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ESTIMATION OF CAPACITY AND MODEL DEVELOPMENT USING LINEAR REGRESSION

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Abstract - *Two lane highway play a major role in highway system in India. The assessment of performance of two-lane roads is necessary for the future traffic planning, design, operation and also maintenance. Indian roads have mixed traffic flow which leads to traffic congestion. It causes slower speeds, vehicular queuing, and various safety issues. Assessment of two-lane road is according to the methodology of Indo Highway Capacity Manual. To achieve this objective the study area selected are Kanjany-Olari and Pazhuvil Peringottukara in Thrissur district of Kerala.Videographic data from which volume count of vehicle and spot speed of vehicle is calculated. The aim of the study is to model the capacity for the selected road stretch using multiple linear regression.*

Key Words: **Stream equivalency, Capacity, Congestion, Vehicular queuing, Multiple Linear regression**

1. INTRODUCTION

Most of the National and state highway system are composed of two-lane roads. More than 50% of State Highways and two-thirds of National Highways still have two lanes in each direction. Traffic operation on a two-lane two-way highway is unique. Lane changing and overtaking are possible only in the face of on- coming traffic in the opposing lane. The overtaking demand increases rapidly as traffic volume increases, while passing opportunities in the opposing lane decline as volume increases. Therefore, flow in one direction influences flow in the other direction. When there is a significant speed difference among various vehicle classifications in mixed traffic, the problem is more severe. With limited chances to overtake, it substantially increases the desired number of overtakes.

In the design, planning, operation, and layout of road network sections, predictions and knowledge of capacity is essential. Lane width, gradient, lateral clearance, width, and type of shoulder are all elements that affect a two-lane road's capacity. Traffic capacity can be significantly impacted by lane and shoulder width. Vehicles in narrow lanes travel closer to one another laterally by slowing down or by observing wide longitudinal gaps at a particular speed. Important traffic conditions which affect capacity are composition of traffic stream, directional split and presence of slow-moving vehicles in the stream.

The performance and consequent capacity of the driver are impacted by environmental factors such as wet pavement, snow and ice conditions, rain, darkness, fog, and parking regulations. There are indications that slippery or wet pavement can reduce capacity by 5% to 15%.

1.1 objectives

- To determine Vehicle proportion of the selected road stretch
- To develop multiple linear regression model to determine capacity of the selected road stretch.

2. BACKGROUND OF THE RESEARCH

Manish. Jain, Ajinkya Mane, et.al. [1] conducted study on capacity estimation on 2-lane hilly roads under heterogeneous traffic condition in India.The present study is made on the estimating capacity on hilly road under heterogeneous traffic.Here they develop a relationship between capacity v/s operating speed of car, capacity v/s gradient magnitude. Finally, they conclude by saying that undivided hilly roads decrease with increase in magnitude gradient.

Vijay B. G, Dr. Rajendra Khatawkar [2] Data collected for seven days at different sections of two-lane national Highways (NH-206, NH-209 and NH-207). Manual and videographic method and developed a linear regression equation using SPSS. The result shows that capacity of the roadway will increase proportionally as lane width and the horizontal curve radius increase, whereas the capacity of the highway decreases as gradient increases.

Gauri.S. Biraje, Prof A.S Thorbole [3] conducted study on capacity assessment on two lane road on state highway. This study used the capacity evaluation of a 2-lane road by the Indo-Highway Capacity Manual to determine the causes of traffic congestion in a case study location in Maharashtra and found that capacity is reduced, and traffic congestion is more during peak hours.

Pinakin Patel, Ashish Dhamaniyab [4] study is conducted at five signalized intersections of Ahmedabad, Surat and Noida, India. A stream equivalency model based on regression has been created. By developing stream equivalency based on the calculated PCUs during saturated green time, this study provides an approach for estimating saturation flow. The equations are validated by comparing the field and calculated values of saturation flow.Model value is closer to the field saturation flow, according to the results.

ChetanR.Patel et.al. [5] Author conducts a case study on six-lane roads in Pune and Patna to examine the sudden impact of roadside friction on a given traffic flow condition. The author compares service volume and stream speed at various volume-to-capacity ratios to assess the presence of roadside friction. Study analysis reveals that roadside friction has a significant impact on the capacity of urban arterials.

Thamizh Arasan et.al. [6] provides a computer simulation model (heterosim) to assess PCU values in heterogeneous traffic flow situations and states that PCU values considerably changes with changes in traffic volume and road width.

V. Thamizh Arasan et.al. [7] The author deceives diversified flow with vehicles having different steady and moving parameters without taking lane discipline into account, and the study's results accurately replicate heterogeneous traffic flow conditions on roads where vehicles are moving while taking the absence of lane control into account.

3. STUDY AREA

Study areas were identified as Kanjany-Olari and Pazhuvil Peringottukara of Thrissur district in Kerala. State highway 75 is the state highway in Kerala which starts in Thrissur and ends in Vadanapally. Kanjany-Olari is the part of SH 75.

4. METHODOLOGY

The study stretch was identified. Data collection includes collection of videographic data and geometric data of the study stretch. Spot speed and Volume count data were extracted from the videography. Geometric data collected include Carriageway width, Shoulder width, type of shoulder, parking characteristics, presence of footpath and side roads which affects the capacity of road. The model was developed with dependent variable capacity of the selected stretch and independent variables are speed, volume count, carriageway width, shoulder width, type of shoulder and parking characteristics of vehicle.

5. DATA COLLECTION

Primary data is collected for 2 stretches which include geometric details and traffic data. Traffic data include spot speed data and volume count for the stretch. For the data extraction, video was extracted for a time period of 4hrs (morning and evening). Spot speed was extracted for time period of 5-minute interval. geometric data were collected from the field.

6. DATA ANALYSIS

With the aid of Excel tool data analysis in which vehicle proportion in which composition of vehicle in percentage for the Kanjany-Olari and Pazhuvil-Peringottukara were estimated.

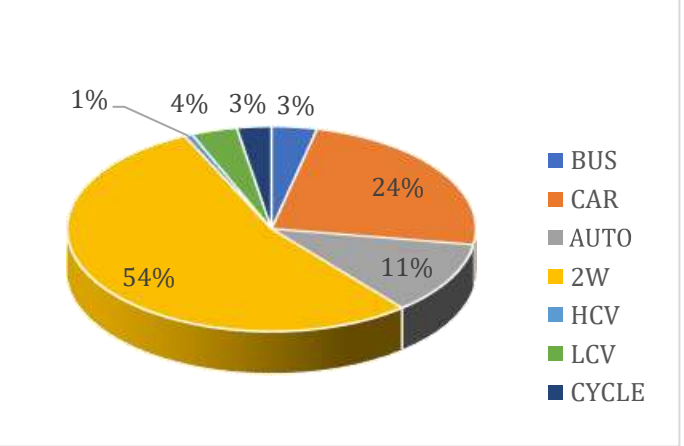

Chart-1: Vehicle proportion for Kanjany-Olari

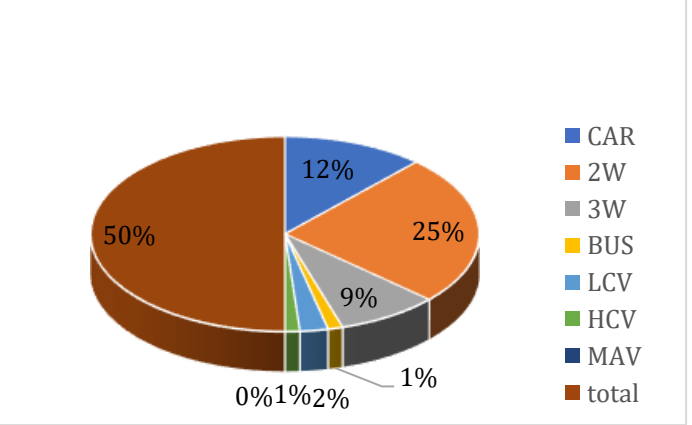

Chart-2: Vehicle proportion for Pazhuvil-Peringottukara

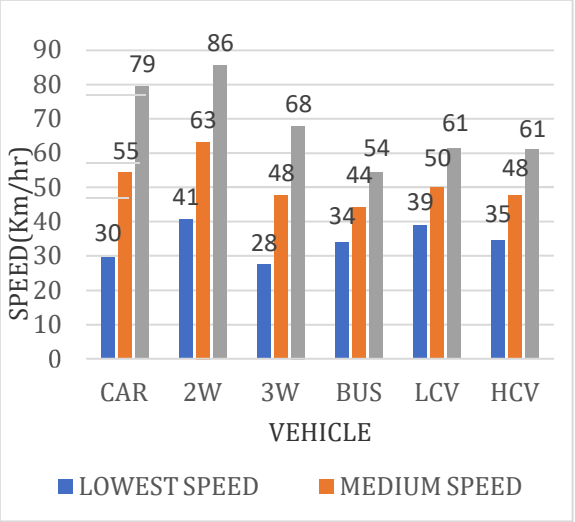

Chart-3: Spot speed analysis of Kanjany-Olari

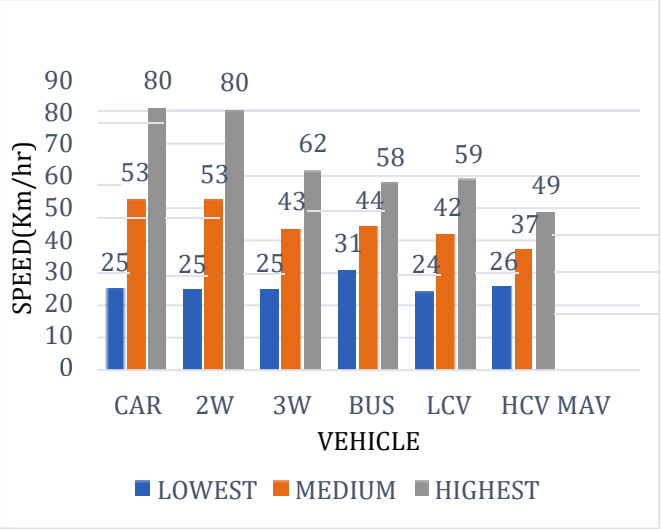

Chart-4: Spot speed analysis of Pazhuvil-Peringottukara

7. MODEL DEVELOPMENT OF CAPACITY USING SPSS

Multiple linear regression for capacity was developed using SPSS Software. Dependent variable used is Capacity(C) and independent variable used were Stream equivalency factor (SEF), Shoulder width left (SWL), Speed (S)

C=602.505-419.961 x SEF+108.459x SWL+42.831x S

Model developed with R^2 value 0.996 which indicates the best fit.

Table -1: ANOVA table

modal		Sum of square	df	Mean square	F	sig
1	Regression	904640.294	3	301546.765	2276.401	.000b
	Residual	3709.060	28	132.466		
	Total	908349.354	31			

Table -2: Coefficients

Model	Coefficient	Remark
Constant	602.505	significant
Stream equivalency factor	-419.961	significant
Shoulder width (m) left	108.459	significant
Speed (Km/hr)	42.831	significant

Parking condition and Carriageway width show a negative relationship. When parking on the carriageway exists the capacity of road reduces. An increase in carriageway can lead to decrease in capacity because there may be chance of on street parking on road.

8. CONCLUSION

The model was developed with R^2 value 0.996 which show the best fitof model. Shoulder width, Stream Equivalency factor and Speed of vehicle show good correlation. When the width of shoulder increases, capacity can also be increased that can lead to a reduction in congestion. The value of stream equivalency factor indicates that a greater proportion of small vehicles are present in the road rather than heavy vehicles. Standard errorof regression is smaller value which indicates it is better because it indicates that the observations are closer to the fitted line. From the obtained linear regression equation, The coefficient of SEF shows that 1unit increase in value of SEF would result in 419.961 decrease in capacity and other variable being held constant. The coefficient of SWL shows that 1m increase in value of SWL would result in 108.459 increase in capacity other variable being held constant. The coefficient of S shows that 1Km/hr increase in value of speed would result in 42.831increase in capacity other variable being held constant.

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