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Characteristics Of Traffic For Non-Motorized Vehicles In Mixed Traffic

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ABSTRACT :

This thesis investigates the traffic characteristics of Non-Motorized Vehicles (NMVs) within mixed traffic conditions, with a specific focus on Nabarangpur City, India. The study is divided into two main sections: an experimental inquiry and a statistical analysis.The experimental segment examines fundamental diagrams, section capacity, and lateral occupancy through data collected from various locations in Nabarangpur City. Findings reveal that fluctuations in NMV percentages significantly impact traffic parameters such as speed, density, and flow. Notably, in one-way divided traffic, NMVs predominantly occupy the left lanes, while Motorized Vehicles (MVs) utilize right lanes for overtaking. Conversely, in undivided two-way traffic, traffic concentration occurs in the middle lanes due to vehicles moving in opposing directions. The subsequent statistical analysis compares traffic parameters in Odisha City between 2011 and 2014. Hypothesis testing reveals significant variations over time, with a notable decrease in NMV percentages from 2011 alongside increased speed and flow. This research provides valuable insights into the dynamics of mixed traffic environments, offering essential considerations for the design and management of traffic infrastructure, particularly in regions characterized by diverse vehicle types and traffic behaviors.

Kewords:motorizedvehicles;non-motorizedvehicles;heterogeneoustraffic;fundamentalvariables;lateral occupancy; queue.

INTRODUCTION:

In today's traffic landscape, mixed traffic comprising both Non-Motorized Vehicles (NMVs) and Motorized Vehicles (MVs) predominates. NMVs, propelled by human or animal power, encompass bicycles, rickshaws, hand-drawn vehicles, and pull carts, among others. In contrast, MVs derive power from engines, categorized into light and heavy variants. Light MVs include auto rickshaws, jeeps, taxis, motorcars, and three-wheeler vans, while heavy MVs, with more than six wheels, comprise buses, lorries, and trucks.
In India, the feasibility of separate tracks for NMVs is limited, necessitating a thorough examination of NMV characteristics within mixed traffic environments. Consequently, this project focuses on understanding NMV movement and its impact on traffic dynamics within mixed traffic streams.

NEEDFORTHE STUDY:

Extensive research on non-motorized vehicles has primarily focused on determining capacity and Level of Service, with limited exploration into their effects within mixed traffic streams, particularly in the Indian context. Moreover, scant attention has been given to understanding the lateral occupancy of non-motorized vehicles and their influence on traffic characteristics. Given the impracticality of establishing separate tracks for non-motorized vehicles in India, there is a pressing need for comprehensive studies on their characteristics within mixed traffic environments. Consequently, this project endeavors to assess non-motorized vehicular movement and its repercussions on traffic dynamics, thereby addressing a crucial gap in existing research.

OBJECTIVES

The objective of the work is to find traffic characteristics of Non-Motorized vehicles in mixedstreamand its effect on traffic stream.
Theentireworkisdividedintotwo categories.

- Experimentalpart
- StatisticalAnalysispart

EXPERIMENTAL ANALYSIS

EXPERIMENTAL PART:

Theexperimentalpart consistsofthe followingobjectives

- Tostudyabout fundamentaldiagramsof trafficflow obtained fromvariouslocations
- Tofind thecapacityof thesectionsfrom the fundamental diagrams mentioned
- To find thelateral occupancyof the section
- Tostudythebehavior of Non-Motorized vehiclesin thestream.

STATISTICALANALYSISPART:

Thisstatisticalanalysisincludesthefollowingobjective

- Tocomparethetrafficparameters ofthepast data with referencetothepresentdata
- TofindthevariationofcapacitywithrespecttopercentagechangeinNon-Motorizedvehicles.

RESEARCHMETHODOLOGY

The data collection methodology entails capturing video footage from multiple locations, with a primary focus on Nabarangpur and Boriguma in Odisha. Specifically, data is gathered from five distinct locations within these areas, chosen to represent diverse traffic conditions and roadway layouts. The selected locations are as follows:

- RoadnearFamily Market.
- Road near Med pixie.
- Road from Axix Bank Road to Kerala Hotel
- RoadnearSanthoshi Maa Temple

Sl.no	Location	Length(meters)	Width(meters)	Time
1	Family Market	5	9	10:00am to 10:40am
2	Med pixie	7	10	9:30 to 10:15 am
3	Kerala Hotel	5	7	5:00 to 5:45 pm
4	Santhoshi Maa Temple	5	7.5	10:00 to 10:45 am
5	Parli high School	5	7	9:00 to 9:40 am

- RoadfromParli high School roadto, Petrol Pump,Nabarangpur.

The road sections chosen for data collection purposes exhibit significant traffic volume, devoid of parking zones, and with minimal turning vehicle activity. Video data is meticulously recorded using high-resolution digital cameras to ensure maximum clarity and detail. Each road section has a minimum length of 5 meters, allowing ample space for data extraction. Careful consideration is given to camera placement and alignment to achieve optimal coverage of the road section. The camera is positioned strategically to encompass the maximum portion of the road, ensuring comprehensive data capture.

DATA EXTRACTION:

Fundamental diagram is the diagrammatic representation of the relationship between various traffic parameters such as flow, speed and density. Data collected for this study is from thefollowingsections

- Road near Family Market.
- Road near Santhoshi Maa Temple.
- Road from Axix Bank Road to Kerala Hotel.
- Road from Parli high School road to, Petrol Pump, Nabarangpur.

STUDY OF LATERAL OCCUPANCY

The determination of lateral occupancy involves analyzing the behavior of vehicles within the traffic stream concerning adjacent moving vehicles. To accomplish this, data was collected from four distinct locations, each selected for its unique characteristics. These locations are detailed below:

- Road near Family Market.
- Road near Santhoshi Maa Temple.

- Road from Axix Bank Road to Kerala Hotel.
- Road from Parli high School road to, Petrol Pump, Nabarangpur.

The main purpose of this study is to find how the Non-Motorized and Motorized vehicles are varying across the section with the change in percentage of Non-Motorized vehicles.

RESULTS

COMPARISONGRAPHS:

Speedvs.%NMVgraph:

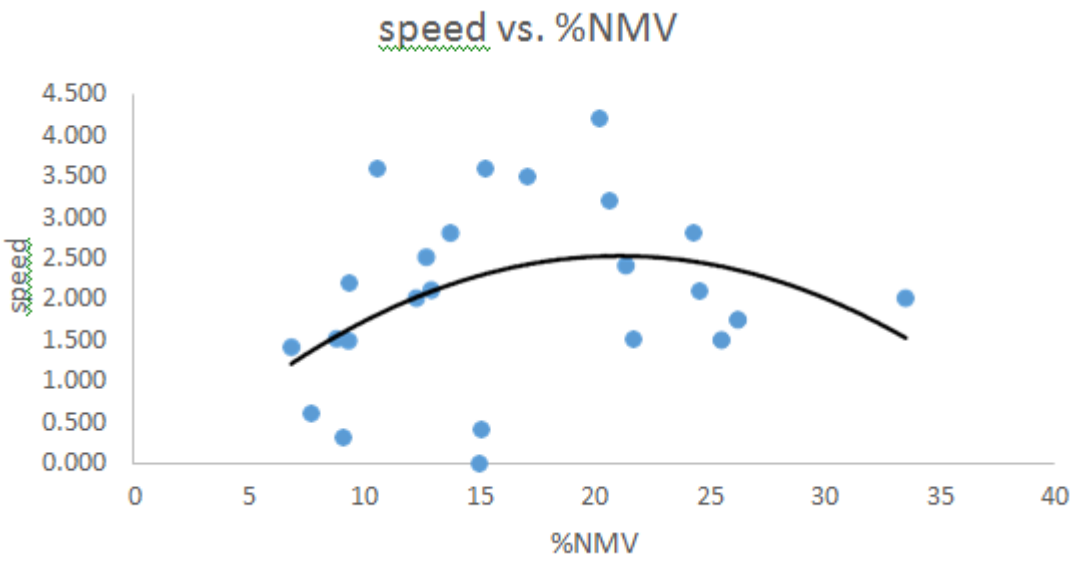
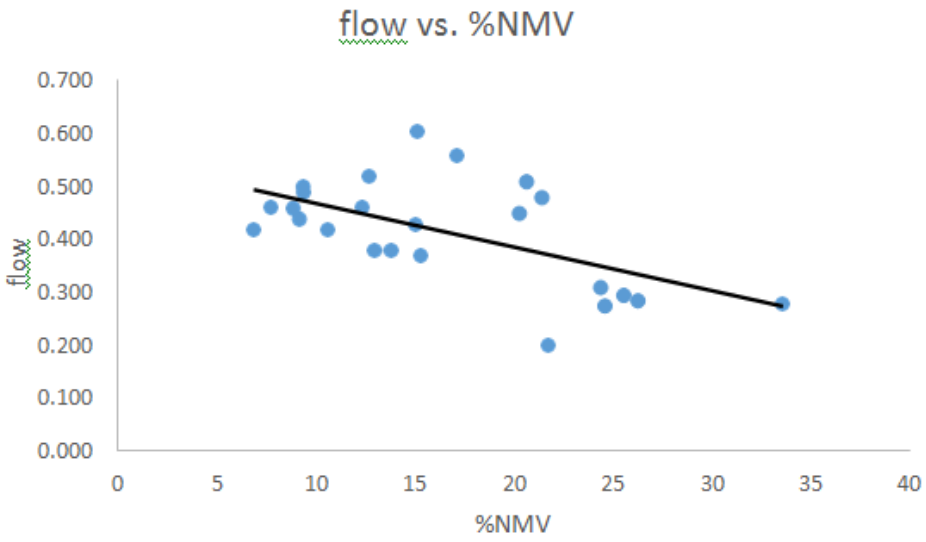


Fig.1 speedvs.%NMV graph

From the above figure shown, it is observed that the speed of the section is increasing till 20% of NMV and then it starts decreasing. It is due to a reason that with the increase of NMVcontent in the stream, traffic congestion starts increasing and it reduces the overall speed of thesection.

Flowvs.%NMV:



The figure indicates that the flow of the section starts decreasing with the increase ofpercentage Non-Motorized Vehicles. This is due to the fact that the NMVs are the slow moving vehicles as compared to that of MVs and as the NMV content increases, the room for the other vehicles to pass through the section decreases and it reduces the speed of the following vehicles which results in the decreasing of the flow of the section.

Densityvs. %NMV:

Thefollowingfigure3.indicatesthedensityvs.percentageNMVtrend.This shows that the density of the section starts decreasing with theincreaseof theNMVcontent.

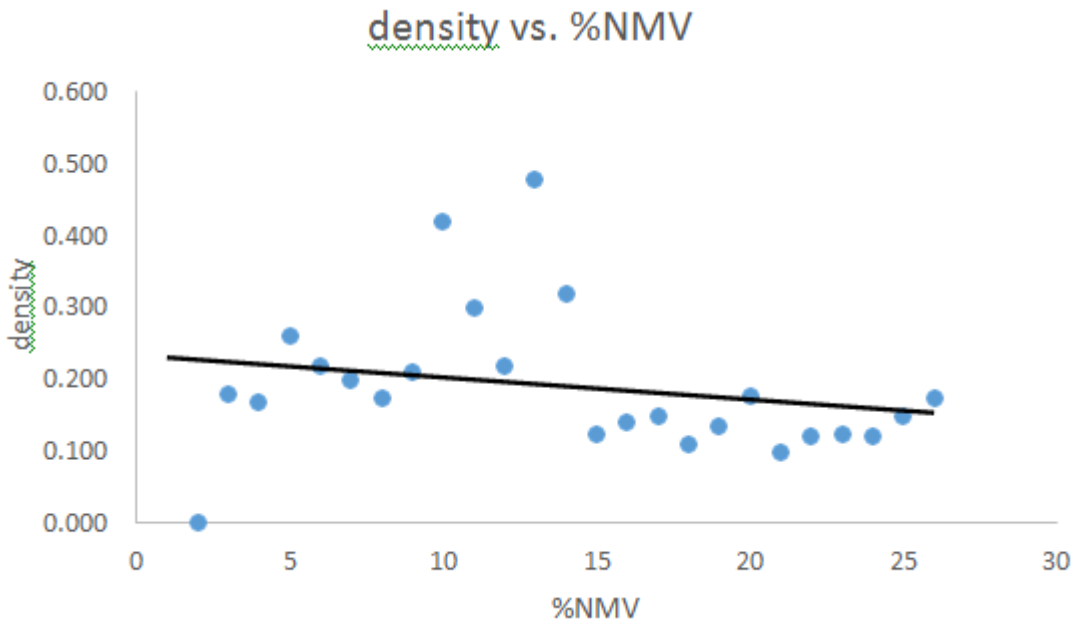


Fig3.densityvs.%NMV

Fundamentaldiagramsfordifferent% NMV:

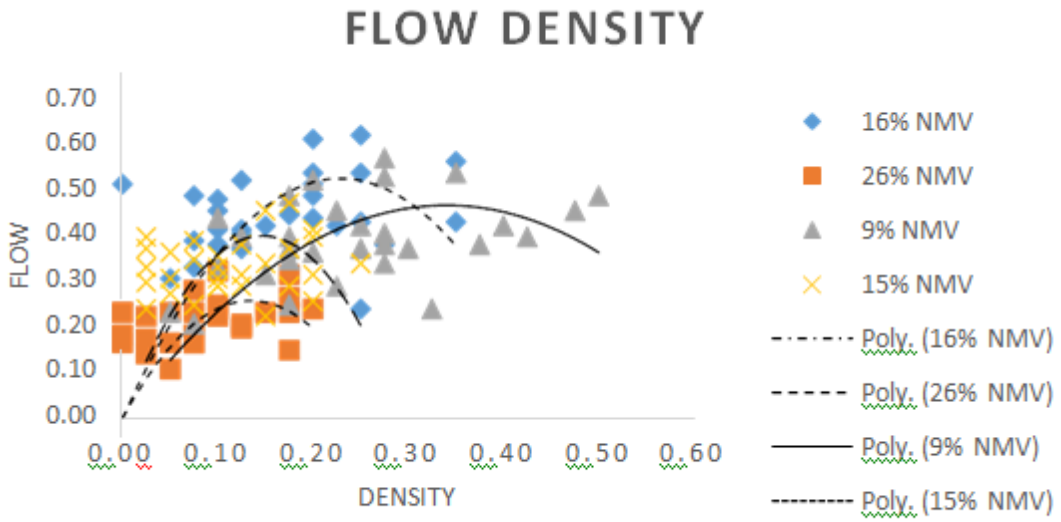


Fig.4flow densitycurve

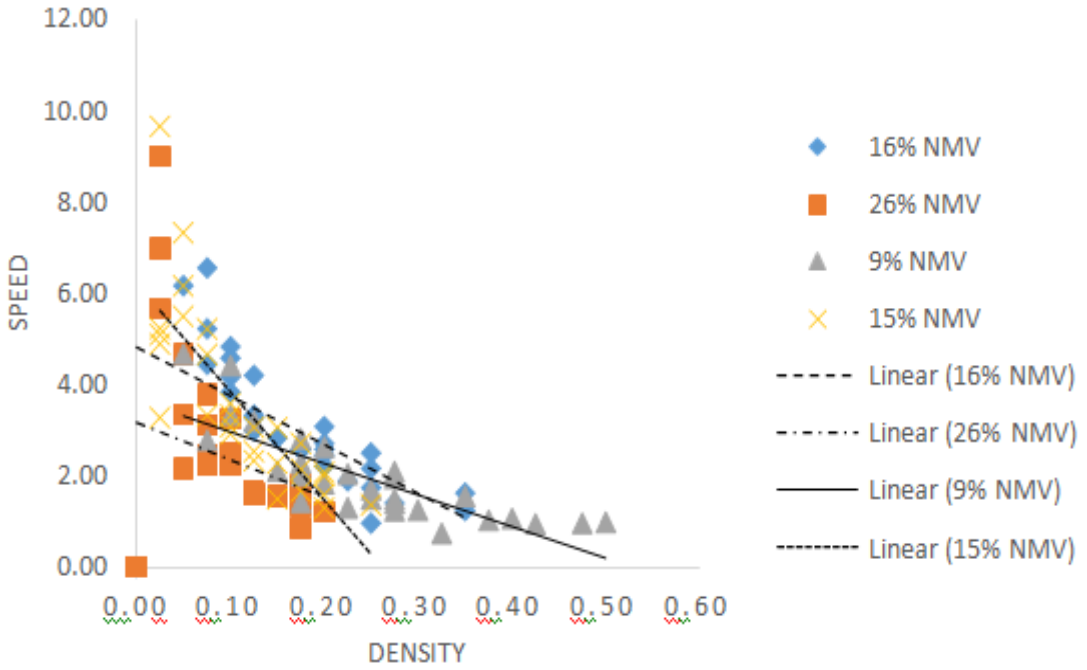


Fig.5speed densitycurve

In the above fundamental diagrams (fig 3.24, 3.25), %NMV of 9 and 15 are for one way divided traffic and 16 and 26 are for undivided two way traffic. In the case of one way traffic, for 9 %NMV the flow, density and speed are 0.47 PCU/sec, 0.34 PCU/m and 1.6 m/sec and for 15 %NMV, 0.40 PCU/sec, 0.15 PCU/m and 3.20 m/sec respectively. Whereas in the case of two way traffic, for 16% and 26% of NMV flow, density and speed are 0.53PCU/sec, 0.23PCU/mand2.4m/sec and 0.26 PCU/sec, 0.13 PCU/m and 2.10 m/sec respectively. For one way traffic it isobserved that the flow and density decreased and the same pattern is seen for the two way traffic also.

STATISTICAL INFERENCE

The probability of getting z stat is defined by P value. To find the *p* value or probability of gettingthe z stat, we look into the normal distribution table. To get the *p* value of a *z* statistic, find itsprobability (toward the tail) in the normal distribution table and multiply this probability with the number of tails for alpha.

	Road at FAMILY MARKET(Zobserved)			Road at SANTHOSHI MAA TEMPLE(Zobserved)			AXIS BANK ROAD(Zobs)		
	Speed	Flow	Density	Speed	Flow	Density	Speed	Flow	Density
NMV	-1.68	3.25	5.22	1.97	2.22	2.84	4.27	4.04	3.29
MV	-5.43	-2.73	8.38	-0.78	-2.25	-0.26	-0.21	5.17	1.5
TOTAL	-6.84	-0.62	10.87	-1.53	-1.55	0.42	-2.36	6.05	3.22

Table.2showingtheZobservedvalues fordifferentlocations

The decision to reject the null hypothesis if the Z observed is more than Z stat and if the P value is less than α value.Thefollowing table indicates the results of the P values for the compared data.

	Road at FAMILY MARKET			Road at SANTHOSHI MAA TEMPLE			AXIS BANK ROAD		
	Speed	Flow	Density	Speed	Flow	Density	Speed	Flow	Density
NMV	0.0093	0.001	$<10^{-4}$	0.049	0.026	0.005	$<10^{-4}$	$<10^{-4}$	$<10^{-3}$
MV	$<10^{-3}$	0.006	$<10^{-4}$	0.436	0.025	0.792	0.831	$<10^{-4}$	0.135
TOTAL	$<10^{-3}$	0.534	$<10^{-4}$	0.127	0.121	0.675	0.018	$<10^{-4}$	$<10^{-3}$

Table.3 showing P values

From the above tables the speeds at the family market got reduced and the density increased as compared to2011and at Santhoshi Maa temple the speed of NMV is increased and the remaining (MV and total)speeds decreased

CONCLUSIONS

From the analysis of fundamental diagrams, it becomes evident that the composition of non-motorized vehicles (NMVs) significantly influences traffic parameters within the section. Whether the lanes are divided or undivided, an increase in the percentage of NMVs correlates with a decrease in parameters such as density, flow, and speed. This effect is more pronounced in undivided lanes due to the presence of vehicles traveling in opposing directions.

The examination of lateral occupancy patterns reveals that NMVs tend to occupy the left-hand side of the road, consistent with the left-hand driving practice in India. Motorized vehicles (MVs) typically overtake NMVs from the right-hand side. Notably, the first strip from the left edge often remains vacant, reflecting drivers' tendency to avoid road edges when no shoulders or raised kerbs are present. However, on roads with shoulders, vehicles may occupy this strip.

In divided one-way traffic, vehicles distribute across all lanes, with NMVs primarily occupying the first two strips and overtaking vehicles concentrated in the last two strips. Flow is highest in these overtaking lanes. Conversely, in undivided two-way traffic, vehicles tend to occupy the left three strips due to the presence of opposing traffic. The middle strips experience the highest occupancy, while the remaining strips are primarily used by slower-moving vehicles.

Regarding the percentage of NMVs, a consistent distribution pattern emerges: moderate NMV percentages result in NMVs occupying the left two strips, while lower percentages lead to NMVs occupying the leftmost strip. Higher NMV percentages prompt MVs to overtake from the right strip.

Comparative analysis indicates that the speed of the section initially increases with up to 15% NMV content before declining. This suggests that within a certain threshold, NMV presence does not significantly affect traffic parameters. However, beyond this threshold, an increase in NMV content leads to adverse effects on flow and density, resulting in decreased traffic parameters.

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