Journal of Engineering Sciences
Vol 13, Issue 03, MARCH/2022
ISSN NO:0377-9254

ESTIMATION OF PASSENGER CAR UNIT AND CAPACITY OF MIXED TRAFFIC CONDITION

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ABSTRACT

At present traffic is heterogeneous in nature. It consists of a wide range of vehicle categories that are different from each other in terms of Static and dynamic behavior. The main objective of the study is accomplished in three parts. The first part is to estimate the passenger car unit value for rapid transit buses and for all categories and types and the second part includes speed-density relation on multi-lane highways found on urban for inter-state transport. To full fill the objective all vehicles are converted to passenger car units (PCU) or passenger car equivalent units(PCUE). It is a factors to convert all vehicle types other than passenger cars into a single passenger car unit. To attain these objectives on the basics segment in the flat terrain of selected road sections moving from Hyderabad to Andhra Pradesh and vice versa. The data were collected by means of video recording by selecting a favorable area on the study area. Depending on the concept, the vehicles are classified as the standard car, HCV, LCV, RTC bus, Rapid transit bus. For each vehicle, data such as vehicle class, the number of vehicles, and travel time were measured from vehicles traveled in the study section between the two reference lines to arriving vehicles. The data collected was used for estimating the actual PCU value for rapid transit buses and all vehicle types by using Chandra's method and homogenization coefficient method and to estimate the road capacity. From obtained data, was analyzed using linear regression for speed -density relationship. The results indicate that the PCU values for different types of vehicles were found to be different for different intervals of traffic volume. The PCU resulted by Chandra's method for rapid transit bus for moving and returning (5.49, 5.35, 5.59) were greater than the PCU value resulting by Homogenization coefficient methods (3.33, 3.47, 3.53) The Capacity of the road at entering and leaving city road was obtained from the average PCU by using Green Shield's Model and Greenberg model for all road section depending on the direction of flow. Later in this study simulation of VISSIM software was done for the data analysis for obtaining the headway, speed, delay, and driver's behavior. Further, the simulated data is calibrated to find v/c ratio and difference of speed, volume from the field and observed and determine PCU values from calibrated data and compare both PCU for simulated and field.

Key words: *PCU, Speed, Density Traffic volume, capacity, Rapid transit bus.*

1. INTRODUCTION

In India, the movement of personal and goods from one state to another state is increasing as a result of an increase of inter-state transport is developing at a very fast rate. Because of rapid growth in urban traffics, it is evident the need to improve the interstate transport conditions on highways by estimating the capacity of the highways which are having large amounts of interstate transport result in highlight the role of usage of a rapid transit bus. Traffic flow is generally heterogeneous in nature in India. Different vehicles occupy the different spaces on road, which move with their own speed and acceleration and the driver behavior. As a result, standard relationships and factors used in one country may not be appropriate in another. A uniform measure

of vehicles is necessary to estimate traffic volume or capacity of the road. For this reason, the passenger car unit value (PCU) of rapid transit bus vehicle and overall PCU value for each vehicle type in transit stream was evaluated for better performance, this transit stream is mostly visible on Highways. A multilane interurban highway approaches to Expressway traffic condition if its access point density and turning volume approach to zero. Our present current study is on inter-state transport on Mumbai national highway in Hyderabad city, having Rapid Transit Bus with the traffic moving Hyderabad city to Andhra Pradesh and vice versa in opposite direction with mixed traffic condition. In our study it is difficult to analyze such traffic stream with the different physical, size and operational characteristics of different categories such as rapid transit buses having a large size such as length, width, and height and occupy the different spaces on road, which move with their own speed and acceleration and the driver behavior also which varies from buses traveling to Andhra Pradesh from Hyderabad city make the traffic operation of very complex, they generate a large number of possible operating conditions which may have to be satisfied in the design of the road. Without the careful study of these factors, it is difficult to develop the traffic stream models we need to convert this heterogeneous traffic into homogeneous by deriving the passenger car unit values of Rapid transit bus and each vehicle type in the transit stream for estimation of capacity for our study inter-state transport Hyderabad city Andhra Pradesh under mixed traffic condition. In this study we used Green shield's and Greenberg's models for estimation of capacity by considering the average Individual vehicle type PCU values on a multilane highway Macroscopic stream models depict how one parameter of traffic flow changes in relation to another. Green shield recommends the first and most basic relationship between them. Green shield assumed a linear speed-density relationship. Traffic simulation VISSIM software is used to replicate the actual field conditions in software and the primary data used are directly collected from the field different conditions such as volume speed and vehicle type and other road data also includes car-following model, lane change model, for the estimation of PCU and capacity in software a network model is generated and important simulation parameters are adjusted to reflect the heterogeneous condition of the study area which is further validated with field data.

2. LITERATURE REVIEW

Hitachi Barve, (**2018**)[1]The capacity estimation of road and PCU estimation of different vehicles under heterogeneous traffic conditions was estimated. The data was collected at five main highways around Khandwa city using a video recorder. The detailed extraction of traffic volume and speed were made for every five-minute time interval, covering both the peak and non-peak period. PCU values were compared, and Chandra's method was found to produce more reliable and realistic results. The passenger unit value for different vehicles can be determined at the unique sections of the highways. This indicates, it is required to adopt the mixed traffic into homogeneous by using a common unit, which is termed as passenger car equivalent. The density method and Chandra's model have been used to determine the passenger car unit for different vehicle groups. **Thasneem Nadirsha, Archana et.al**(**2018**)[2] the basic parameters of traffic flow have been obtained through research on urban roads. In the uncongested regime, these parameters were used to create diagrams of the relationships between flow, speed, and density. This enabled the development of model equations that can be used to theoretically determine road characteristics in an urban road network under non-congested traffic conditions.**Shalini1,**(**2015**)[3]that the Rahman and Nakamura, (2005) used a deterministic model of traffic flow to estimate the impedance-flow relationship. They also suggested that PCE values are related to the speed and length of subject vehicles and to vary with the proportion of trucks in the traffic stream. **Giuffrè,** (**2015**)[4] Simulation data were used to develop relationships between traffic flow variables and to calculate passenger car equivalents for heavy vehicles by comparing a fleet of only passenger cars to a mixed fleet with varying percentages of heavy vehicles. The conclusion of this paper is that "PCE estimations are small at low flow rates and increase with increased flow rates due to low volumes there are few passenger cars that can be influenced by heavy vehicles. **"Rahman**

and Nakamura,(2005)[5]used a deterministic traffic flow model for estimating the impedance-flow relationship. They also suggested that PCE values are related to the speed and length of subject vehicles and vary with the proportion of trucks in the traffic stream. Sumner et al., (1984) further developed Huber2's method by including more than one truck type in the traffic stream.

3. RESEARCH METHODOLOGY

The research approach used in this study is as shown as methodology includes Estimating passenger car unit value for rapid transit buses and all vehicle types on the multi-lane national highways connecting the state-to-state transport. Determining the capacity in PCU/hr on the study area with derived PCU values of all individual vehicles and developing the capacity models by using linear regression and similarly developing PCU values of individual vehicle type and capacity models by obtained simulation data. Selection of study area confining to the present study. The data for this study is gathered from the field using a video graphic survey and extracting all the required parameters required in this study. The collected data was used to extract the volume, flow, and speed of vehicles, projected area vehicle dimensions. In the present study, a Green shield and Greenberg model was developed using linear regression. For the purpose of this study, data set was collected to develop an empirical relationship for estimating capacity on the Multilane National highway. The data sets include the average speed, flow, density, speed of each vehicle type for every 15 min time interval. By using the above data models capacities are generated further, this data can also be utilized to analyze and develop simulated models. The results were discussed.

4. SELECTION OF STUDY AREA ON MULTILANE NATIONAL HIGHWAY

In this research, there were 2 routes were selected having each 3 locations on Mumbai highway moving from Hyderabad city to Andhra Pradesh and returning from Andhra Pradesh to Hyderabad city. The study area has four lanes in each direction. The study site was selected considered has large amount Rapid transit buses along with two wheelers, three wheelers, car, HCV and LCV which increase the capacity of the road.

Study area 1: The selected route ***Kothapet - L.B Nagar – Hayatnagar*** locations, it is the busiest traffic movement from Hyderabad city to Andhra Pradesh the transit starts from MGBS at ***9:00pm*** and transit reaches to L.B nagar at ***10:00 pm*** and reaches to Hayatnagar ***12:00 pm***.

Study area 2: The selected route ***Hayatnagar - L.B Nagar – Kothapet*** locations, it is the busiest traffic returning from Andhra Pradesh to Hyderabad the transit stream starts from A.P at ***4:00am*** and reaches to Hayatnagar at ***4:00am*** and transit reaches to L.B Nagar at ***5:00am*** and reaches to Kothapet 6:00 am.

Figure 1

Study Area 1

Figure 2

Study Area 2

5. DATA COLLECTION

Data collection can be done at the junctions manually or video-graphically for a stretch of the time interval. The Video-graphic mode captures data continuously without any interruptions. Video–graphic data were collected during the morning 4 am to 7 am and evening hours 9 pm to 10 pm. The video has recorded the movement of vehicular traffic, in one direction of travel by considering a trap length of l00m for four lane road, the electric pole was used as a reference for trap length determination. Each electric poles are used as a reference we adopt a manual method for data extraction. The video-graphic data were collected and extracted through the indirect manual method. We play the video frame by frame for 15 minutes time Interval in this indirect manner.

5.1 DATA EXTRACTION

The video graphic data collected from the site locations are analyzed by playing the video for an interval of 15 min and data is filled in tally sheet for site locations. Video- recordings are then played back in the laboratory to process the collected data, as required. This Table includes the date, time interval car, two-wheeler, three-wheeler, heavy Commercial Vehicles (HCV), Low Commercial Vehicles (LCV), RTC buses, Rapid transit buses. The data extraction from video films is performed to get the information on traffic volume (veh/hr.), Speed(km/hr.) of individual vehicles, and composition on different locations of multilane national highway (route from Hyderabad city to Andhra Pradesh) and vice versa In present study on capacity of multilane highway. To meet the goal of this study three locations were taken moving from Hyderabad city to Andhra Pradesh.

6. DATA ANALYSIS AND RESULTS

6.1 DIMENSIONS OF VEHICLES

For this study vehicles were classified into seven main classes based on AASHTO vehicle classification scheme. Classifies two wheeler, three wheeler, car, HCV,LCV,RTC bus, Rapid Transit bus the size of this type of vehicle was measured in the field by taking the average of maximum and minimum values for both length and width.

Table 1 Dimensions of vehicles

Type of vehicle	Average length(m)	Average width(m)	Average area(m)	Area ratio of standard car to standard vehicle
Standard Car	3.7	1.6	5.92	1.00
2-W	2.05	0.755	1.54	3.84
3-W	2.8	1.2	3.36	1.76
LCV	6.21	2.45	15.19	0.38
HCV	9.51	2.5	23.775	0.25
RTC Bus	12	2.35	3.06	0.19
Rapid Transit Bus	13.5	2.6	35.1	0.16

6.2 MEASUREMENT OF SPEED

The speed for our study area on a multilane national highway with plain terrain is taken by using traffic data extractor software. This start and end time for each vehicle type was extracted which gives the speed of each vehicle type. Speed of individual vehicle type of vehicles was measured by noting down the time taken by a vehicle to cross the longitudinal trap of 100m from traffic data extractor software. In this study speed of each vehicle type in location in both directions.

Each vehicle type speed of each location moving from Hyderabad to Andhra Pradesh and vice versa are given below.

Table 2 Speed of each vehicle type moving from Hyderabad city to Andhra Pradesh.

S. No	Location	Car (km/hr)	2W (km/hr)	3W (km/hr)	HCV (km/hr)	LCV (km/hr)	RTC bus(km/hr)	Rapid Transit bus(km/hr)
1.	Kothapet	53.42	40.16	37.27	52.25	55.85	54.8	58.125
2.	L.B nagar	64.62	50.02	45.8	58.25	54.25	70.6	74.12
3.	Hayatnagar	70.12	45.12	39.17	60.6	52.87	64.12	72.2

Table 3 Speed of each vehicle type Returning from Andhra Pradesh to Hyderabad city

S. NO	Location	Car (km/hr)	2W (km/hr)	3W (km/hr)	HCV (km/hr)	LCV (km/hr)	RTC bus(km/hr)	Rapid Transit bus(km/hr)
1.	Hayatnagar	70.5	47.5	38.95	65.5	67.85	70.15	74.5
2.	L.B nagar	69.8	52.42	40.02	51.25	58	66.625	70.2
3.	Kothapet	56.62	47.25	40.01	52.14	56.12	60.8	66.25

6.3 ESTIMATION OF PCU VALUES

In a mixed traffic situation traffic volume in terms of vehicles per hour may vary widely depending on traffic mix and different compositions may occur at the same traffic volume. therefore, it is necessary to estimate the passenger car unit value and variation of PCU with volume and vehicle type.

CHANDRA'S METHOD

$$PCU_i = \frac{\frac{V_c}{V_i}}{\frac{A_c}{A_i}}$$

Where, V_c & V_i denotes the mean speed of standard car and vehicle type i respectively and A_c and $A_i$denotes their respective projected rectangular area.

Area of vehicle type = Average length of similar vehicle × Average width of similar vehicle

HOMOGENIZATION COEFFICIENT METHOD

$$PCU_i = \frac{\frac{L_i}{V_i}}{\frac{L_C}{V_C}}$$

Where, PCU_i = Passenger car unit for type "i" vehicle.L_i= length of corresponding vehicle. Lc = length of the car

v_i= speed of the corresponding vehicle, v_C = speed of the car

6.4 PASSENGER CAR UNIT VALUE OF RAPID TRANSIT BUS (VOLVA BUS):

Developing a New PCU Value of rapid transit bus by two methods Chandra's method and homogenization method is given below:

Table 4: Average PCU values of Rapid transit bus for all three locations for Chandra's and homogenization method

Location	Kothapet	L.B Nagar	Hayat Nagar
PCU of Transit bus (Chandra's method)	5.49	5.35	5.59
PCU of Transit bus (Homogenous method)	3.33	3.47	3.6

From the above Table 4 It is observed that the PCU value of rapid transit bus is more for Chandra's method when compared to the homogenization coefficient method.

6.5 ESTIMATION OF PCU BY CHANDRA'S METHOD AND HOMOGENIZATION COEFFICIENT METHOD FOR ALL TYPE OF VEHICLES

In order to develop a proper speed–flow equation to estimate the capacity and design of traffic facilities for heterogeneous traffic, it is important to change the heterogeneous traffic into homogeneous by using a common unit, which is termed PCU. Chandra's method and Homogenization coefficient method has been used to determine the PCU of different vehicle categories. It has been observed that the speed of the individual vehicle class is different at different road sections and PCU resulted at each place of road section have a little difference.

Table 5 PCU values by Chandra's and Homogenization Method

PCU for sections moving from Hyderabad to Andhra Pradesh												
	PCU by Chandra's method						PCU by homogenization coefficient method					
	Type of vehicle						Type of vehicle					
Locations	S.C	2W	3W	HCV	LCV	RTC Bus	S.C	2W	3W	HCV	LCV	RTC Bus
Kothapet	1	0.4	0.80	4.33	2.36	5.13	1	0.74	1.07	2.6	1.8	3.114
Lb nagar	1	0.34	0.80	4.4	3.10	4.78	1	0.717	1.07	3.4	2.26	3.4
Hayatnagar	1	0.405	1.07	4.64	3.48	5.73	1	0.86	1.34	2.88	2.25	3.59
PCU for sections Returning from Andhra Pradesh to Hyderabad												
Locations	PCU by Chandra's method						PCU by Homogenization coefficient Method					
	Type of vehicle						Type of vehicle					
	S.C	2W	3W	HCV	LCV	RTC Bus	S.C	2W	3W	HCV	LCV	RTC Bus
Hayatnagar	1	0.39	1.02	4.3	2.73	5.28	1	0.86	1.44	2.9	1.8	3.4
L .b nagar	1	0.34	1.01	5.44	3.15	5.47	1	0.73	1.32	3.492	2	3.39
Kothapet	1	0.31	0.82	4.3	2.65	4.89	1	0.86	1.32	3.492	2	3.39

6.6 Comparison of PCU values for Chandra's and homogenization method all vehicle Types

Comparing the value resulted by two methods Chandra's method and homogenization coefficient method, this study is necessary to compare with the PCU value HCM (2010) road section.

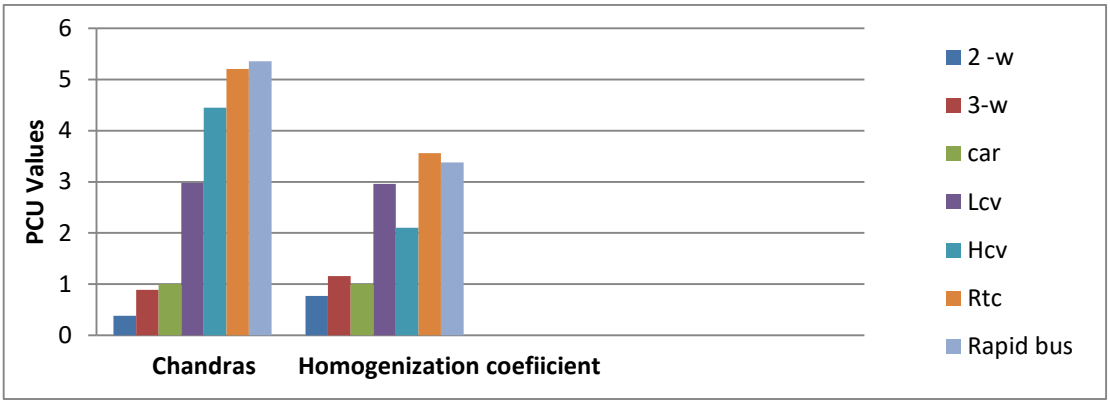


Figure 3 PCU values for each vehicle Type by Chandra's and Homogenization coefficient method.

The value resulting from the Chandra method is slightly greater than the value resulting from the Homogenization coefficient methods

Table 6 Average PCU values by Chandra's Method

PCU for sections moving from Hyderabad to Andhra Pradesh PCU by Chandra's method						
Type of vehicle						
S. car	2W	3W	HCV	LCV	RTC bus	Rapid Transit bus
1	0.38	0.89	4.45	3.98	5.21	5.36
PCU for sections Returning from Andhra Pradesh to Hyderabad						
PCU by Chandra's method						
Type of vehicle						
S. car	2W	3W	HCV	LCV	RTC BUS	Rapid transit bus
1	0.34	0.95	4.68	2.84	5.21	5.59

The PCU obtained by Chandra's method is best so converting the traffic volume to PCU/hr by obtained Chandra's method PCU value. so, the data collected from the site locations is converted from veh /hr to pcu/hr

Table 7 Composition of vehicles for Three locations (PCU/hr) moving from Hyderabad to Andhra Pradesh.

Location	Proportion of vehicles	Composition of vehicles						
		Car	2W	3W	HCV	LCV	RTC Bus	Rapid Transit Bus
Kothapet	2064	726.16	433.2	166.43	53.4	32.78	119.83	64.32
Lb nagar	1838	118.92	64.22	14.24	480.6	93.34	349.07	460.96
Hayatnagar	1778	455	761	115	99	156	80	1112
Grand total	5680	1300.08	1258.42	295.67	633	282.12	548.9	1637.28

Table 8 Composition of Three locations for vehicle volume Returning from Andhra Pradesh to Hyderabad.

Location	Proportion vehicles	Car	bike	Auto	HCV	LCV	RTC buses	Rapid transit bus
Hayatnagar	1985.566	233.24	222.3	372.93	119.28	290.16	390.75	357.76
l.b nagar	2064.2	289.94	277.4	281.92	153.36	363.36	250.08	486.33
Kothapet	1964.2	233.24	222.3	372.93	119.28	290.16	390.75	357.76
Grand total	6013.96	756.12	722	1027.78	391.82	943.68	1031.58	1201.7

6.7 CAPACITY

Three basic parameters of traffic flow, speed, volume, and density are used for estimating of traffic capacity of a road. For determination of speed volume relationship in heterogeneous traffic conditions, the volume calculated by total vehicles recorded in each counting period was converted into an equivalent number of PCUS using Chandra's method

The speed density relationship

Q = U_S*K Where Q = Flow (PCU/hr) , U_S= macroscopic speed (km/hr), K = density (PCU/km)

Chandra's method has higher PCU values when compared to the homogenization coefficient method and manual method so, Chandra's method PCU is more appropriate and has higher accuracy for finding the speed-density relationship and finding the maximum flow and capacity by Green shield and Greenberg model

6.7.1 Data analysis by speed density flow

The data collected on a multilane highway at Hayatnagar, Lb nagar, Kothapet Locations returning from Andhra Pradesh to Hyderabad and moving from Hyderabad to Andhra Pradesh. The data set includes every 4 observations for 15 min interval speed, No of vehicles in PCU, flow, and density.

6.8 Different models for capacity on a multilane highway.

There are two types of traffic speed-density relation models: single-regime and multi-regime models. Single-regime and multi-regime models.

Green shield model

Analysis of the multilane highways is done by considering only one direction. In the same way, in this study, both direction was investigated separately and analysis is based on 15-minute time intervals.

Green shield model: The linear model proposed by Green shields was represented by the following equation.

$$\mathbf{U} = U_f\left(1-\frac{K}{K_j}\right)$$

Where,

U=space mean speed, U_f=free flow speed (km/hr), K_j=jam density (PCU/km), K= density (PCU/km)

GREENBERG MODEL

The logarithmic model proposed by Greenberg is represented by the following equation

$$\mathbf{U} = U_o \ln\left(\frac{K_j}{K}\right)$$

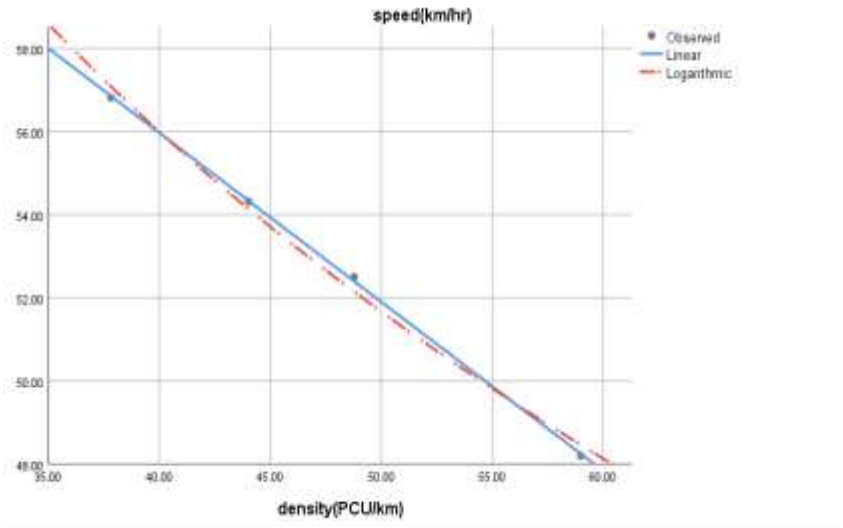
Where: U_o =speed at maximum flow, km per hour , k=traffic density (PCU/km) .The unknown parameters are optimum speed, U_o, and jam density K_j. These parameters as well as the Coefficients of determination (**R^2**) relevant to each data set were generated by regression analysis. The regression analysis was performed using data of each road section and gave the following values of the capacity of each road section.

6.8.1 DETERMINATION OF SPEED-DENSITY RELATIONSHIP BY GREEN SHIELDS MODEL AND GREENBERG'S MODEL BY LINEAR REGRESSION MODEL

Green shields and Greenberg models are used to plot the speed-density curve, where density is the independent variable and speed is the dependent variable. When velocity equals zero (v=0), the Green shield and Greenberg model can predict traffic conditions. The green shield model is linear while the Greenberg model is nonlinear. Both of them have the highest point cannot represent the maximum congestion level the forms are linear or exponential.

6.8.1.1Analysis on multilane highway moving from Hyderabad city to Andhra Pradesh

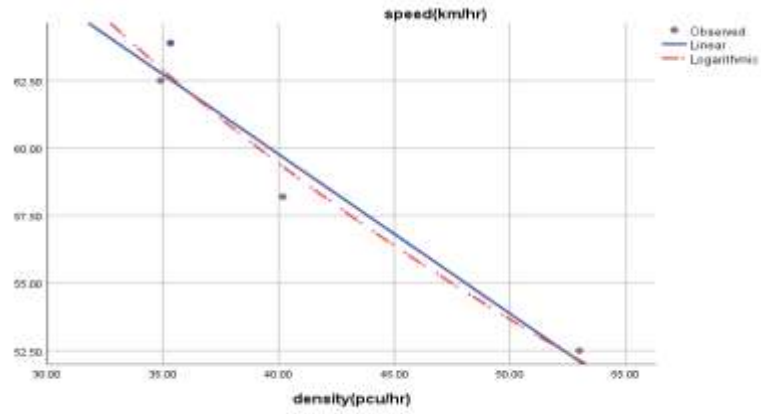
Analysis at kothapet location Green shields model and Greenberg model and Greenberg model



Green shields
U= (72.234e0.407) K
R^2=0.98,
Q_{max} = 3264PCU/hr
Greenberg
U=127.5ln$\frac{788}{K}$, R^2 = 0.99
Q_{max} = 5088PCU/hr

Figure 4 Relationship between Speed and density using Green shields and Greenberg model Kothapet.

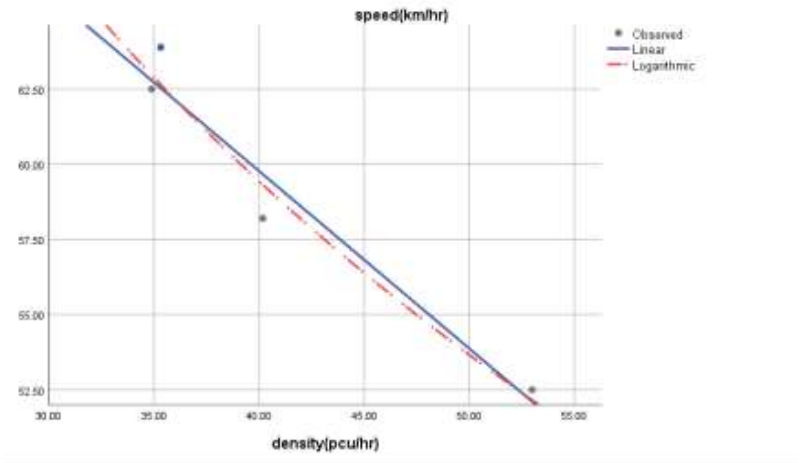
Analysis at Lb nagar location Green shields model and Greenberg model



Green shields
U= (83.393e0.591) K
R^2=0.94,
Q_{max} = 3477PCU/hr
Greenberg
U=154.8ln$\frac{403.4}{K}$, R^2 = 0.98
Q_{max} = 3840PCU/hr

Figure 5 Relationship between Speed and density using Green shields and Green berg Lb nagar

Analysis at Hayatnagar location Green shields and Greenberg model and Greenberg model

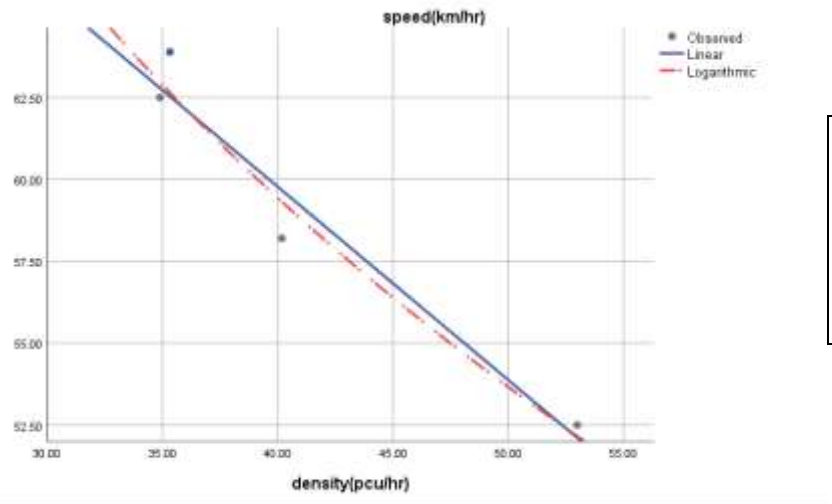


Green shields
U= (83.475e0.515) K
R^2=0.925,
Q_{max} = 3382.56PCU/hr
Greenberg
U=148.9ln$\frac{544.5}{K}$, R^2 = 0.953
Q_{max} = 4721PCU/hr

Figure 6 Relationship between Speed and density using Green shields and Green berg model Hayatnagar

6.8.1.2 Analysis on multilane highway returning from Andhra Pradesh to Hyderabad city

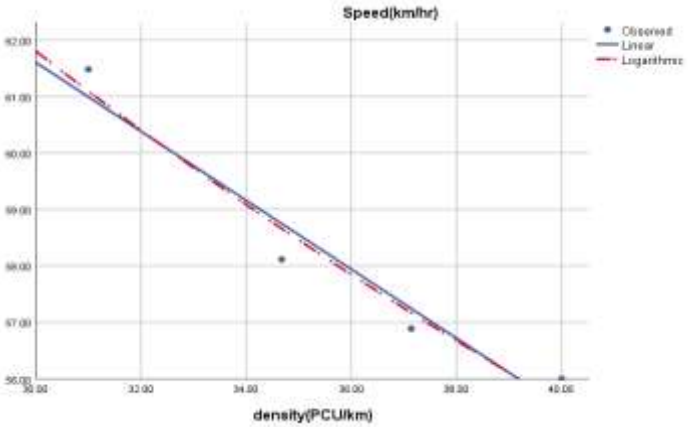
Analysis at Hayatnagar location Green shields and Greenberg model



Green shields
U= (72.796e0.524) K
R^2=0.881,
Q_{max} = 2553PCU/hr
Greenberg
U=114.56ln$\frac{871}{K}$, R^2 = 0.882
Q_{max} = 5050PCU/hr

Figure 7 Relationship between Speed and density using Green shields and Green berg Hayatnagar

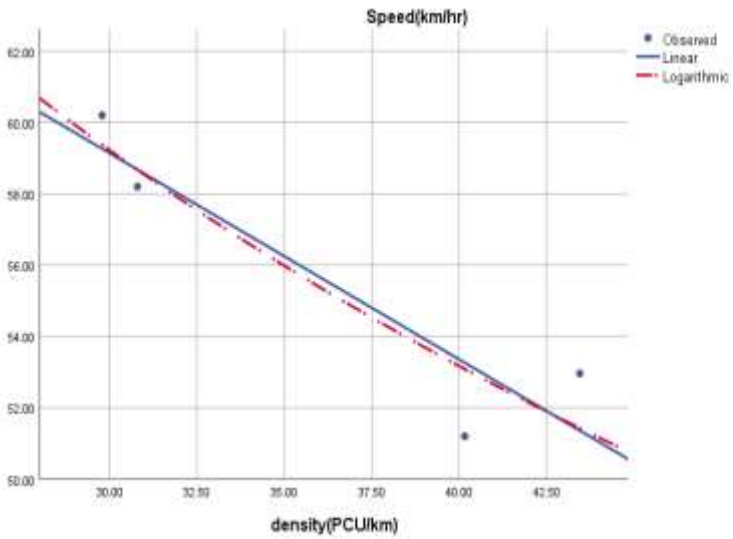
Analysis at L.B nagar location Green shields and Greenberg model



Green shields
U= (79.915e0.610) K
R^2=0.941,
Q_{max} = 2618PCU/hr
Greenberg
U=135.6ln$\frac{492}{K}$, R^2 = 0.865
Q_{max} = 3933PCU/hr

Figure 8 Relationship between Speed and density using Green shield and Greenberg Lb nagar

Analysis at Kothapet location Green shields and Greenberg model kothapet location



Green shields
U= (76.495e0.579) K
R^2=0.85,
Q_{max} = 2526PCU/hr
Greenberg
U=130.8ln$\frac{492}{K}$, R^2 = 0.822
Q_{max} = 3817PCU/hr

Figure 9 Relationship between Speed and density using Green shield and Greenberg model Kothapet

6.9 Capacities by Green shields model and Greenberg model with Chandra's method PCU values

The capacities were derived from Green shield and Greenberg model by converting traffic volume into PCU/hr using Chandra's PCU values. These models are based on Speed-Density-Flow Relationships.

Green shields model is Linear whereas Green berg is Logarithmic

Table 9 Capacities by Green shields model and Greenberg model

Capacity for locations (moving from Hyderabad city to Andhra Pradesh)				
S.No	Location	Chandra's method		
		Green shield (PCU/hr)	Greenberg (PCU/hr)	v/c ratio
1.	Kothapet	3264	5088	0.7
2.	L.B nagar	3477	3840	0.57
3.	Hayatnagar	3382	4721	0.82
Capacity for locations(returning from Andhra Pradesh to Hyderabad)				
4	Hayatnagar	2553	5050	0.78
5	l.b nagar	2618	4094	0.79
6	Kothapet	2527	3817	0.77

6.9.1 CAPACITIES OF GREEN SHIELD AND GREEN BERG

From the above Table capacity values, we conclude that Green shields model is more reliable to site conditions having good v/c ratios 0.57, 0.7, 0.77, 0.78, 0.79, 0.82. PCU_iValue varies with volume to capacity ratio. As v/c ratio increases PCU values also increases, Heavy vehicles, Rapid Transit Bus has higher PCU value with respect to v/c ratio. In addition, the values of PCU obtained by PTV VISSIM software is slightly lower for all vehicle types when compared with values obtained by Chandra's method.

6.10 MODELING USING MICRO-SIMULATION

VISSIM was used to simulate the existing conditions and a featured scenario of traffic operations at the goal was to evaluate speed, density and capacity measurement, volume to capacity ratio, passenger car unit (PCU).

6.10.1 CAPACITY OF MOVING TO ANDHRA PRADESH AND VICE VERSA ON MULTI-LANE HIGHWAY BY MICRO SIMULATION DATA

The capacity estimation is done by obtained simulated data from the link results like speed, density and flow data by using the green shield model and calculation of v/c ratio is also calculated for simulated output data. For this validation of speed and volume is necessary.

Table 10 Capacity by simulated speed and calculation

S. No	Capacity moving from Hyderabad to Andhra Pradesh			
	Locations	Simulated volume(PCU/hr)	Capacity (PCU/hr)	v/c ratio
1.	Kothapet	2346	2432	0.96
2.	l.b nagar	2408	2608	0.92
3.	Hayatnagar	2485	2772	0.89
	Capacity returning from Andhra Pradesh to Hyderabad city			
	Locations	Simulated volume	Capacity	v/c ratio
5.	Hayatnagar	1879	1967	0.95
6.	L.B nagar	2107	2514	0.83
7	Kothapet	1843	2093	0.88

Table 11 PCU resulted from Simulated Speed depending on the volume ratio

v/c ratio	car	2-W	3-W	HCV	LCV	RTC BUS	RAPID BUS
0.83	1	0.334	0.65	4.182	2.58	4.96	5.86
0.88	1	0.328	0.647	4.17	2.46	4.98	5.64
0.89	1	0.318	0.568	4.15	2.42	4.99	5.46
0.92	1	0.312	0.546	4.10	2.32	5.03	5.12
0.95	1	0.308	0.512	4.10	2.09	5.12	5.06
0.96	1	0.304	0.508	4.09	2.08	5.14	5.02

PCU_i value varies with volume to capacity ratio. As v/c ratio increases PCU values also increases, Heavy vehicles, Rapid Transit Bus has higher PCU value with respect to v/c ratio. In addition, the values of PCU obtained by PTV VISSIM software is slightly lower for all vehicle types when compared with values obtained by Chandra's method.

7. CONCLUSIONS

7.1 CONCLUSIONS OBTAINED FOR PCU ESTIMATION VALUES

Rapid Transit bus PCU value for 3 locations (moving and returning) 5.49, 5.35, 5.59 and 3.33, 3.47, 3.6 for Chandra's and homogenization coefficient method. Comparing both methods we found that Chandra's method is appropriate. PCU value for 2W, 3W, Car, HCV, LCV, RTC bus, Rapid Transit bus locations (moving and returning) as 0.38, 0.89,4.45, 2.98, 5.2 Chandra's method and 0.34, 0.95, 4.68, 2.84, 5.21 for 3 locations (moving and Returning) by homogenization method. A new set of PCU values are suggested for use by practicing engineers on multilane highway the PCU of Rapid transit bus as 5.21 to 5.36 and HCV ranges 4.45 to 4.8. As the volume increases the PCU value for the vehicle decrease. Passenger car unit value increases as traffic volume increase

7.2 CONCLUSIONS FOR CAPACITY ESTIMATION.

The capacity of multi-lane highways is more significant in PCU/hr. The speed density model for the Kothapet, L.B Nagar and Hayat Nagar (moving from Hyderabad) has an R^2 value of 0..99,0.94,0.97is significant it explains the high percentage of the relation between speed and density with Green shields model capacity has 3264pcu/hr, 3477pcu/hr, and 3382pcu/hr. Green berg model capacity has 5088pcu/hr, 3840pcu/hr, 4721pcu/hr. The speed density model for Hayat Nagar, L.B Nagar, Kothapet, (Returning from Andhra Pradesh) has an R^2 value of 0.88,0.94,0.92 is significant it explains the high percentage of the relation between speed and density with Green shields model capacity has 2553pcu/hr, 2618pcu/hr and 2527pcu/hr. Green berg model capacity has 5050pcu/hr, 4094pcu/hr, 3817pcu/hr. By comparing both Green shields and Greenberg model. Green shields have lesser capacities than the Greenberg model whereas the Green shields model is more appropriate to the field condition and more consistent and has less variation. The volume to the capacity ratio by considering Green shields capacities as 0.57, 0.7, 0.72, 0.77, 0.78, and 0.82 which is nearer to capacities

7.3 CONCLUSIONS FOR VISSIM

The validation result of the VISSIM simulation model for mixed traffic flow done by comparing speed and volume shows microscopic simulation developed for this study has the capability of replicating heterogeneous traffic flow for the multilane highway. Passenger car unit values for heavy vehicles decrease with an increase in volume/capacity ratio. Thus, it is dynamic PCU values instead of fixed values for different types of vehicles

8. FUTURE SCOPE

The rapid transit bus value derived is used in the future study for future not including the transit bus value as bus PCU. This study was conducted on flat terrain on the road segment and further researchers may consider the geometric effect of multi-lane highways. The passenger car unit and the capacity of multi-lane highways found in this study by field data are different values suggested to highway capacity. Based on this, the proposed capacity and PCU for moving Hyderabad to Andhra Pradesh and Andhra Pradesh to Hyderabad city may be important for Hyderabad city traffic engineers who plan, design, operate, and maintain multi-lane highways corresponding to local conditions.

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