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ROADWAY CAPACITY ESTIMATION BY MICROSIMULATION MODELLING

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ABSTRACT

Road network planning and analysis need a lot of data, right from road alignment to the traffic forecasting. Extensive traffic studies are required to carry out accurate data collections which are costly. The traffic scenario in the developing countries like India is heterogeneous traffic which adds to the difficulty in data collection and therefore modelling holds a lot of relevance in understanding the various parameters of traffic flow. Traffic simulation offers a very effective alternate to the conventional practices of elaborate field data collection.

The present study is aimed at understanding the traffic scenario on straight road sections on urban roads. Traffic flow parameters are obtained from three sections viz., Kulur-Ferry Road, M.G. Road & Airport Road. PCU values are computed for the prevailing heterogeneous traffic conditions for all the sections. Correlation between traffic parameters of flow, speed and density are carried out. VISSIM 8.0 microscopic simulation software is used to develop the traffic model and simulation data is compared with field data.

Key Words: Micro simulation, PCU and model

I. INTRODUCTION

1.1General

Transportation is an important aspect in today's world. Economic development of any region has close dependence with the transportation systems. Transport planning and forecasting, are vital for further improvement in the transport network and inter-mode. Transport Planning is an integral part of any town and country planning.

Road-user behaviours are linked to various physiological and vehicular characteristics. There is a continual problem confronting the transportation stakeholders with the evolving vehicular systems. Technologies in vehicles are evolving faster than the road networks. Vehicular characteristics like acceleration, power, braking properties, the vehicular dimensional configuration etc. have a bearing in arriving at a very important index called the Passenger Car Unit.

It is well established that modern civilization has been engulfed in two primary features of globalization and industrialisation. There has been unprecedented growth in traffic and often the roads are getting congested leading to traffic jam. The pattern of urban sprawl is changing. A lot of measures are being contemplated by traffic engineers to arrive at a feasible solution.

1.2 Statement of Problem

Transportation network is confronted with many complex problems. Capacity estimation is a dynamic problem. Vehicle density is increasing every year and is leading to congestion on many roads. Vehicle shapes and characteristics are changing rapidly. Therefore study of road traffic essentials like planning, designing of roadway, operations of roadway facilities along with control and regulation become necessary. On field observations and data collection and analysis is tedious and time consuming. Broad spectrum collection of data collection is therefore very difficult. Modelling of traffic flow is a time-tested alternate.

Generally, in developing and under developing nations the nature of traffic is heterogeneous. There is no separation of traffic and all vehicles share the same space. Direct adoption of traffic parameters of different countries is not a viable solution. Modifications to PCU would enable more realistic outcome. Unrestricted movements of vehicles make the lane concept, flow values parameters taken from standard lane width invalid.

1.3 Main Objectives and Scope of Present Study

Direct adoption of traffic parameters from homogeneous conditions to suit the heterogeneous conditions is not the best solution. Systematic approach to determine PCU, flow, density, speed and capacity are absolutely necessary. The objectives of the study are enlisted below.

1. To determine the roadway capacity of straight section.
2. To obtain speed-flow-density parameters.
3. To compare both macroscopic and microscopic simulation method.
4. To understand traffic patterns on the study sections.

1.4 Scope of the Study

This study is aimed at traffic data collection on three important urban arterial roads. Kulur-Ferry road is the first study section and is one of the important roads of the city. This road is a divided carriageway with pedestrian footpaths on either side. Second study section is M.G. road which extends from PVS intersection to Lady hill rotary intersection. Airport Road is the third road section where the traffic parameters have been captured. Broadly the road geometrics are the same and the roads are at grade. The scope of the study includes collection of traffic parameters of speed, volume, vehicle characteristics, and roadway parameters.

II.STUDY METHODOLOGY

2.1 Experimental procedure

Data collection is a very important step. It should be very efficient to proivde all the data required for analysing the traffic flow. There are several techniques available for traffic study. The choice of method depends on the importance and the extensiveness of the data required. The duration of the count depends on the purpose and the requirements of the traffic engineer. The following are the methods of data collection

1. Mechanical method
2. Manual method

3. Combination of mechanical and manual method
4. Automatic devices
5. Moving observer method
6. Photographic method
7. Video recording method

2.2 Mechanical Method

Mechanical methods are broadly classified into intrusive method and non-intrusive method. These methods are generally expensive in comparison with other methods. The intrusive methods comprises of a data recorder and a sensor. The non-intrusive methods are passive and active infra-red method, passive magnetic method, micro wave radar method, ultrasonic and passive acoustic method.

2.3 Manual Method

Manual method is perhaps the oldest methods of traffic counting. The number of observers needed to count the vehicles depend on the number of lanes from which information is to be collected.

2.4 Combination of Mechanical and Manual Method

A primitive example of this method is multiple pen recorders. A display chart moves continuously at speed of clock. Pressing of the switch actuates the pen recorder. Simultaneous operations of classification and count are performed.

2.5 Automatic Devices

These devices facilitate large volume data extraction with high degree of accuracy. Generally, traffic counts are taken on hourly basis on a 24-hour time schedule. This method is suited to identify the peak hour traffic and jam density.

2.6 Photographic Method

Techniques such as stereo-continuous strip photography and time lapse photography have been found extremely useful for traffic engineers. Aerial photographs have been captured for carrying traffic analysis. This technique allows for greater accuracy of data collection.

2.7 Video Recording Method

This method offers great varsatility. Video on a 24-hour tie interval can be captured and frame by frame analysis is possible with high end video recorders.

III.RESULTS AND DISCUSSIONS:

3.1 Development of Base Network

Background maps are used to setup the VISSIM network to scale. Hence it is important to place and scale background images correctly. Links and connectors are very important in development of road network and is the first step involved in development of the model. Next, inputs to follow are road geometry, routing decisions, turning movements assignments are to be completed. Traffic volumes, classification and vehicle classes depending on the extracted field data are entered.

3.2 Traffic Categories

By default VISSIM doesn't have most of the Indian vehicle categories; therefore it is necessary to create an Indian vehicle categories required for the present study. Vehicle categories like 2 wheelers, motorized 3 wheelers, Car, LCV, Buses and trucks are created in VISSIM for the further study.

3.3 Traffic Flow and Composition

Traffic volume has to be given from the collected traffic volume count form the field at different time interval. Vehicular composition extracted from the classified traffic volume count has to be given as input. Desired speed distribution is also one of the inputs at this stage. VISSIM would generate random traffic volume and vehicle composition from the given data. Figure 3.3 shows the vehicle compositions and relative flow input. Example showing traffic volume input and selection of vehicle composition type for particular study section.

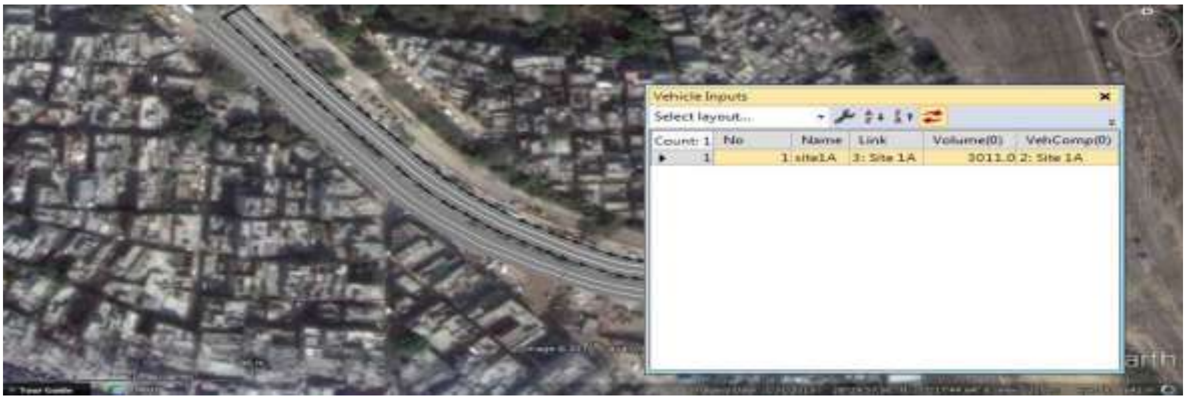

Plate 3.1 Representation of Vehicle Input

3.4 Desired Speed Distribution

Based on the observed data, minimum speed, maximum speed and their distribution of each vehicle type has to be given as input in VISSIM. In the present study speed distribution has been plotted for all the vehicle categories for both horizontal curved section and straight section separately. Figure 3.2 shows the desired speed distribution graph for car.

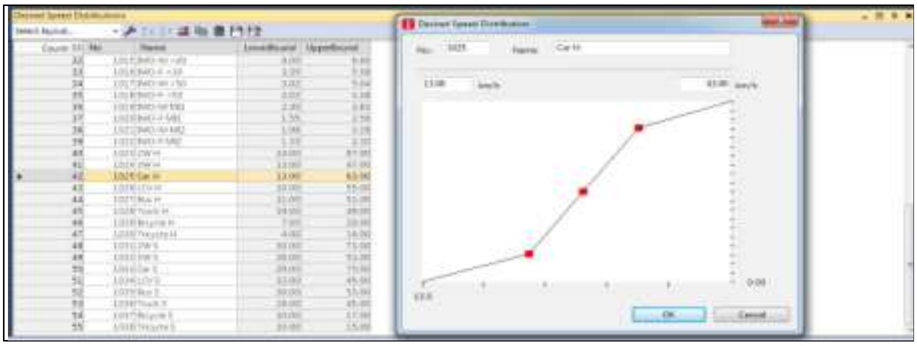

Plate 3.2 Representation of Speed Distribution Curve

3.5 Driving Behavior Parameter

As discussed earlier in this chapter Wiede mann 74 car following model's three driving beha viour parameters are average stand still distances, additive part of safety distance, multiplicative part of safety distance. In the present study by changing the value of these parameters traffic models are calibrated for all the section. Table 3.1 lists the default driving behaviour parameters of VISSIM

Description of the Parameter	Default Value
Average standstill distance	2m
Additive part of safety distance	2m
Multiplicative part of safety distance	3m

Table 3.1 Default Driving Behaviour Parameter

3.6 Calibration and Validation of Simulation Model

After input of all the parameters are completed, it is necessary to calibrate and validate the simulation model. By modifying the driver behaviour parameters using iterative method, VISSIM simulation model is calibrated. Simulation model is then validated by comparing the observed classified volume count and obtained traffic volume count from the VISSIM. Table 3.2 lists the traffic flow validation for site 1.

Average standstill distance = 1m **Additive part of safety distance = 1m** **Multiplicative part of safety distance = 2m**	**Vehicle Type**	**Observed Data** **(Field Data)**	**VISSIM Generated Data**	**% Difference**
	Car	290	294	1.4
	Motorized 2 Wheeler	279	281	0.7
	Motorized 3 wheeler	105	99	5.7
	LCV / mini bus	47	46	2.1
	Bus	104	101	2.9
	Truck	30	31	3.3
	Total	855	852	**MAPE =2.68%**

Table3.1traffic Flow Validation for the Site

Table shows the MAPE value is 2.68% that means obtained values for particular driver behavior parameters are accurate and within acceptable limits. Similarly, MAPE value for site 2 is 3.63% and for Airport Road is 2.90%.

Roadway Capacity Estimation by Micro Simulation Approach

Once the classified traffic volume is obtained from the VISSIM simulation, by modified density method volumes which are in vehicle per hour are converted into PCU per hour. PCUs obtained from the modified density method are multiplied by number of that vehicle type and then these values are added to obtain the total volume in PCUs in that five minutes interval. To obtain the flow values in PCU/hour, the volume obtained for 5 minutes is multiplied with 12 (number of 5 minutes in an hour). Speed – flow – density curves are drawn for obtained values from VISSIM and optimum capacity has been calculated.

Optimum capacity obtained from modified density method, speed area method and microscopic simulation methods for all the test sections are listed in Table 3.3

Road Section	Optimum Flow PCU/hr	
	Speed Area Method	Microscopic Simulation Method
Site 1	1550	1470
Site 2	1865	1835
Site 3	1900	1865

Table3.2. Roadway Capacity

IV. CONCLUSSION AND SCOPE FOR FUTURE STUDIES

The findings from the study are presented below.

1. In the present study, the optimum roadway capacity observed on three straight sections was calculated using the macroscopic and microscopic approaches.
2. It has been seen from the macroscopic analysis; it is evident PCU values of vehicles are dependent on the traffic composition.
3. Traffic volumes obtained from the macroscopic analysis are showing good correlation with microscopic analysis.
4. Traffic volumes from microscopic analysis are showing same trend as macroscopic approach
5. In the present study PCU values are calculated from speed area method. Hence, it is proposed to attempt to use Area Occupancy method and Modified Density method.
6. Impact of lane changing behaviour on traffic flow can be analysed.
7. Microscopic simulation study can be performed by using other traffic simulation software and methods.

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