Traffic Parameters Of Non-Motorized Vehicles In Various Types Of Traffic Conditions

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ABSTRACT

In present day scenario, in countries like India we can find mixed traffic conditions, i.e. traffic flow constituting of all sorts of vehicles like cycles, rickshaws, auto and so on. During the peak hours, the flow of NMVs is high. The presence of NMV in the traffic stream affects the traffic characteristics like speed, density and flow of the stream. In order to design a traffic facility, the traffic behaviour has to be understood. For the mixed traffic conditions, it is difficult to understand the behaviour of the stream. In this thesis, an endeavour is kept to study the traffic characteristics of NMVs in mixed stream.

The entire project work is consists of two parts. The former is the experimental part and the latter is the statistical testing part. The former part of study includes the study of the fundamental diagrams, finding the capacity of the section and the lateral occupancy of the section for the data obtained from the various parts of the Visakhapatnam and Vizianagaram districts. It was seen that with the change in the NMV percentage an adversity is found in the parameters like speed, density and flow. In the study of lateral occupancy, it is observed that in one way divided traffic flow, the maximum number of NMVs are occupying the left two strips and the MVs are occupying the right most strips as our Indian traffic behaviour is left handed and it is easy for the MVs to overtake the slow moving vehicles. In the case of undivided two way traffic, the maximum number of traffic is found in the middle portions but a minimum on the right and left strips in the light of fact that the vehicles are present in the opposite directions.

In the statistical analysis part, a comparison is made for the traffic parameters in Visakhapatnam and Vizianagaram between 2014 and 2016. The hypothesis testing is conducted between the traffic parameters and variations are found. The hypothesis testing compares the means of the two observed samples. The procedure follows four steps. The first step is of stating the null hypothesis, it is followed by test static, P-value and conclusion and finally decision making. The decision is made on the basis of Z observed and the obtained P-value. The results indicate that the percentage NMV is decreased from 2014 and the speed and flow got increased from 2016.

1. INTRODUCTION

In the present day scenario almost all the road traffic consists of mixed traffic, i.e. the combination of both Non-Motorized and Motorized traffic. The mixed traffic affects the characteristics of the traffic stream to a great extent.

Non-Motorized Vehicles are the vehicles which will run with the power of human beings or animals. The non-motorized vehicles include bicycles, rickshaws, and hand drawn vehicles, pull carts and so forth.

Motorized vehicles are those vehicles which run with the power of the engines. The motorized vehicles are divided into light motorized vehicles and heavy motorized vehicles. Light motorized vehicles consist of auto rickshaws, jeeps, taxis, motorcars, three-wheeler conveyance vans and soforth. Motorcycles do not come under this category. Heavy motorized vehicles consists of vehicleswith number of wheels more than six. This Heavy Motorized Vehicles consists of Buses, Lorries, and Trucks etc.

As per the World Bank survey about 50 percent of the non-motorized vehicles are present in the south Asian nations like India, Bangladesh. In Bangladesh, the maximum number of trips generated during peak hours is due to non-motorized vehicles like bicycles, rickshaws.

The presence of non-motorized vehicles affects the capacity of the section. With the increase in the Non-Motorized vehicle capacity, the total capacity of the section will be reduced, affects the safety of the total stream and the declining of energy resources (petrol, diesel etc.). In order to minimize the consequences of Non-Motorized vehicles there should be a separate track for Non-Motorized Vehicles like in U.S.A. or else proper study should be made on the Non-Motorized vehicles and its effects on the traffic stream.

In India practically it is not possible to lay a separate track for Non-Motorized vehicles, so proper study has to be conducted on Non-Motorized Vehicles and

its characteristics along the mixed stream. Hence Non-Motorized vehicular movement and its effects on traffic characteristics are taken into account in the project.

2.LITERATURE REVIEW

☐ Rahman et al (2005) conducted research on "The Effect of Rickshaws and Auto Rickshaws at Signalized Intersections" in Dhaka city. He collected data from four signalized intersections where there is minimum proportion of turning vehicles, no parking, and high traffic volume. Later he developed a model for finding passenger car equivalents of rickshaws and auto rickshaws at signalized intersections do not affect the PCE of rickshaws and auto rickshaws, the vicinity of rickshaws and particles. He concluded the outcome as the green light time, the width of the signalized intersection and auto rickshaws in the mixed traffic lane affects the traffic stream a lot. The number of rickshaws is more the effect is less and vice versa.

☐ Rahman et al (2003) conducted a study on the "Effect of Non-Motorized Vehicles on Urban Road Traffic Characteristics." The target of this paper is to present analytical procedure of traffic flow and to create models of passing, surpassing and lane utilization for heterogeneous traffic flow. All the data were collected at the mid-block sections located in Dhaka. The vehicle movements were recorded using a portable video camera and the data was decoded using time code reader software. The data were recorded in five minute interval. The results are shown in the speed-density, speed-flow, and flow-density diagrams. With the increase of non-motorized vehicles the speed, density and flow reduces significantly at a certain rate.

☐ Rahman of Bangladesh and Fumihiko of japan (2004) conducted a study on "Passing Overtaking Characteristics and Level of Service of Heterogeneous Traffic Flow." This study was conducted in the city of Dhaka, Bangladesh. In this study he developed a passing-overtaking model on heterogeneous traffic flow in urban cities with undivided lanes having more proportion of rickshaws. He attempted to provide level of service (LOS) for this type of roads. He categorized level of service into six categories (A, B, C, D, E and F). Based on the traffic characteristics of the road, he classified into four groups, LOS 1 indicates a free flow condition, LOS 2 shows that it is a partial flow condition where as LOS 3 and LOS 4 represents constraint flow and congested flow conditions respectively. The traffic characteristics considered in this study are average speed of the passenger car and the number of passing and surpassing vehicles in the stream along the section. The results showed that the presence of the rickshaws has an adverse effect on the passing-overtaking characteristics.

3. METHODOLOGY

As explained in the above section the whole project is divided into two parts.

☐ Experimental Part
☐ Statistical Analysis Part.

The experimental part comprises of data collection, data extraction and results of the collected data

The statistical analysis part is described in the following section (Chapter 4)

3.1 DATA COLLECTION:

➢ The data collection consists of manual collection of the data from various locations. The project primarily aims in and around Visakhapatnam and Vizianagaram districts. The data is collected from five different locations in Visakhapatnam and Vizianagaram districts. The locations are selected such that they have different traffic conditions and different roadway patterns. The five locations are enlisted below

- Road at Anandapuram.
- Road near Pendurthi.
- Road near Kothavalasa.
- Road near Chodavaram.

The sections should contain traffic volume, minimum number of turning vehicles, no parking zones. The surface of the road should be even and level terrain. The section should not contain bus stops. The data are collected for a minimum of 30 minutes in each section with the help of manual counting. The section is of 15 meters length and the section is fixed by placing markers at each end.

3.2 DATA EXTRACTION:

As per the objectives of the experimental part, the data extraction or data decoding consists of the following.

- To study the fundamental diagrams of traffic flow obtained from various locations
- To find the capacity of the sections from fundamental diagrams
- To find the lateral occupancy of the section

- To study the behaviour of Non-Motorized vehicles in the stream.

4. STATISTICAL INFERENCE
INTRODUCTION TO HYPOTHETICAL TESTING:

Hypothesis testing or statistical testing is used to determine whether the statement is correct or incorrect.

This hypothetical testing is carried out in four steps.

1. Null and alternative hypothesis.
2. Test static
3. P-value and conclusion
4. Decision.

STEP 1:

The primary step of the hypothesis test is to form a question into null hypothesis and the alternate hypothesis. Null hypotheses demonstrate that there is no significant distinction between the observed means. Alternate hypotheses indicate that there is a difference between the observed means.

Null hypotheses (H0): $\mu1-\mu2 = 0$

Alternate hypotheses (Ha): $\mu1-\mu2 \neq 0$

Where $\mu1$ = mean of the first sample

$\mu2$ = mean of the second sample

Both the null hypothesis and alternate hypotheses refer to population values, but not observed statics.

STEP 2:

We find the **test statistic** from a set of observed data. There are different kinds of test statistics one of them is one-tailed z-test. This z test differentiates the detected sample mean μ to an expected population mean μ_0. More number of test statistics demonstrate that information (the data) are along way from expected, providing confirmation against the H0 (null hypothesis) and for Ha (alternative hypothesis).

STEP 3:

The test measurement (test static) is changed over to a conditional probability called P-value. The *P*- value answers the inquiry "If the null hypothesis were genuine, what is the likelihood ofobserving the present data or data that is more extreme?"

Little P values provide proof against the null hypothesis in the light of the fact that they say the observed data are far-fetched when the null hypothesis is valid.

STEP 4:

Alpha (α) is the probability threshold for a decision. If $P \leq \alpha$, then we will not accept the null hypothesis. Else we will accept the null hypothesis.

ONE-SAMPLE *Z* TEST:

A test in which the alternative hypothesis indicates that the population parameter lies altogether above or below the value specified in H_0 is a one-sided (or one-tailed) test.

TWO-SIDED ALTERNATIVE:

An alternative hypothesis that predefined that the parameter can lie on either side of the value specified by H_0 is called a two-sided (or two-tailed).

Whether to utilize a 1-tailed or 2-tailed test relies upon the way of issue. Typically we use a 2-tailed test. A 1-tailed test regularly obliges somewhat more hypothesis. Two tailed test is moregeneralized as compared to that of one-tailed test. For one tailed test, it requires a stronger reason that in which direction it is varying where as in the case of two tailed test no such reason required.

In this hypothetical testing we compared two test results of 2015 and 2016 and the variation of the means in the traffic parameters like flow, density and speed were found A two tailed z test is conducted on the traffic parameters as we do not know whether they are increasing or decreasing.

STEP 1:

H0 is stated as the difference between the means of traffic parameter (speed or flow or density) is zero

Ha is the alternative hypothesis and is stated as the difference between the parameters is non zero.

STEP 2:

The level of significance (α) is taken as 0.05. To find the probability of getting a sample mean from a given population, we use the standard normal distribution. We will find the z scores in a standard normal distribution that are the limits, or **critical values,** for test mean values with notas much as a 5% likelihood of occurrence if the value expressed in the null is true.

As it is a two tailed test we have to divide α value into two equal halves so that an equal portion of the area is placed between upper and lower tails. The z critical value for this α value is ±1.96 from unit normal tables. If the values fall beyond these critical regions, then we reject the null hypothesis else we retain the null hypothesis.

The z stat is calculated from the following mathematical equation

$$\text{Z stat} = \frac{^-\mu}{\sigma_M}$$

Where M= sample mean,

μ= populated mean,

σ_M = standard error of the mean.

5.CONCLUSION

- From the fundamental diagrams, it can be observed that the traffic parameters in the section are affected largely by the percentage of non-motorized vehicles in the section. For both the divided and undivided lanes the pattern remains same, i.e., as the

percentage non-motorized vehicles increasing the parameters like density, flow and speed of the total section decreased. In divided lanes the effect is less as compared to the undivided lanes as there exists the effect of vehicles coming in the opposite direction.

☐ It can be observed from the lateral occupancy graph that the NMVs are occupying the left hand side of the road. As we follow left hand side drive in India and the MVs try to overtake them from the right hand side of the road. Also in the left first strip or 1 m from the left edge no vehicles are present as the vehicles try to keep away from road edges as far as possible and it is the psychological behaviour of drivers, they try to avoid moving at the edge when there are no shoulders or raised kerbs. Roads in which there are shoulders the vehicles are found in the first strip from left side also.

☐ In the case of divided one way traffic, the vehicles occupies in all the strips equally. As the NMVs are the slow moving vehicles they try to occupy the first two strips and the last two strips (6th and 7th) are occupied by the overtaking vehicles. The flow is maximum in the last two strips.

☐ In the case of undivided two way traffic, the occupancy pattern is not the same as that of the one way divided traffic. The vehicles will try to occupy the left three strips and rarely the fourth strip as there are the vehicles coming in the opposite direction. In this undivided two way traffic the maximum occupancy is in the middle 3rd, 4th and 5th strips and the minimum in the remaining strips as they are mostly occupied by the slow moving vehicles.

☐ From the percentage NMV point of view, there exists a uniform pattern of distribution of NMVs if the NMV percentage is moderate, the NMV occupies the left two strips if there is less percentage of NMV and if the NMV content is high then the MVs try to overtake from the right strip of the NMVs.

☐ From the comparison graphs, it is observed that the speed of the section is increased up to 15% NMV and then starts decreasing. This indicates that up to a certain limit of NMV in the stream there is no effect on the traffic parameters and as the NMV content increased more than this limit, the adversity in the traffic parameters occurs. The flow

and density will decrease with the increase in NMV content.

☐ From the data collected, it is observed that there is an increase in NMV's during day time as well as evening time as it is a rural area. So to decrease Flow, density, speed it is required to allow the NMV's to allow in the early times in the morning for both upstream and downstream, as well as the same to allow in the afternoon session so that the NMV's doesn't affect the MV in the locations.

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