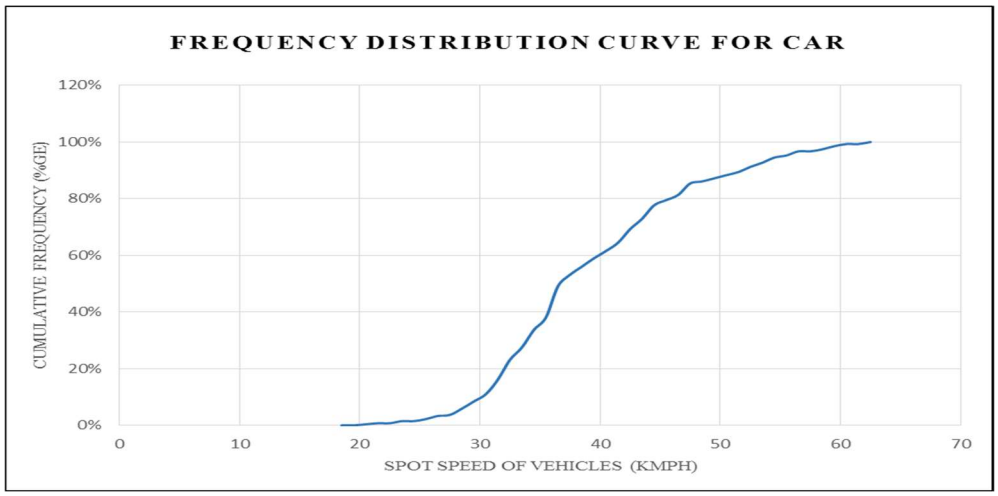

Figure 3 Frequency Distribution curve for car

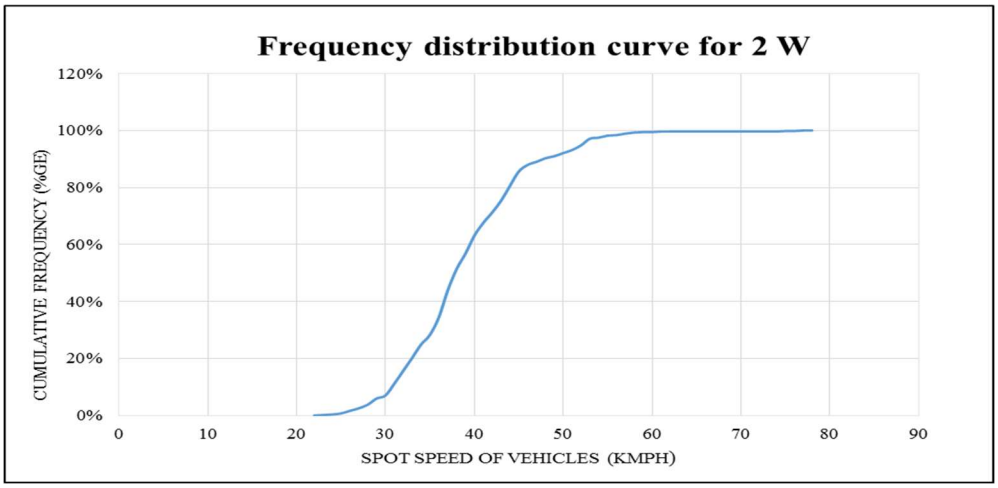

Figure 4 Frequency distribution curve foe 2 W

Table 1 Free Speed Statistics of different vehicles for IIM to Shivranjani mid-block section

Vehicle type	Sample size	Avg. Speed (Kmph)	Max. Speed (Kmph)	Min. Speed (Kmph)	Std. Dev. (Kmph)	Percentile speed (Kmph)		
						v50	v85	v90
Car	273	**40.25**	70.39	24.05	**8.36**	41.51	48.95	49.87
LCV	150	**36.08**	57.27	23.33	**5.73**	36.94	42.04	42.67
3W	390	**36.69**	55.26	21.36	**5.69**	37.54	42.61	43.24
Bus and HCV	90	**38.30**	53.85	21.72	**6.67**	39.30	45.23	45.97
2W	555	**41.02**	79.25	22.58	**2.50**	41.40	43.62	43.90

Table 2 Free Speed Statistics of different vehicles for Shivranjani to Nehru Nagar mid-block section

Vehicle Type	Sample size	Avg. Speed (Kmph)	Max. Speed (Kmph)	Min. Speed (Kmph)	Std. Dev. (Kmph)	Percentile speed (Kmph)		
						v50	v85	v90
Car	293	39.89	62.69	19.87	7.92	41.08	48.13	49.00
LCV	143	35.34	50.60	23.33	5.59	36.17	41.15	41.76
3W	372	36.43	51.43	19.38	5.83	37.30	42.49	43.13
Bus and HCV	93	37.89	53.62	26.81	6.14	38.81	44.28	44.96
2W	586	39.29	78.75	21.72	2.01	39.59	41.38	41.61

The spot speeds of vehicles were measured by spotting the time taken by the vehicles to pass through a longitudinal section of 40 m for the IIM mid-block section and 50 m for the Shivranjani mid-block section. The observed maximum, minimum and mean speeds of various types of vehicles and the corresponding standard deviations are shown in tables 2 and 3 for the selected study stretches. These tables also present various percentile speeds and standard deviation of speeds values for a different types of vehicles.

Speed-Flow Relationship

The speed-flow curve, which is significant graph of traffic stream, which is parabolic in nature. The parabola begins from the free speed, having low volume and as volume rises, the speed typically tumbles down. The most extreme stream saw at the section is considered as the capacity.

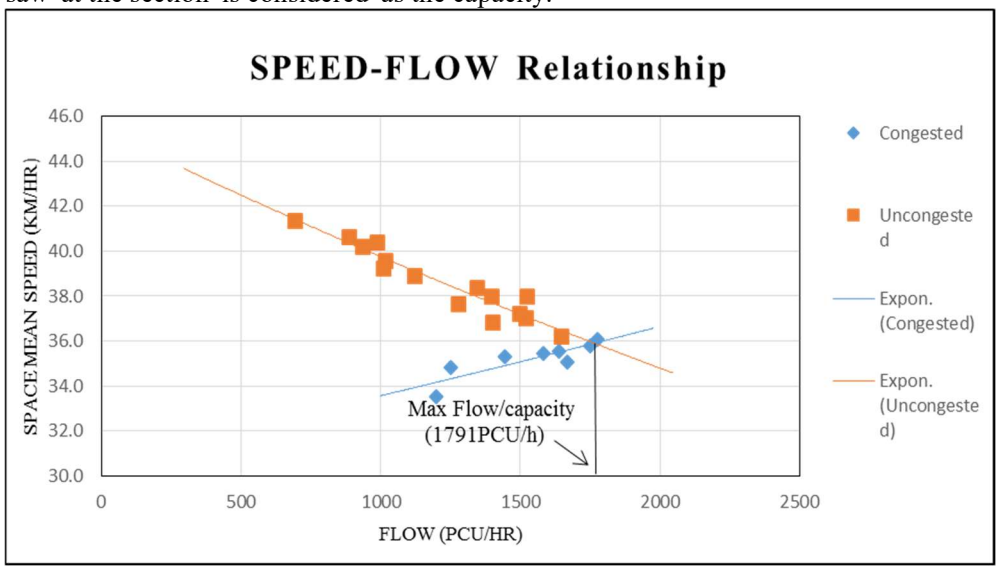

Figure 5 Speed-Flow Relationship for IIM to Shivranjani Road

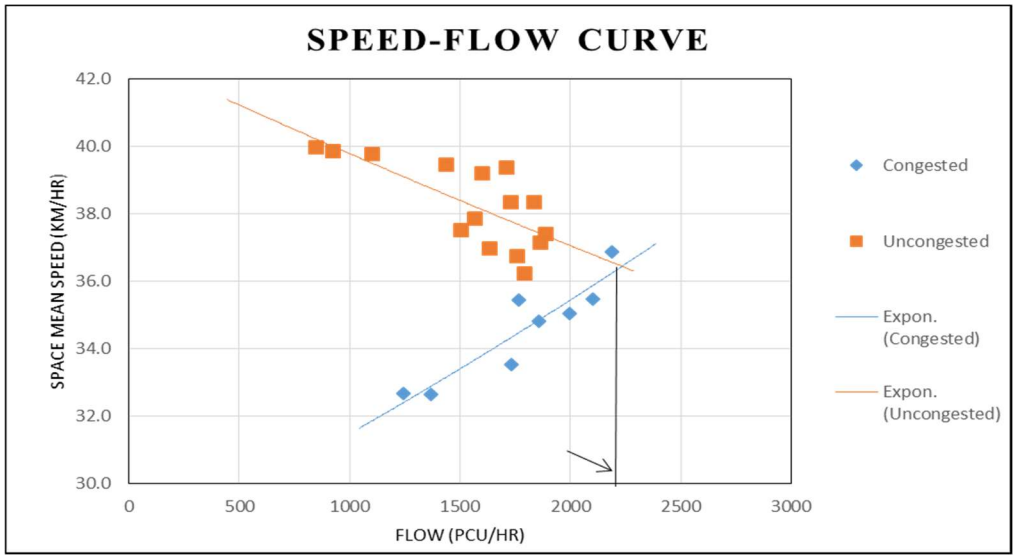

Figure 6 Speed-Flow Relationship for Shivranjani to Nehru Nagar Road

From the speed-flow graph, it was observed that maximum flow is 1791 PCU/hour and 1924 PCU/hour for IIM to Shivranjani and Shivranjani to IIM, and at Shivranjani to Nehru Nagar and Nehru Nagar to Shivranjani observed maximum flow was 2134 PCU/hour and 2060 PCU/hour respectively. The maximum traffic volume observed was considered as the capacity for the selected road links for the collected data.

4.4 Comparison between Observed Capacity and Capacity Suggested by INDO-HCM 2017

The capacity by INDO-HCM 2017 for a six-lane divided road is 8400 (4200) PCU/hour, here the values in brackets represent PCUs per hour per direction. IIM road and Shivranjani road is a six-lane divided road, so we considered six-lane divided road capacity. In IIM road no adjustment factor considered because there is no side friction at this road link. In our second study area Shivranjani road on basis of data collection, there were two adjustment factors, so we considered (i) Adjustment Factor for On-street Parking (Fop) (ii) Adjustment Factor For impedance to traffic flow at BUS Stops (FBS). After the considered of adjustment factor the value of basic capacity at IIM road and Shivranjani road were 4200 PCU/hour and 2184 PCU/hour respectively.

Table 3 Comparison of observed capacity and capacity suggested by INDO-HCM 2017 at IIM Road

Sr.No	Study Area	Observed capacity	INDO-HCM Capacity	% difference
1	From IIM to Shivranjani	1791 PCU/hour	4200 PCU/hour	**57.35 %**

2	From Shivranjani to IIM	1924 PCU/hour	4200 PCU/hour	**54.19 %**

Table 4 Comparison of observed capacity and capacity suggested by INDO-HCM 2017 at Shivranjani Road

Sr.No	Study Area	Observed capacity	INDO-HCM Capacity	% difference
1	From Shivranjani to Nehru nagar	2134 PCU/hour	2184 PCU/hour	**2.28 %**
2	From Nehru nagar to Shivranjani	2060 PCU/hour	2184 PCU/hour	**5.67 %**

4.5 Level of Service

By and large, the term 'capacity' and 'LOS' will have a cozy relationship. Capacity states to the quantitative proportion of street unit and LOS portrays the qualitative measure of the road section (Bhuyan and Rao 2010, 2011, Patel and Joshi, (2012). For a given road facility, limit can be steady while real stream will be a fluctuating parameter relying upon the time. The objective of LOS is to related to the traffic service quality to a given traffic flow rate. It is a term that depicts range of operating conditions on a actual type of facility.

Table 5 LOS for IIM Road

approach	Time	(V)	(C)	V / C	LOS
From IIM to Shivranjani	Morning (7 AM to 7:45 AM)	**694.4**	**8400 (4200)**	0.17	**B**
	Morning peak hour (10 AM to 12 AM)	**1781.65**		0.42	**B**
	Noon (2 PM to 3 PM)	**1030.72**		0.25	**B**
	Evening peak hour (6 PM to 8 PM)	**1730.37**		0.41	**B**
From Shivranjani to IIM	Morning (7 AM to 7:45 AM)	**888.94**		0.21	**B**
	Morning peak hour (10 AM to 12 AM)	**1873.05**		0.45	**B**
	Noon (2 PM to 3 PM)	**1039.79**		0.25	**B**

	Evening peak hour (6 PM to 8 PM)	**1847.57**		0.44	**B**

Table 6 L0S for Shivranajani road

approach	Time	(V)	(C)	V / C	LOS
From Shivranjani to Nehru nagar	Morning (7 AM to 7:45 AM)	**1056.85**	**4368 (2184)**	0.91	**E**
	Morning peak hour (10 AM to 12 AM)	**2008.51**		0.48	**C**
	Evening peak hour (6 PM to 8 PM)	**2056.40**		0.94	**E**
From Nehru nagar to Shivranjani	Morning (7 AM to 7:45 AM)	**2025.63**		0.92	**E**
	Morning peak hour (10 AM to 12 AM)	**989.52**		0.45	**B**
	Evening peak hour (6 PM to 8 PM)	**2080.80**		0.95	**E**

4.5.1 Level of Service for pedestrian and bicycle lane

In our study area IIM road was a institutional area, so for LOS criteria we considered institutional PLOS for IIM road. Our second study area Shivranjani road was a commercial area so for that we considered commercial PLOS criteria for them. Both commercial and institutional PLOS criteria was taken from INDO-HCM 2017.

Table 7 LOS for pedestrian flow

approach	Time	flow	LOS
From IIM to Shivranjani	Morning peak hour (10 AM to 12 AM)	18	A
	Noon (2 PM to 3 PM)	13	A
	Evening peak hour (6 PM to 8 PM)	19	A
From Shivranjani to Nehru nagar	Morning peak hour (10 AM to 12 AM)	235	A
	Noon (2 PM to 3 PM)	127	A
	Evening peak hour (6 PM to 8 PM)	213	A

So as per the LOS table for IIM and Shivranjani road, both stretches of sidewalks were underutilized.

The capacity of a bicycle lane relies upon the quantity of viable lanes utilized by bikes. A standard width of a powerful bicycle path referenced in HCM is roughly 1.2 m. The American Association of State Highway and Transportation Officials suggests off road bike ways of 3 m wide. In HCM 2010, for select bicycle facilities operating under uninterrupted flow conditions the capacity seen is 1600 bikes/h/ln for two way bicycle offices and 3200 bikes/h/ln for one way offices. The Highway Capacity Manual 2010 suggests that a saturation flow rate of 2000 bikes/h/ln for a one direction bicycle lane.

Compared the bicycle hourly flow for the different time intervals with suggested capacity by IRC 86-2018. It is clearly shown that the difference between the bicycle hourly flow and suggested capacity by IRC 86-2018 was huge. So the study location at IIM road with a separate bicycle lane facility was underutilized.

5. DATA ANALYSIS USING VISSIM

Simulation is used when some scientific strategies or conditions can't be described by utilizing numerical conditions. Traffic simulation programming have become mainstream as a traffic investigation gadget now-a-days. The geometric features and street complexity of the street organization can be considered in detail by rebuilding. It is hard to amount the information physically on location, so with the utilization of VISSIM, the genuine situation can be set up and it likewise notices the conduct of vehicles during simulation run.

Table 8 Actual and Simulated Capacity Comparison

Approaches	Actual		Simulated		%Difference
	V/hr	V/600	V/600	V/hr	
From IIM to Shivranjani	3282.00	547.00	567.00	3402.00	-3.66
From Shivranjani to Nehru Nagar	3567.00	594.00	432.00	2592.00	27.27

It was shown in table 38 that the actual capacity is lower than the simulated capacity at IIIM mid-block. The actual capacity for the IIM mid-block section was 3282 vehicle/hour and the simulated capacity was 3402 vehicle/hour, which was 3.66% lower than the simulated capacity. At the Shivranjani mid-block section, the actual capacity was higher than the simulated capacity. The simulated capacity was lower at the Shivranjani road section because in the simulation we considered on-street parking. The actual capacity for the Shivranjani mid-block section was 3567 vehicle/hour and the simulated capacity was 2592 vehicle/hour, which was 27.27% higher than the simulated capacity.

6. Parking Studies

In my study area Shivranjani road on-street parking was major problem, many road user or visitors parked their vehicle alongside the road in no parking zone. Vehicle parked alongside the road causes congestion on main stretch, also they reduce the capacity of road. Data collection was carried out on 26 February at 10 am to 11 am. In-out survey was carried out data collection.

From an in-out survey conducted for a parking area consisting of 24 bays at Shivranjani to Nehru Nagar and 28 bays at Nehru Nagar to Shivranjani, the initial count was found to be 21 at Shivranjani to Nehru Nagar side and 24 at Nehru Nagar to Shivranjani side. Table 10 gives the result of the survey.

Table 9 Parking Study (In-out survey)

Shivranjani to Nehru Nagar (10 am to 11 am)					
Time	In	Out	Accumulation	Occupancy	Parking Load
5	3	2	22	87.50	110
10	2	3	21	87.50	105
15	5	2	24	100.00	120
20	6	1	29	120.83	145
25	3	4	28	116.67	140
30	2	3	27	112.50	135
35	4	1	30	125.00	150
40	4	3	31	129.17	155
45	2	1	32	133.33	160
50	3	1	34	141.67	170
55	4	2	36	150.00	180
60	4	2	38	158.33	190
Total					1760
Veh hour					29.33

Majority users are parked their vehicles in No Parking zones due to in sufficient parking space available.

From Parking study data were summaries that 28.6% road users and visitors have to pay for parking around 28 Rs. It was depended on how long you parked your vehicle in the parking zone.

28.1% road users parked there vehicle more than 5 hours in a day and 42.2% road users may parked there vehicle less than 1 hour which is may be on side or at curb side (In No parking zone) parking.

More than 95% road users accepted that parking rating at Shivranjani side is poor and they suggested to shift parking towards IIM side. We recommend on street parking at IIM side is free of cost on the basis of public opinion and they will travel through their destination by e-bike or by walking.

7. RESULT AND CONCLUSIONS

The observed capacity for the IIM mid-block section was less than the capacity suggested by INDO-HCM 2017, which derived from the capacity and LOS comparison with INDO-HCM 2017 which simply means IIM road is underutilized.

Also, there is no utilization of bicycle lane as well as sidewalk, which I found from the compared bicycle flow per hour with capacity suggested by IRC 86-2018 and for pedestrian sidewalk compared with PLOS suggested by INDO-HCM 2017.

The Shivranjani mid-block section, the observed capacity was quite similar to the capacity suggested by INDO-HCM 2017.The following conclusions are drawn from this study.

1. From comparing capacity and LOS criteria with INDO-HCM 2017 IIM road is underutilized as compared to Shivranjani road.

2. At IIM mid-block both sides separate bicycle lane and sidewalk provided. For bicycle lane, their existing flow compared with the capacity suggested by IRC 86-2018 and the difference between their existing and capacity suggested by IRC 86-2018 is 96%, so as per the percentage difference the bicycle lane is in underutilization.
3. PLOS criteria from INDO-HCM 2017, the IIM side sidewalk and Shivranjani side sidewalk has LOS A. both stretches of sidewalk lanes have very less flow of pedestrians so this lanes are underutilized.

Table 10 Comparison between new strategy with existing condition

Approaches	Condition	Actual		Simulated		%Difference
		V/hr	V/600	V/600	V/hr	
From IIM to Shivranjani	With Parking	-	-	459.0	2754.0	19.04
	Without Parking	3282.0	547.0	567.0	3402.0	
From Shivranjani to Nehru Nagar	With Parking	3567.0	594.0	432.0	2592.0	31.9
	Without Parking	-	-	635.0	3810.0	

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