



# COMPARATIVE STUDY OF THE METHODS USED TO ESTIMATE THE CAPACITY OF NATIONAL HIGHWAY WITH UNDIVIDED TWO LANE

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**Abstract:** The traffic on the road is increasing very fast with different types of vehicles having different static and dynamic qualities. Due to unrestricted movements all fast- and slow-moving vehicles without any separation, the roads will face severe congestion and lower speeds. The two-lane highways achieve its greatest limit soon and require consistent upgradation. In the study, traffic volume will be collected for whole 3 days at National Highway. Also, PCU values at selected stretches on highways are computed and by using those values capacity will be estimated and compared with the regression equation values. The values will be verified with IRC values. It is found that with the increase in lane width, speed substantially caused increased in PCU value. Also, we developed linear regression equations to estimate capacity and compared those values with the values as we got using Chandra's method. In most of the cases the error is observed to be less than 3%. The percentage error is in the range between 0.84% and 2.83% which is very marginal. Finally, from the study it has been observed that increase in lane width and traffic stream speed obviously increases the capacity they're by increases both comfort and safety of the road users.

**Index Terms:** Traffic volume count, PCU, Mean speed, Capacity, Linear regression equation.

## I. INTRODUCTION

India has the world's second-largest road network (3.3 million km). The entire length of Indian highways is 55,000 km, with 55% of roads being two-lane facilities with varied lane widths, but India continues to face huge challenges in delivering better vehicular traffic flow and operations. The road is India's primary mode of transportation. For roadway engineers, the rapid and constant increase in population is a serious issue. As the population of cities grows, so does the number of forms of transportation available, resulting in gridlock on the roads. For short to medium distances, roads play an essential role in the transportation of products and passengers, and road transit is more adaptable than other forms of transportation.

However, due to a wide range of vehicles with varying static and dynamic properties, traffic situations on Indian roadways are today exceedingly heterogeneous. In the design, planning, operation, and design of road geometrics, capacity expectations and learning are critical. These provide the foundation for determining the lane width and number of lanes to be supplied at any time in a road system considering the volume and creation of movement, among other things. They are profitable tools for evaluating ventures.

Separated from other variables, the limit is influenced greatly by road and driver conditions. The bulk of the geometric factors portraying the highway, such as the existence of nearby intersections, lane width, lateral clearance, and shoulder width, vertical as well as horizontal alignment.

The width of the lane and the width of the shoulder can have a significant impact on mixed traffic flow. Vehicles in limit lanes are spaced closer together horizontally. This may slow them down or widen the longitudinal gaps. Both conditions result in a reduction in capacity. The goal of this study was to see how lane width, average spot speed of different vehicles, and standard projected area of different vehicles affected the capacity of a two-lane road under varied traffic scenarios. By

evaluating straight areas, data was obtained at several stretches of two-lane highways (NH-41 & NH-341) with carriageway widths varying from 6.35m to 10.2m.

The number, movement, and kind of vehicles at a specific site are all determined by traffic flow studies. Traffic flow analysis aids in the improvement of flow capacity. The use of traffic flow analysis can also help to reduce the number of accidents. The interaction between vehicles and drivers is also described mathematically using traffic flow ideas.

## II. LITERATURE SURVEY

Capacity Estimation of Urban roads under Mixed Traffic Condition by Pratik U.Mankar; Dr. B.V Khode, International Research Journal of Engineering and Technology(2020).<sup>[1]</sup>, Study on Effect of Gradients on PCU and Capacity Factor for Undivided Two-Lane National Highway (NH-209) by Priynaka. K. P. ,Vijay B.G., International Journal of Engineering Research & Technology (2017)<sup>[2]</sup>, Capacity Estimation for a Two Lane Undivided Carriageway-A Case Study for National Highway -63 by Kamplimath, H. M. International conference on science, Technology and Management(2016)<sup>[3]</sup>, PCU Estimation on Two-lane Undivided National Highway by Raghava.B, Umapathi, Dr.Rajendra Khatavkar, International Research Journal of Engineering and Technology(2021)<sup>[4]</sup>, Comparative analysis of saturation flow using various PCU estimation methods by Satyajit Mondal , Vijai Kumar Arya , Ankit Gupta, Samsi Gunart, World Conference on Transport Research(2019)<sup>[5]</sup>, Effect of Mixed Traffic on Capacity of Two-Lane Roads: Case Study on Indian Highways by Nabanita Roy, Rupali Roy, Hitesh Talukdar, Pritam Saha, Elsevier Ltd.(2016)<sup>[6]</sup>, Effect of lane width on Capacity under Mixed Traffic Condition in India by Chandra, S., and Kumar U., American society of civil engineering (2003)<sup>[7]</sup>.

## III. STUDY AREA, DATA COLLECTION AND METHODOLOGY

Kutch district (also spelled as Kachchh) is a district of Gujarat state in western India, with its headquarters (capital) at Bhuj. Covering an area of 45,674 km<sup>2</sup>, it is the largest district of India. The area of Kutch District is larger than the entire area of states like Haryana (44,212 km<sup>2</sup>) and Kerala (38,863 km<sup>2</sup>) The population of Kutch is about 2,092,371. It has 10 talukas, 939 villages and 6 municipalities. National Highway 41 is a primary national highway in India. This highway runs entirely in the state of Gujarat starting from Samakhiali and terminating at Narayan Sarovar. This national highway is 290 km long. Length: 290 km, West end: Narayan Sarovar, East end: Samakhiali. National Highway 341 is a spur of National Highway 41. NH-341 traverses the state of Gujarat in India. The road goes up to the India-Pakistan border. Length: 162 km, South end: Bhimsar, North end: Dharamshala. There are five locations to be selected for estimation of the capacity of a road, each of which has a different road width.

### III.I PROPOSED METHODOLOGY

Methodology begins with problem identification, which is addressed in the Introduction chapter, and then a suitable study area is chosen based on the problem. Following the selection of the study area, data was gathered using two surveys: Classified volume count and Spot speed survey. Various type of vehicle speed is obtained from the Spot speed survey, and the current road capacity was estimated. A classified volume count survey was used to count peak hour traffic. After the data collection, the results show that the average speed of vehicles and the width of the road are directly connected to its capacity. Then a linear capacity regression equation based on road width and the average speed of the traffic stream was determined. Finally, the survey results and conclusions have been discussed.

Various steps of proposed method:

Step 1: Collection of various data by Classified volume count and Spot speed survey

Step 2: Analysis of data obtained from the above two surveys.

Step 3: Discussion of Results and Conclusions

Step 4: Providing a Linear regression equation based on road width and average speed of traffic stream.

## IV. DATA COLLECTION

Various traffic surveys have been carried out all sections for the collection of data required for determine capacity of road. Following surveys were carried out in the peak period of the day at morning and evening time, data were collected by video graphic survey at mid-blocks.

- Classified Volume Count
- Spot Speed Study

### IV.1 Classified volume count

Traffic Volume studies are conducted to determine the number of vehicles and category of vehicle. The survey was carried out in morning peak period between 08:30AM to 11:30AM and in evening peak period between 5:30PM to 7:30PM.

**IV.II Spot Speed Survey**

Speed is one of the most important characteristics of a traffic stream, and its calculation is also necessary in rush hour traffic studies. Speed is the rate at which traffic or certain segments of traffic move, expressed in kilometres per hour (kmph). Exact speed information is useful for determining issues of congestion on streets and linking speed limits to limits. Speed is also important for road network geometric design, setting safe speed limits, and comparing before and after studies of road development projects. The instantaneous speed of a vehicle in a demonstrated region is known as spot speed. Various typical or usual attributes can be derived from a distribution of vehicle speeds to describe the traffic flow as a whole.

**V. DATA ANALYSIS**

**V.I Determination of Passenger car unit (PCU) by Chandra’s Method**

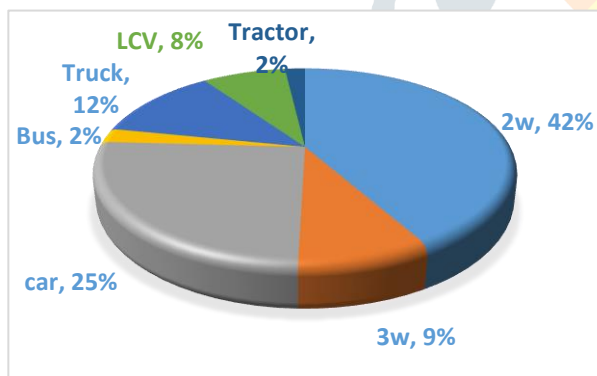
This method uses two factors: namely, velocity of vehicle type and its projected rectangular area to calculate the PCU value.

$$(PCU)_i = \frac{(V_c/V_i)}{(A_c/A_i)}$$

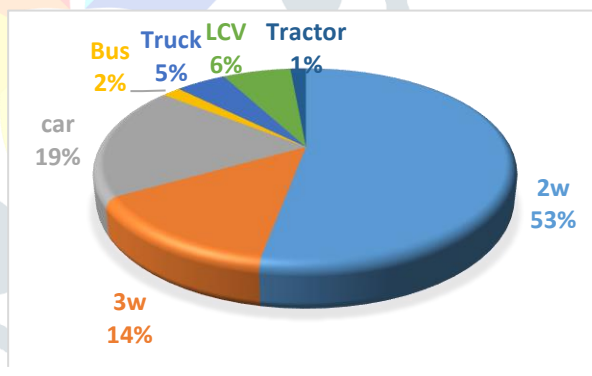
where  $V_c$  and  $V_i$  are mean speeds of car and vehicle of type  $i$  respectively and  $A_c$  and  $A_i$  are their respective projected rectangular area length \* width on the road.

**Table 1: Projected area of vehicle**

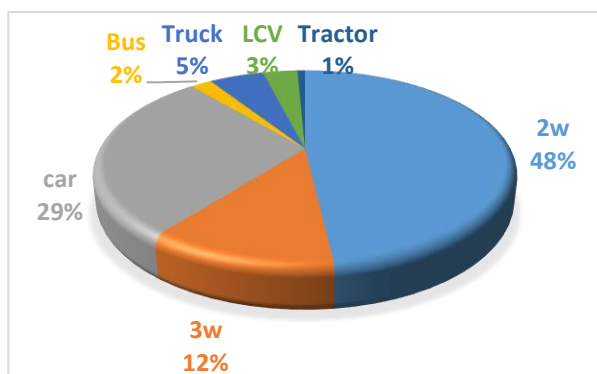
Vehicle Type	Dimension	Projected Area (m <sup>2</sup> )
Car	3.72 x 1.44	5.39
Bus	10.10 x 2.43	24.74
HCV	7.50 x 2.35	17.62
LCV	6.10 x 2.10	12.81
2-Wheelers	1.87 x 0.64	1.20
3-Wheelers	3.20 x 1.40	4.48



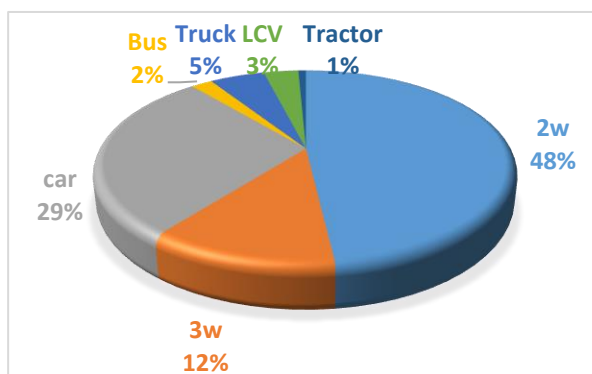
**Figure 1 Traffic Composition at Anjar Highway**



**Figure 5 Traffic Composition at Anjar-Bhuj Highway**



**Figure 3 Traffic Composition at Mandvi-Bhuj Highway**



**Figure 4 Traffic Composition at Koday-Bidada Highway**

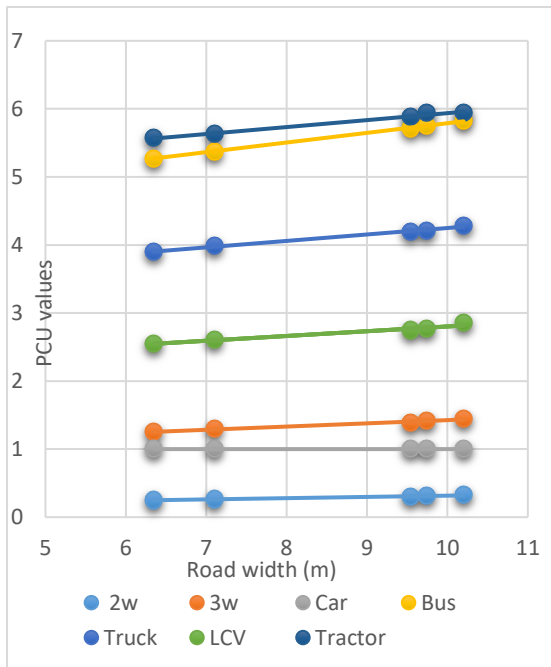


Figure 5 Graph of PCU values vs Road width

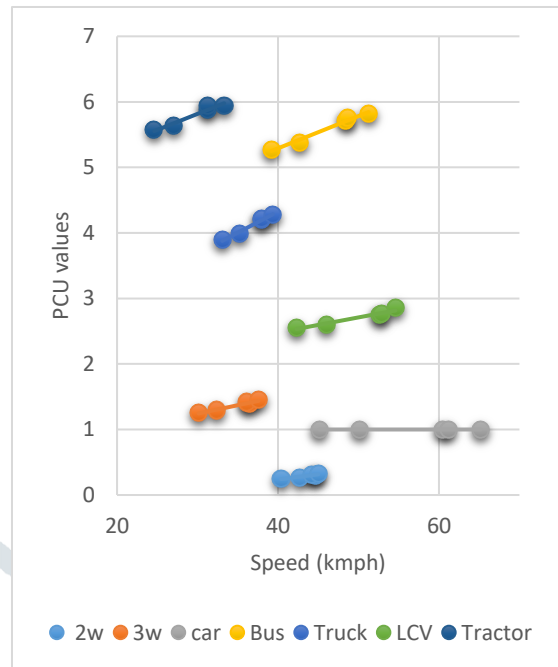


Figure 5 Graph of PCU values vs Speed

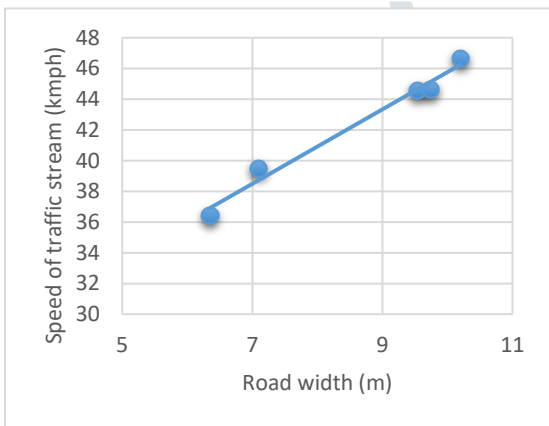


Figure 5 Graph of speed of traffic stream vs Road width

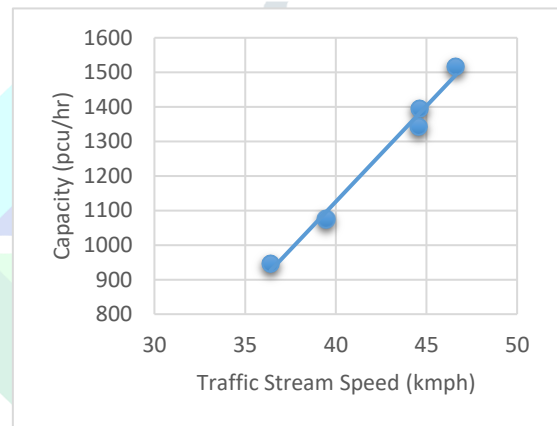


Figure 5 Graph of Capacity vs Traffic stream speed

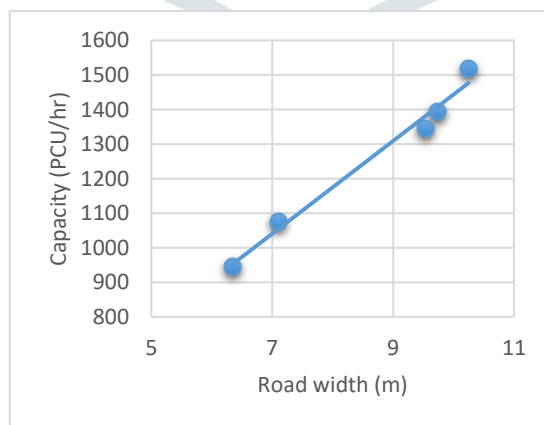


Figure 5 Graph of Capacity vs Road width

The equations obtained are as follows:

Linear Regression Equation with respect to road width

$$\text{Capacity} = 134.2679 * \text{Road Width} + 100.6312$$

Linear Regression Equation with respect to Traffic stream speed

$$\text{Capacity} = 55.436 * \text{Traffic stream speed} - 1092$$

## V. CONCLUSIONS

Based on field observations and analysis carried out on both national highways, the following conclusions are drawn:

- Collected geometric details and compared the width of the carriageway, shoulder and their conditions, as it may affect the capacity of a road.
- The capacity obtained from the Satish Chandra method and the capacity obtained from the linear regression equation have been compared and the variation is found to be very marginal as the maximum difference is 2.83%.
- The calculated PCU values as per Chandra's method at various sections of highway may have a marginal difference with the values recommended by IRC, and we considered these values to estimate capacity.
- It is found that with the increase in lane width and traffic stream speed, the PCU value also increased.
- Attempts have been made to develop a linear regression equation and compare it with the capacity values we got using Chandra's method.
- In most cases, the error is observed to be less than 3%. The percentage error is in the range between 0.83 and 2.83, which is very marginal.
- It has been observed that an increase in lane width obviously increases the capacity, which increases both the comfort and safety of the road users.

## V.I Scope of future works

- The impact of shoulder width, roughness, gradients, radius of horizontal curve, intersections, driving behaviour (physical and psychological), and other factors may be taken into account when calculating PCU values and capacity.
- The purpose of developing models is to estimate capacity at various portions of roads by taking into account a larger number of national highways.

## VII. REFERENCES

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