The International Journal of Engineering and Science (IJES)
ISSN (e): 2319 – 1813 ISSN (p): 23-19 – 1805
|| Pages || PP 62-66 || 2018 ||

Analysis and Modeling of Heterogeneous Traffic in Nagpur City (Nh-07)

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ABSTRACT: *This paper model based on Heterogeneous traffic in Nagpur . First we observed the behavior of the traffic i.e. Homogeneous and Heterogeneous traffic and found that the behavior of Indian traffic is heterogeneous . For that we select the section of NH-07 near MIHAN bridge , Nagpur. Then we studied the traffic parameters such as speed ,flow and density, and their relation between speed ,flow and density. We recorded the video data of traffic stream and analyze the data to study the different traffic parameters such as , speed ,flow and density . We get the different relationship between speed flow and density which was then compared with standard fundamental diagrams given by Highway Capacity Manual (HCM) . From this graph we get new equations for Heterogeneous traffic for that section of road i .e on NH-07, Nagpur by using the SPSS software. This model is helpful for road planning and traffic Parameters management to reduce the jam density and accident on the highways and increase the safety for road users.*
KEYWORDS :-*Density, Flow, Heterogeneous traffic , Speed, , SPSS Software*

I. INTRODUCTION

Indian roads are among the most motorized in the world as it claims over 1.5lakh lives each year and followed in foreign countries but the behavior of traffic flow in foreign countries is homogeneous and Indian traffic is heterogeneous. Mixed or heterogeneous traffic flow is defined as traffic stream containing various vehicles either motorized or non-motorized. In order to understand what the exact meaning of mixed traffic, it is important to understand the traffic flow itself. Traffic flows occur because of the intersection between its components comprising land use, road infrastructure and vehicles.

Traffic flow defined as "The movement of pedestrian, cyclist and motorized vehicle along routes". Moreover motorized vehicles are classified into five groups i.e. two wheelers, cars, buses, truck, commercials vehicles. In contrast to (TRB-TRANSPOTATION REASERCH BOARD COMMITTIES) classify motorized vehicle into six classes i.e. cars, trucks, vans, buses, recreational vehicles and motorcycles.

Based on the above explanation the definition of mixed traffic is closer to various transport modes or types of vehicles available in the road segments. Different types of vehicle will have

different characteristics affected by the environment surrounding the road. Such characteristics play a key role in the analysis of traffic flow characteristics, road capacity and road pavement.

The characteristics include the physical properties of vehicles (i.e. dimensions and weight) and also the operation of the vehicle i.e. speed and movement. Therefore, the vehicle standard is needed in the analysis.

Understanding traffic behavior requires a thorough knowledge of traffic stream parameter and their mutual relationship. The traffic stream parameter provide information regarding the nature of traffic flow, which help the analyst in detecting any variation in flow characteristics the fundamental parameter of traffic flow are:-

Speed:- Speed is considered as a quality measurement of travel as the drivers and passenger will be concerned more about the speed of the journey than the designed aspect of the traffic . It is defined as the rate of motion in distance per unit of time. Mathematically, v=d/t

where,

v=speed of vehicle in m/s.
d=distance travel in m.
t=time in sec.

Flow: - There are practically to ways of counting the no. of vehicles on a road. One is flow or volume, which is defined as the no. of vehicles that passes a point on highway or a given lane or direction of highway during specific time interval. The measurement is carried out by counting the no. of vehicles 'n_t', passing a particular point in one lane in define period,

Mathematically, $q= n_t/t$

where,

n_t= no. of vehicles.

t=time in sec.

Density :- It is define as the no. of vehicle occupying a given length of highway or lane and is generally expressed as vehicle per km.

Mathematically, $k= n_x/n$.

where,

x= length of road.

n_x = counted no. of vehicle.

1.1 Green shield's macroscopic stream model (1935)

1.1.1 Relation between speed and density

Macroscopic stream models represent how the behavior of one parameter of traffic flow changes with respect to another. The first and most simple relation between them is proposed by Green shield (TRB Monograph). Green shield assumed a linear speed-density relationship as illustrated in figure 1 to derive the model.The equation for this relationship is shown below.

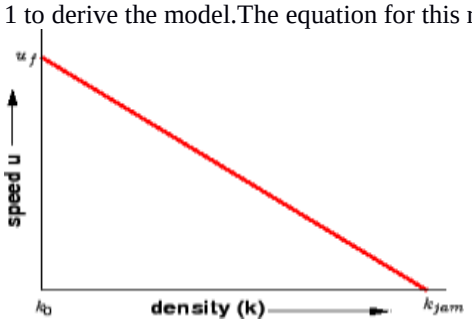

Fig. 1: Relation between speed and density

This relationship is described using equation 1.

$$v = v_f - \left[\frac{v_f}{k_j}\right].k$$

Where, *v* =mean speed, m/s

k = density corresponding to speed (veh/m)

v_f=free flow speed (m/s)

k_j=jam density (veh/m)

This equation is often referred to as the Greenshield model. It indicates that when density becomes zero, speed approaches free flow speed (i.e. $v \rightarrow v_f$ when $k \rightarrow 0$).

1.1.2 Relation between speed and flow

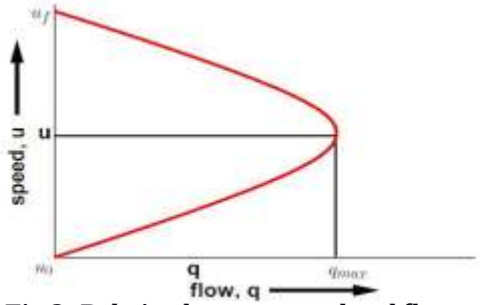

Fig-2: Relation between speed and flow

1.1.3Relation between flow and density

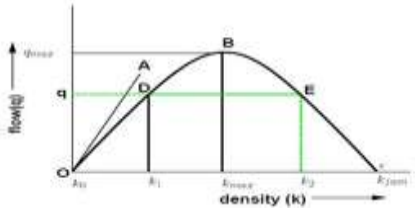

Fig-3: Relation between flow and density

$$q = v_f.k - \left[\frac{v_f}{k_j}\right]k^2$$

$$q = v_f.k - \left[\frac{v_f}{k_j}\right] k^2$$

II. METHODOLOGY

Traffic data was collected on NH 7 i.e. Nagpur to Wardha . The data was collected by considering the flow near the Mihan Flyover. By using the digital video camera . The camera was kept stationary above the MIHAN FLYOVER from where entire view of highway was observed . A

50m length was marked on roadway section to locate the distance travelled and to record time taken by vehicle the 50m distance.

The data was collected for 2 days from 9am to 6pm. This covered peak flow and off peak flow condition. The road section was access control. The data contained in video clips was analyzed in the VLC Media Player using frame by frame analysis. The time required by each vehicle to covered the distance of 50m was recorded from the video clips and the number of vehicle of each entity type crossing a particular section in 5 mins. was recorded.

General inspection of data showed presence of heterogeneous vehicle classification of road shown in table

Sr. No	Types of Vehicles
1	Heavy Vehicles
2	Big Cars
3	Small Cars
4	Three Wheelers
5	Two Wheelers

Table 1 : Classification of Vehicle

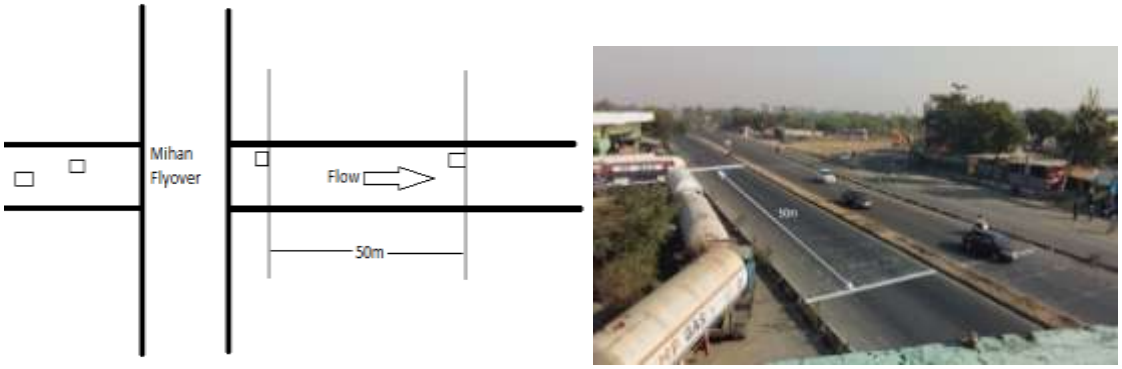

Fig.4 50m marking on road

Time Interval (min.)	No Of Vehicle (veh/5min)	speed (v) (kmph)	flow (q) (veh/hr)	Density (k) (veh/km/hr)
0-5	42	64.61	504	7.80
5-10	45	65.77	540	8.21
10-15	55	64.84	660	10.18
15-20	62	60.01	744	12.40
20-25	41	70	492	7.03
25-30	65	55	780	14.18
30-35	55	65.84	660	10.02
35-40	57	59.33	684	11.53
40-45	42	64.98	504	7.76
45-50	62	60.15	744	12.37
50-55	52	63.22	624	9.87
55-60	66	50.01	792	15.84

Table2:-Sample data

This covered peak flow and off peak flow condition. The time required by each vehicle to cover the distance of 50m was recorded from the video clip and the number of vehicles of each entity type crossing a particular section in 5 minute was recorded.

III. ANALYSIS AND RESULT

Fig.5 :- Speed-Flow curve

Fig.6 :- Speed-Density Curve

Fig.7 :- Flow-Density Curve

IV. MATHEMATICAL MODEL

In this study it is observed that the data points in congestion region do not exist. This is due to lesser no. of vehicles utilizing facility. Hence the data points on congested or infeasible region are not observed. By using SPSS software, we find out the correlation between traffic stream parameters of observed data. And we get the following regression equations:

Flow-Density relationship:-

$$k = 0.024q - 4.721 \quad (1)$$

Speed-Density relationship:-

$$k = -0.476u_s - 40.093 \quad (2)$$

Speed-flow relationship:-

$$k = q/u_s$$

Therefore eq^n (2) becomes,

$$q = -0.476u_s^2 - 40.093u_s \quad (3)$$

Density is the dependent variable and speed and flow are independent variable. Flow-density curve and speed-density curve shows the linear relationship and we get non-linear regression model. –Ve sign in flow-speed equation shows the negative behavior of the curve.
Speed-Flow-Density relationship is given by

$$k = 0.014*q - 0.232*u_s + 15.725 \quad (4)$$

Where, k= traffic density in lanes in vehicles/km.
q = traffic flow across the lane in a vehicle/hr.
u_s = weighted average speed in km/hr.

V. CONCLUSION

From the survey we find out that our Indian traffic is heterogeneous traffic. It is concluded that existing equation of traffic stream are not suitable for these Heterogeneous traffic. Thus we need to create new equation for this Heterogeneous traffic of Indian scenario. According to our complete analysis we found the traffic stream parameters. We get standard relationship between traffic stream parameters. We get a simple regression equation for heterogeneous traffic of Nagpur city.

REFERENCES

6.1 Journal Papers

[1]. Francesc Soriguera, Ph.D.(2012),Deriving Traffic Flow Patterns from Historical Data, JOURNAL OF TRANSPORTATION ENGINEERING,ASCE / DECEMBER 2012/1432
[2]. Mohammed A. Quddus,Chao Wang, Stephen G. Ison (2010), Road Traffic Congestion and Crash Severity: Econometric Analysis Using Ordered Response Models,JOURNAL OF TRANSPORTATION ENGINEERING ASCE / MAY 2010/424.
[3]. Maria de Lurdes Simões, Paula Milheiro-Oliveira2, Américo Pires da Costa(2010), Modeling and Simulation of Traffic Movements at Semi actuated Signalized Intersections,JOURNAL OF TRANSPORTATION ENGINEERING ASCE / JUNE 2010/554
[4]. Man Wo Ng, (2012), Traffic Flow Theory–Based Stochastic Optimization Model for Work Zones on Two-Lane Highways, JOURNAL OF TRANSPORTATION ENGINEERING ASCE / OCTOBER 2012 / 1269
[5]. Pan Liu, Ph.D., Xu Qu2, Hao Yu, Wei Wang, Ph.D., Bing Cao(2012), Development of a VISSIM Simulation Model for U-Turns at Unsignalized Intersections, JOURNAL OF TRANSPORTATION ENGINEERING, ASCE / NOVEMBER 2012 / 1333.
[6]. Suren Chen, P.E., M.ASCE1; and Feng Chen, S.M.ASCE2, Simulation-Based Assessment of Vehicle Safety Behavior under Hazardous Driving Conditions, JOURNAL OF TRANSPORTATION ENGINEERING © ASCE / APRIL 2010,304
[7]. Tom V. Mathew, Padmakumar Radhakrishnan(2010), Calibration of Micro simulation Models for Nonlane-Based Heterogeneous Traffic at Signalized Intersections,JOURNAL OF URBAN PLANNING AND DEVELOPMENT ASCE / MARCH 2010 / 53.
[8]. Xumei Chen, Lei Yu, Ph.D., P.E., M.ASCE, Lin Zhu3, Jifu Guo, Mingzheng Sun(2010), Microscopic Traffic Simulation Approach to the Capacity Impact Analysis of Weaving Sections for the Exclusive Bus Lanes on an Urban Expressway,JOURNAL OF TRANSPORTATION ENGINEERING, ASCE / OCTOBER 2010 / 895.
[9]. Xiugang Li1; Dominique Lord, M.ASCE2; and Yunlong Zhang, M.ASCE3, Development of Accident Modification Factors for Rural Frontage Road Segments in Texas Using Generalized Additive Models JOURNAL OF TRANSPORTATION ENGINEERING © ASCE / JANUARY 2011,74
[10]. Yali Chen, Ph.D., Xiao Qin, Ph.D., P.E., David A. Noyce, Ph.D., P.E., Chanyoung Lee, Ph.D.(2010),Interactive Process of Micro simulation and Logistic Regression for Short-Term Work Zone Traffic Diversion,JOURNAL OF TRANSPORTATION ENGINEERING ASCE / MARCH 2010 / 243.
[11]. Zhongzhen Yang, Gang Chen, Douglas R. Moodie.(2010), Modeling Road Traffic Demand of Container Consolidation in a Chinese Port Terminal, JOURNAL OF TRANSPORTATION ENGINEERING ASCE / OCTOBER 2010 / 881.

6.2 Books

[12]. L. R. Kadiyali, Traffic Engineering and Transport (Khanna Publishers, Delhi, 2007