

# Determination of Dynamic PCU in Ahmedabad city

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## Abstract

Due to rapid growth in population and vehicle ownership, there is tremendous traffic congestion on signalized intersections of urban corridors. If signalized intersections coming frequently on the corridor without coordination, then the vehicular delay is enormous during peak hours. Signal cycle timings are generally depending on arrival rate and saturation flow rates of approaches. For the mixed traffic conditions, vehicles are converted into Passenger Car unit (PCU) to estimate the flow values. PCU values of different types of vehicles are varying with composition of vehicles, time, situation, location and their interaction. Static PCU values suggested by Indian Roads Congress (IRC) for the signalized intersection is generally overestimate the saturation flow rate. Dynamic PCU value for mid-block section in the Indian traffic scenario has been found by the several researchers, but very few researchers have attempted to find the dynamic PCU on the signalized intersections. Dynamic PCU can be co-related with projected area of car and vehicle category as well as with departure flow rate (saturation flow rate), speed, headway, travel-time etc. The actual travel-time to cross the signalized intersection includes most of the factors like acceleration, deceleration, manoeuvrability etc.

## I. INTRODUCTION

In Indian road traffic, the heterogeneity is of high degree with vehicles of widely varying static and dynamic characteristics. Under this condition, it becomes difficult to make the vehicles to follow traffic lanes. Consequently, the vehicles tend to choose any advantageous lateral position on the road based on space availability. Under the said traffic conditions expressing traffic volume as number of vehicles passing a given section of road per unit time will be inappropriate and some other suitable base needs to be adopted for the purpose. The problem of measuring volume of such heterogeneous traffic has been addressed by converting the different types of vehicles into equivalent passenger cars and expressing the volume in terms of Passenger Car Unit (PCU) per hour. The PCU is the universally adopted unit of measurement of traffic volume, derived by taking the passenger car as the 'standard vehicle'. The interaction between moving vehicles in a traffic stream is highly complex and is influenced by a number of roadway and traffic factors. The accurate estimation of the magnitude of vehicular interaction for different roadway and traffic condition is the prerequisite for better operation and management of roadway facilities in their prevailing conditions. This paper focuses on the determination of dynamic PCU values for different category of vehicles at signalized intersections under mixed traffic conditions by adopting directly proportional to the ratio of travel time of vehicle, and inversely proportional to the space occupancy ratio of vehicle with respect to the standard area of vehicle, i.e. a car.

## II. AIM OF STUDY

The main aim of study is to determine the dynamic PCU value at signalized intersection.

## III. OBJECTIVE

The objective of work are,

- To determine dynamic PCU values for varying traffic composition at signalized intersections in the city,
- To compare static PCU value to dynamic PCU value.

## IV. SCOPE OF STUDY

- The relationship between the dynamic and static PCU value can be utilized for the same situation at other sites.
- The scope of study is limited for Four legged signalized intersection.

## V. METHODOLOGY

The Data is collected with the help of videography at decided intersection during peak hours which helps to determine the difference between static PCU value and dynamic PCU value,

**5.1 Field Videography**

Video Camera is used to collect the data. The video camera takes continuous picture of the traffic and pictures are recorded on the videotape.

The Video recording has number of advantage as under,

- Require of small amount of labour.
- It produce permanent record.
- Record can be reanalyzed at any time.

**5.2 Methods for Dynamic PCU at Signalized Intersection**

In these research work the method to estimate the dynamic PCU value is directly proportional to the travel time and inversely proportional to space occupancy ratio of vehicle with respect to area of car.

$$Dy.PCU = \frac{T.T_i}{T.T_c} \times \frac{A_i}{A_c}$$

Where,

PCU = passenger car unit value of ith type vehicle

T.T.i = travel time of ith category of vehicle (sec)

T.T.c = travel time of car (sec)

Ac = static area of a car (m2)

Ai = static area of ith category of vehicle (m2)

From the above equation of the dynamic PCU value, if the area of the ith category of vehicle and travel time of the ith category of vehicle is increased, then the value of the dynamic PCU also increases. The travel-time of each category of vehicle is different in particular cycle, thus average travel time is considered. The area of each category of vehicle is same for the all cycle.

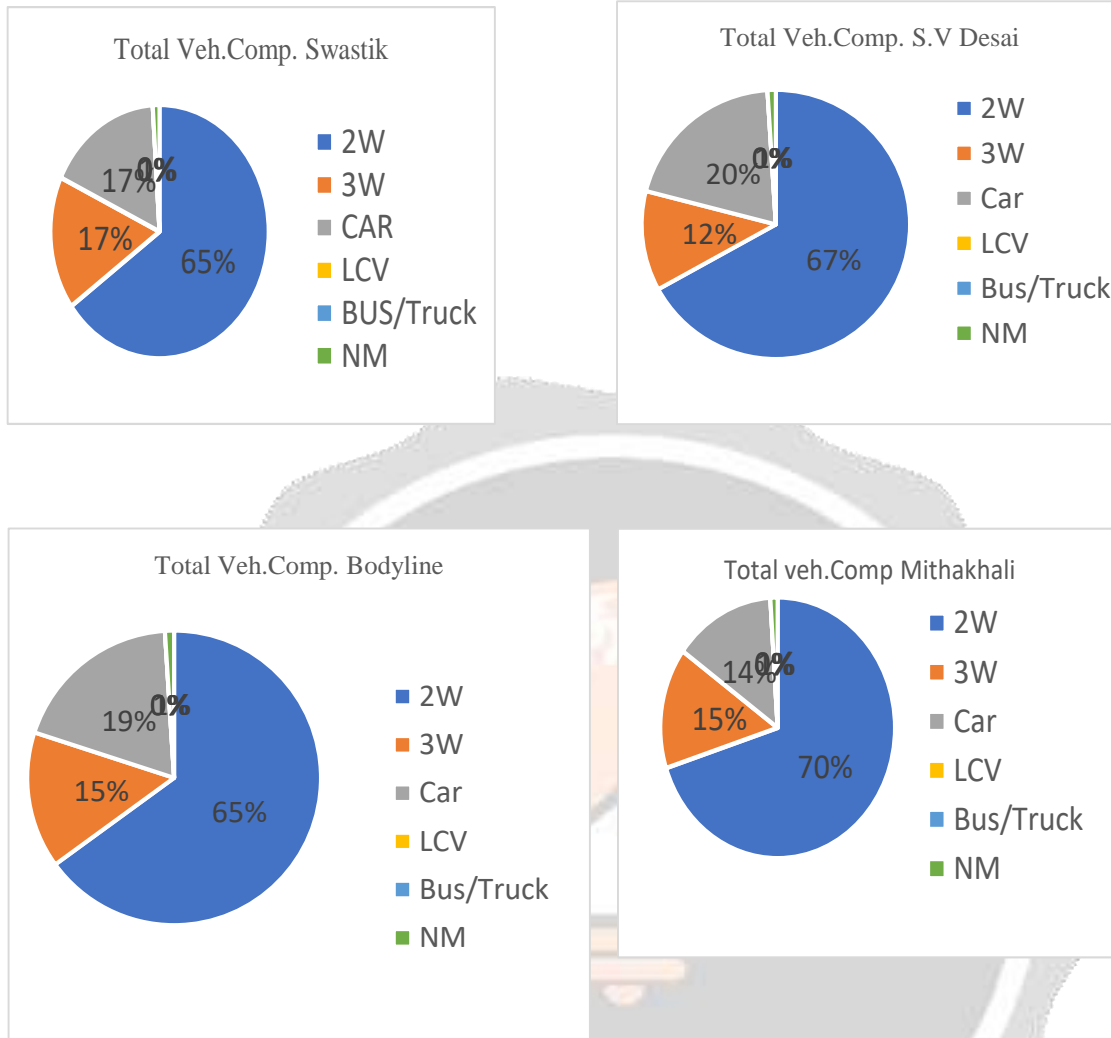
**5.3 Data Analysis**

From the videos different vehicles were tracked at different intersections. In analyse the data vehicles were tracked in three different directions i.e. straight, right and left.

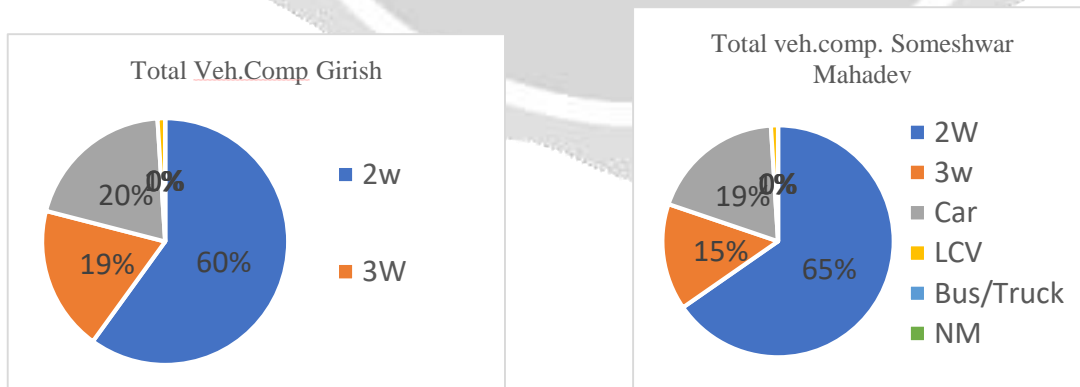
**Table 1: Comparison of dynamic PCU value by proposed method and S. Chandra’s method**

	Dynamic PCU Value											
	Swastik Char Rasta				Girish Coldrinks Char Rasta				Bodyline Char Rasta			
	By proposed method		By Chandra’s method		By proposed method		By Chandra’s method		By proposed method		By Chandra’s method	
	S	R	S	R	S	R	S	R	S	R	S	R
2W	0.22	0.22	0.22	0.24	0.22	0.28	0.22	0.28	0.24	0.27	0.24	0.27
3W	0.61	0.59	0.62	0.59	0.51	0.59	0.51	0.59	0.66	0.89	0.66	0.89
L.C.V	3.25	3.39	3.25	3.39	2.96	2.81	2.96	2.81	2.52	2.34	2.52	2.34
Bus/ Truck	5.54	-	5.54	-	5.42	5.75	5.42	5.75	5.42	6.78	5.42	6.78
N.M	0.19	0.20	0.19	0.20	0.28	0.16	0.28	0.16	0.20	-	0.20	-

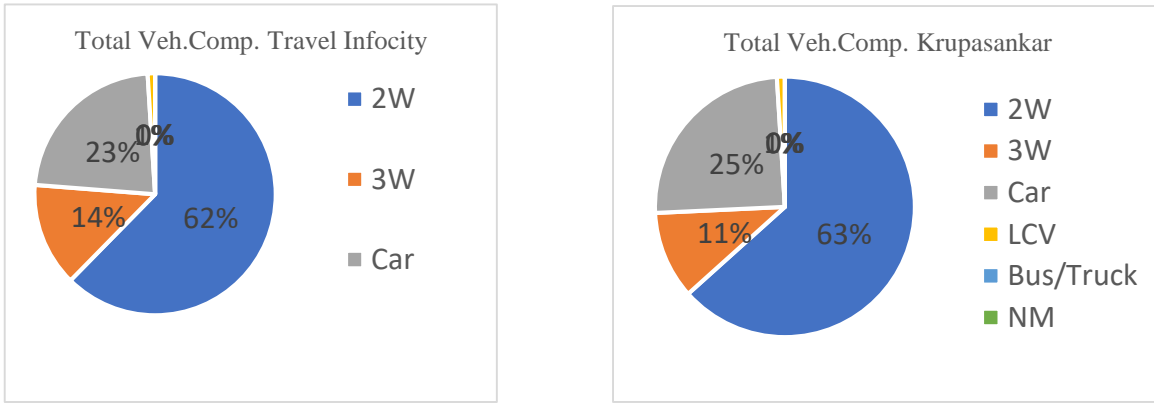
**5.4 Total vehicle composition at interection.**



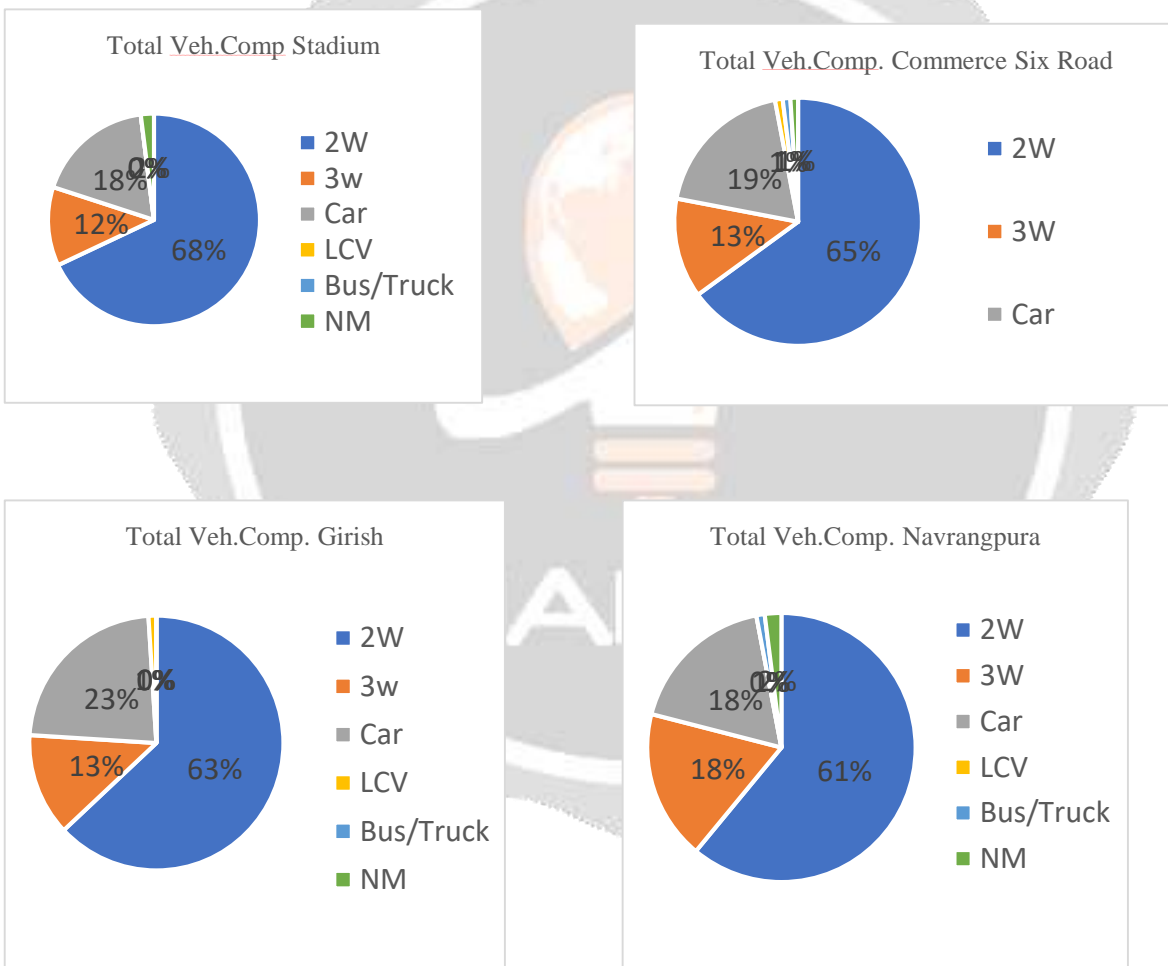
**Figure 1: Vehicle composition at Girish Coldrink Intersection**



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**Figure 2: Vehicle composition at Bodyline Intersection**



**Figure 3 : Vehicle composition at Swastik Char rasta Intersection**

### 5.5 Comparison of Static PCU values and Dynamic PCU values

Table 2 shows comparison of static pcu values at signalized intersections suggested by IRC and Justo & Tuladhar with dynamic pcu values obtained in this proposed study.

**Table 2: Comparison of Static PCU values and Dynamic PCU values at all Intersections**

Vehicle Type	Dynamic PCU values							
	As per IRC SP-41-1994	As per Justo & Tuladhar (1984)	Swastik Char Rasta Intersection		Girish Coldrinks Intersection		Bodyline Intersection	
			Straight	Right	Straight	Right	Straight	Right
2W	0.5	0.3	0.22	0.22	0.24	0.23	0.24	0.24
3W	1.0	0.4	0.65	0.65	0.63	0.63	0.62	0.68
Car	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LCV	1.5	-	2.6	2.71	2.71	3.16	2.65	2.73
Bus/Truck	3.0	2.8	6.1	-	4.9	5.75	4.8	6.78
NM	0.5	0.4	0.23	0.19	0.25	0.19	0.18	-

## VI. CONCLUSION

Major findings of the study are briefed as under;

- Mix and composite traffic observed during study.
- At all intersection it is found that composite of two wheelers is quit high (60%-70%).
- Three wheelers composite varies between (11%-19%).
- Car composite varies between (14%-25%).
- Light Commercial Vehicle composite varies between (0%-1%).
- Bus composite varies between (0%-2%).
- Non-motorized composite varies between(0%-2%).
- Maximum vehicle are observed at Swastik Char rasta intersection.
- The proportion of 2W,3W and Car is more as compared to LCV,Bus/Truck and NM.

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