ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Effects of Motorcycles on Traffic Operations on Arterial Streets

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ABSTRACT:
This study analyses the effects of motorcycles on traffic operations at signalized intersections. Data collection was done at two intersections, one with motorcycle queue storage and the other without. Discharge headway was used to identify the relationship between a number of motorcycles discharged in each signal cycle and the start-up lost time of passenger cars. In addition, the effectiveness of motorcycle queue storage is also examined. Start-up lost time of passenger cars is found to be linearly correlated with the number of motorcycles in the waiting queue. Motorcycle queue storage is found to increase start-up lost time of the traffic. Although much knowledge about traffic characteristics was acknowledged, very little attention has been paid regarding motorcycle. The purpose of this study addresses a comprehensive analysis of motorcycle behaviour and operation through videotaping of some roads that have significant motorcycle proportion. Four locations in Ongole, India have been found to meet criteria for data collection, including exclusive motorcycle lanes, mixed traffic and undivided roadways.

KEYWORDS:
Traffic survey, purpose of traffic survey, problems of mixed traffic flow, queue discharge characteristics.

1. INTRODUCTION:
Operation and management of urban streets under mixed traffic is a challenging task. In Asian countries, motorcycle constitutes a considerable share of traffic in urban areas. Some researchers made attempt to quantify the effects of motorcycle especially at signalized intersections.

In India, according to the statistics in 2014 the number of motorcycles registered is 12.4 million, equivalent to 70% of total vehicles in the country (Department of Land Transport). It is apparent that effects of motorcycle in these countries cannot be neglected. In addition, motorcycles are also more exposed to traffic accident as shown by the traffic accident statistics of 2014 showing that 80% of traffic death in Thailand is motorcycle users. Transportation involved matters are usual in most urban areas in the world. Many developed countries confront troubles, which relate to four-wheel vehicles. Besides, in the other parts of the world, developing countries are facing with small size motorized vehicles, such as motorcycles, mopeds, etc. Several cities in developing countries have been suffering from a high degree of the congestion problem, which is mostly caused by two-wheel vehicles.

2. REVIEW OF LITERATURE
Transportation involved matters are usual in most urban areas in the world. Many developed Countries confront troubles, which relate to four-wheel vehicles. Besides, in the other parts of the world, developing countries are facing with small size motorized vehicles, such as motor cycles, mopeds, etc. Several cities in developing countries have been suffering from a high degree of the congestion problem, which is mostly caused by two-wheel vehicles. In India, for example, where two-wheelers are more than 80% of the total transportation means, motorcycle reduces the speed of other modes and makes the traffic more congested due to its shapes and behaviours. The main problem in developing the analytical speed-flow relationship is heterogeneity of traffic stream.
The vehicles in the mix produce different impedance due to their varied static and dynamic characteristics.

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Hence simply adding the number of vehicles does not give the authentic speed flow relationship. These are the main problems in intersections.

3. TRAFFIC SURVEY:

Traffic engineers and planners need information about traffic. They need information to design and manage road and traffic system. They use the information for planning and designing traffic facilities, selecting geometric standards, economic analysis and determination of priorities. They use this to justify warrant of traffic control devices such as signs, traffic signals, pavement markings, school and pedestrian crossings. They also use this information to study the effectiveness of introduced schemes, diagnosing given situations and finding appropriate solutions, forecasting the effects of projected strategies, calibrating and validating traffic models. Transportation system is a dynamic system. Information about traffic must be regularly updated to keep pace with ever-changing transportation system. Data must be collected and analyzed systematically to get representative information .Traffic surveys are the means of obtaining information about traffic. This is a systematic way of collecting data to be used for various traffic engineering purposes.

3.1 MAIN PURPOSE OF TRAFFIC SURVEY:

The main purposes of traffic survey are: traffic monitoring, traffic control and management ,traffic enforcement, traffic forecasting, model calibration and validating etc.

3.2 PARTS OF TRAFFIC STUDYS:

Traffic studies include:

- Inventory of road traffic physical features
- Traffic stream characteristics- volume, speed, density, occupancy studies.
- Capacity studies of streets and intersections
- System usage studies- Travel time and delay, O-D survey
- Travel demand- home interview survey
- Road users cost- Value of travel time, vehicle operating cost
- Parking supply & demand studies
- Axle load survey
- Mass transit performance and usage studies
- Traffic accidents studies

4. PROBLEMS OF MIXEDTRAFFIC:

- Heterogeneous or mixed traffic systems operate very differently, compared to homogeneous traffic systems. The traffic in mixed flow is comprised of fast moving and slow moving vehicles or motorized and non-motorized vehicles. The vehicles also vary in size, manoeuvre ability, control, and static and dynamic characteristics. Traffic is not segregated by vehicle type and therefore, all vehicles travel in the same right of way. Smaller size vehicle soften squeeze through any available gap between large size vehicles and move in a haphazard manner.

5. OBGECTIVES

- To establish relationship between the number of motorcycles in waiting queue and Start-up lost time.
- To draw the techniques applied for collecting and analyzing motorcycle speed, headway, and Speed – flow relationships.
- To draw results from data analysis.
- To explain and discuss for better understanding this mode. Moreover, effects of different traffic facilities on motorcycle traffic operation were also investigated. The question addressed is how motorcycle behaviour differs between homogeneous and heterogeneous traffic flows, between divided and undivided roadways?

6. DATA CALCULATIONS:

6.1. HEADWAY CALCULATIONS:

The headway calculations are conducted in different cases that are one with motor cycle queue storage and without queue storage the following process conduct for this study.

- The first headway is the time lapse between the initiation of green signal and the time that the rear wheel (car-following laws assume that the drivers follow the rear bumper of the leader, not the front

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International Journal & Magazine of Engineering, Technology, Management and Research
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bumper) of the first vehicle in the queue cross the stop line.

- The second headway is the time lapse between the time that the first vehicle's rear wheels cross the stop line and the time that the second vehicle's rear wheels cross the stop line.
- Subsequent headways are similarly measured.
- During over saturated condition, only the headway of those vehicles that cleared the intersection by using green time of a phase was considered.

The headway data were collected with the help of stopwatch with an accuracy of 0.01 s. The discharge headway data were collected for the vehicles in each queue position.We calculate the headways in two locations one with motorcycle queue storage and another without queue storage of motorcycles. In this study we divide the two locations like four cases. Case 1 and case 2 are taken in first location and case 3 and case 4 are taken on location two. The headways of each cases are change differently based on vehicle discharge see the table 2 the headways are high in location one means case 1 and case 2 and the headways are low in case 3 and case 4 because in location one motorcycles interlink with the other vehicles but in case 3 and case 4 there is no much motor vehicles in the traffic compared to location one

6.2 SATURATION HEADWAY CALCULATIONS:

Saturation headway calculates with the help of headways in traffic. Saturation headway is calculated with averaging the headways after the third or sixth headways in traffic for better calculations. Saturation headway means the flow of traffic is very nice with the traffic in homogeneous behaviour of the traffic but the flow condition is very difficult in heterogeneous condition.

These saturation headways are calculated with the help of headways in table 2

Saturation headway of different cases are:

Case 1:

= 1.73+1.64+1.53+1.53+1.50+1.51
= 9.44 /6
Aug.=1.57 sec
Case 2:
= 1.93+1.82+1.72+1.62+1.54+1.51
=10.14/6
Aug.=1.69 sec
Case 3:
= 1.97+2.1+1.73+1.62+1.53+1.51
=10.46/6
Aug.=1.74 sec
Case4:
=2.63+2.41+1.71+1.53+1.4+1.32
=11.3/6
Aug=1.88 sec

6.3 SATURATION FLOW RATE CALCULATIONS:

Saturation flow is a macro performance measure of junction operation. It is an indication of the potential capacity of a junction when operating under ideal conditions (no gradient, no parking or bus stops near the intersection, no pedestrians or cyclists etc.). However, to determine the saturation flow rate from time measurements taken in the field the following equation used:

S=3600/hs

Where:

S = saturation flow;
3600 = number of seconds per hour;
Hs = saturation headway.

These saturation flow rate is calculated with the help of saturation headway and the time taken for the study in seconds as shown in the formula.

Saturation flow rate = Number of seconds per hour / saturation headway

Case 1:
=3600/1.57
=2293 veh/h
Case 2:
=3600/1.69
=2130 veh/h
Case 3:

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=3600/1.7
=2068 veh/h

Case 4:

=3600/1.88
=1914 veh/h

In these calculations the number of vehicles per hour is different in four cases. This represent the saturation headway increase then the flow rate decreases means the number of vehicles increase in the traffic like inter link with other vehicles then the start-up lost time and headway and saturation headways increase then automatically the saturation flow rate will be decrease. This condition is very bad for the traffic means the number of vehicles pass in the traffic is very high it is good condition of the traffic and the number of vehicles passing is very low it is a bad condition of the traffic.

6.4 START-UP LOST TIME CALCULATIONS:

Start-up lost time is defined as the total additional headway consumed by the first *n* vehicles in the queue above and beyond the saturation headway a shown in equation.

Start-up lost time = sum of i=(1 to n) (Hi - Hs)

Where

Hi = Discharge headway of i th vehicle (sec)

Hs = Saturation headway (sec)

n = Number of vehicles discharged before saturation headway is achieved

Start-up lost time for different case:

Case 1:

=(2.6-1.57)+(2.8-1.57)+(2.32-1.57)+(2.12-1.57)
= 1.03 + 1.23 + 0.75 + 0.55
=3.56 sec

Case 2:

=(2.82-1.69)+(2.71-1.69)+(2.71-1.69)+(2.42-1.69)
= 1.13 + 1.02 + 1.02 + 0.73
=3.9 sec

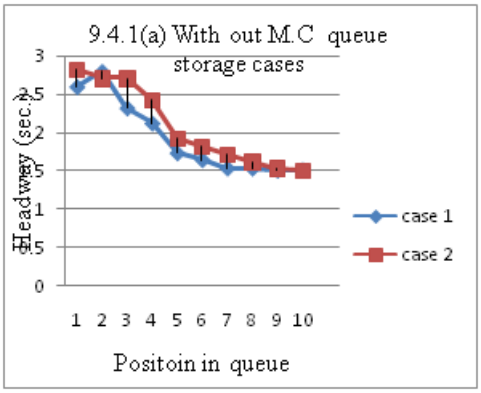
Case 3:

=(3.92-1.74)+(3.21-1.74)+(2.63-1.74)+(2.81-1.74)
= 2.18 + 1.47 + 0.89 + 1.07
=5.61 sec

Case 4:

=(2.63-1.88)+(4.21-1.88)+(3.71-1.88)+(3.81-1.88)
= 0.75 + 2.33 + 1.83 + 1.93
=8.19 sec

Fig: Average Discharge Headway of Vehicles in the Waiting Queue



b

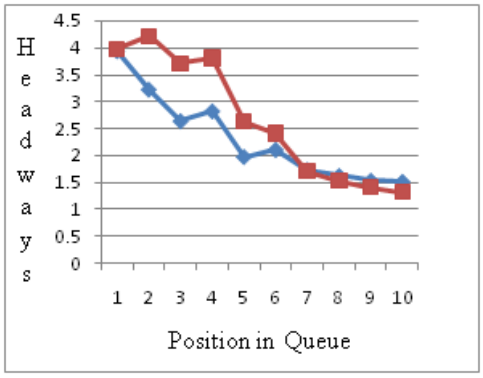


Fig: (b) With M.C queue storage cases

Table : Saturation Headway and Start-up Lost Time for Each Analysis Case

no	Position in queue where saturation flow begins	Saturation headway (sec)	Start-up lost time (sec)	Flow rate (veh/h)
1	5thVehicle	1.57	3.5	2292

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2	5thVehicle	1.69	3.9	2130
3	5thVehicle	1.74	5.61	2068
4	5thVehicle	1.88	8.19	1914

7. SPEED CALCULATIONS:

The speed in traffic flow is defined as the distance cover per unit time. The speed of every vehicle is almost impossible to track on a roadway; therefore in a practice average speed is based on sampling of vehicles over period of time or area and is calculated and used in bellow formula Speed = Distance / Time

8. OBSERVED EFFECTS:

- Increase the start-up lost time in intersection.
- Flow rate decrease when motor cycles increase in intersection.
- In intersection when traffic is high in some time so drivers drive their vehicles slowly so the pollution occur in that place high compared to normal traffic.
- Number of motorcycles increase in intersection accidents will occur in that place and we spend more time to clear that.

9. CONCLUTION:

The following recommendations are made based on the findings of this research.

- Finally this study shall be used to support decision-making in urban traffic management.
- We provide different lanes for different vehicles like motorcycles, cars, and heavy vehicles for better traffic conditions to reduce the time loss and accidents.
- The start-up lost time increase when number of motorcycles increase in intersection. So we provide another way for exclusive motorcycles for safe driving.
- Increase the green phase time in intersection for better moving of vehicles

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