

Effect of Static and Dynamic PCU on Capacity Analysis of Four Lane Divided Urban Road under Mixed Traffic Condition

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ABSTRACT

In India, traffic conditions are of heterogeneous nature due to variety of vehicles with their different static and dynamic characteristics. It is necessary to convert mixed traffic into homogeneous traffic by using PCU values. Roadway and traffic conditions on urban roads vary considerably across the cities which generally affects the PCU values of different vehicles and the capacity of roadway. This shows the dynamic nature of PCU values. In this paper, an attempt is made to study the effect of static and dynamic PCU values on the capacity analysis of four lane divided urban roads and to study the effect of proportion of two-wheeler on PCU values.

Keywords: Traffic Capacity, Passenger Car Unit, Urban Roads, Mixed traffic.

I. INTRODUCTION

The estimation and knowledge of roadway capacity are essential in the planning, designing and operation of transportation facilities. Capacity is greatly influenced by roadway, traffic and driver conditions. Traffic conditions may include traffic volume, traffic composition and stream speed etc. and roadway conditions may consist of various geometric parameters that describe roadways such as lane width, shoulder width, horizontal and vertical geometry.

In India, mixed traffic condition prevails, vehicles like bicycles to very heavy vehicles like multi-axel trucks are moving on the same road at a time. So, it is necessary to convert whole mixed traffic into one common standard vehicle. Traffic volume, composition, stream speed, number of access points, road geometry etc. depends on functional class of the road which ultimately affect the PCU values of different vehicles. IRC: 106-1990 has given Passenger Car Unit (PCU) for different vehicles through sections of urban roads between junctions. The traffic system in developing countries like India has variety of vehicles. Generally the urban roads in India faced wide variety of mixed traffic and disparity in their size, speed and technology.

Due to these wide varieties the use of static PCU values is difficult. For capacity estimation the problem of measuring traffic volume under mixed traffic condition may be addressed by using dynamic PCU values. The main aim of this paper is to study the effect of static and dynamic PCU values on capacity analysis of four lane divided urban road and to study the effect of 2w proportion on PCU values.



Figure 1: Heterogeneous Traffic in India

TABLE I
RECOMMENDED PCU FACTORS FOR VARIOUS TYPES OF
VEHICLES ON URBAN ROADS AS PER IRC 106-1990

Sr. No.	Vehicle type	Equivalent PCU factors	
	Vehicle type	Percentage composition of vehicle type in traffic stream	
	Fast vehicles	5%	10% and above
1	Two wheeler-motor cycles, scooter, etc	0.5	0.75
2	Passenger car, pick-up van	1.0	1.0
3	Auto- rickshaw	1.2	2.0
4	Light commercial vehicle	1.4	2.0
5	Truck or Bus	2.2	3.7
6	Agricultural Tractor – trailer	4.0	5.0
	Slow vehicles		
7	Pedal cycle	0.4	0.5
8	Cycle rickshaw	1.5	2.0
9	Tonga (Horse drawn vehicle)	1.5	2.0
10	Hand cart	2.0	3.0

II. METHODS AND MATERIAL

A. Objectives

- 1) To develop the relationship between speed and flow for the selected urban road.
- 2) To estimate of capacity of urban road under study.
- 3) To compare the capacity by using static and dynamic PCU values for urban road.
- 4) To study the effect of proportion of two-wheeler on PCU for the selected road.

B. Literature Review

S. Chandra et al. (2000) In this paper the dynamic nature of PCU has been studied. The variation of PCU with traffic and geometric variables is explained graphically. A computer program developed suitable for running on a personal computer can be used to estimate the PCU values for a vehicle type under given conditions of composition, road width and traffic volume per lane width. It is applicable to all traffic situations with a maximum number of five vehicle categories in the stream.

Satish Chandra (2003) considered the effect of lane width on the capacity of a two-lane road under mixed

traffic conditions is studied. Data were collected at ten sections of two-lane roads in different parts of India. PCU values were estimated by the equation which was introduced by Chandra and Sikdar. It was found that the PCU for a vehicle type increases linearly with the width of carriageway. The capacity of a two-lane road also increases with total width of the carriageway and the relationship between the two follows a second-degree curve.

Errampalli Madhu et al. (2011) developed the microscopic simulation model by considering eight-lane divided Delhi - Gurgaon urban expressway. From the collected data, speed – flow equations of different vehicle types on was developed using PARAMICS simulation software. The study revealed that the roadway capacity estimated through microscopic simulation approach is 2859 PCU/HR/Lane. Through microscopic simulation approach it has been assessed that the impact of typical Indian driving behavior and lane change behavior affects the roadway capacity.

Chetan R Patel et al. (2012) had carried out empirical investigation in the behaviour of mixed traffic stream speed and flow rate on an access controlled urban arterial in Surat city. Multi regime speed- flow relation was developed and unobserved data was simulated by artificial neural network model (ANN Model). Using speed flow data thresholds on level of service based on volume to capacity ratio were established by cluster analysis approach. It was observed that the traffic flow behavior in heterogeneous traffic is quite complex with loose lane discipline.

Chetan R. Patel et al. (2014) a case study was carried out on six lane divided urban arterial road in Patna and Pune city of India. Speed flow relationship was developed and capacity was determined. Equivalency factor in terms of dynamic car unit is determine to represent the vehicle is single unit. From the study it was observed that there was significant difference in the capacity value. It was found that the capacity of the urban arterial road is greatly affected by effect of lane width, presence of NMV and effect of side friction.

Mr. V Suresh et al. (2014) studied the fundamental details of traffic flow and evaluated the capacity of urban mid-block section, particularly for a two lane divided cross section. Using the fundamental parameters, capacities of ten sections of Chennai city were evaluated by three methods, namely Headway method, Observed volume method and Fundamental diagram method. It

was found that the estimated capacity value by all the three methods are much higher than the IRC recommended value for two-lane, two-way divided urban roads and the reason for the higher capacity value could be attributed to the drastic change in the flow characteristics and the driver behaviour.

M. Mardani et al. (2015) carried out his study at ten sections of intercity roads in different states in India and studied the effect of the carriageway width on PCU of different vehicle categories. He observed that PCU value for a vehicle type varies with traffic volume and composition on the road. He also found that PCU value of different categories of vehicle is also affected by the type of road and the width of carriageway width as well.

III. CONCLUSION

This paper presented literature review on estimation of Capacity and PCU (Passenger car Unit) values. Most papers referred in this context are focused on estimating PCU values and evaluating capacity of particular sections of the road. It has been observed that the capacity and PCU values may change according to roadway and traffic conditions. In India the urban roads faces wide variety of mixed traffic and disparity in their size, speed and technology. Due to these the use of static PCU values is difficult. Dynamic PCU values are used to address the traffic flow for capacity estimation under mixed traffic condition.

IV. REFERENCES

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