

PROVISION OF EXCLUSIVE LANES FOR BUSES ON ROADS CARRYING HETEROGENEOUS TRAFFIC



Authors

Dr. V. Thamizh Arasan, Professor,
P. Vedagiri, Ph.D. Scholar,
Indian Institute of Technology Madras, Chennai, India

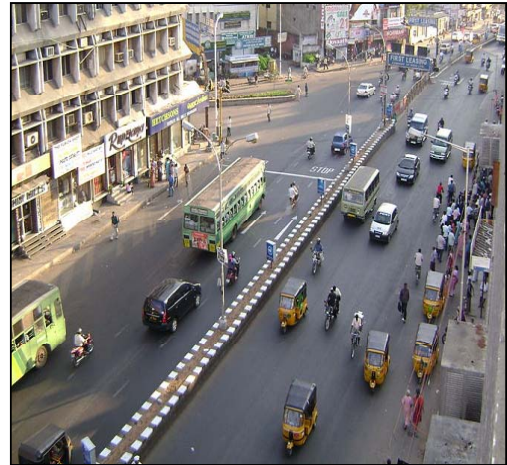
Introduction

Road Transport in Indian Cities



Introduction...

- Urban road traffic in India comprises different types of vehicles with wide ranging static and dynamic characteristics.
- By virtue of the high level of heterogeneity of the traffic, the vehicles occupy any lateral position on the road depending on the availability of road space at a given instant of time without any lane discipline.



Introduction...

- The road traffic in Indian cities has grown at a very steep rate in the recent past making the available transport infrastructure inadequate.
- As augmentation of urban transport infrastructure is expensive, there is a need to find alternative solutions to the problem.
- Encouraging public transport modes like buses is the best solution, for increasing capacity of transportation system in terms of person flow.
- This may be achieved by providing exclusive road space for buses, which will facilitate faster movement of more people in less number of vehicles.

Major Benefits of Exclusive Bus Lanes

- Facilitate enhancement of the level of service of buses, in terms of speed and reliability, which in turn, may attract a significant section of the users of other modes to buses.
- Reduce the level of heterogeneity of the traffic, which may facilitate smoother movement of the other vehicles also in the traffic.
- Eliminate almost all the accidents involving buses.
- Help to achieve the global objectives of energy conservation, environmental protection and sustainability in urban transport.

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Need for the Study

As all the earlier studies on this subject are related to homogeneous traffic conditions, at present, no comprehensive reference material is available to assist in exclusive bus-lane planning under highly heterogeneous traffic conditions.

Hence, there is a need to devise methodology to study the effect of exclusive bus lanes on urban roads and this study is an attempt in this direction.

Objectives

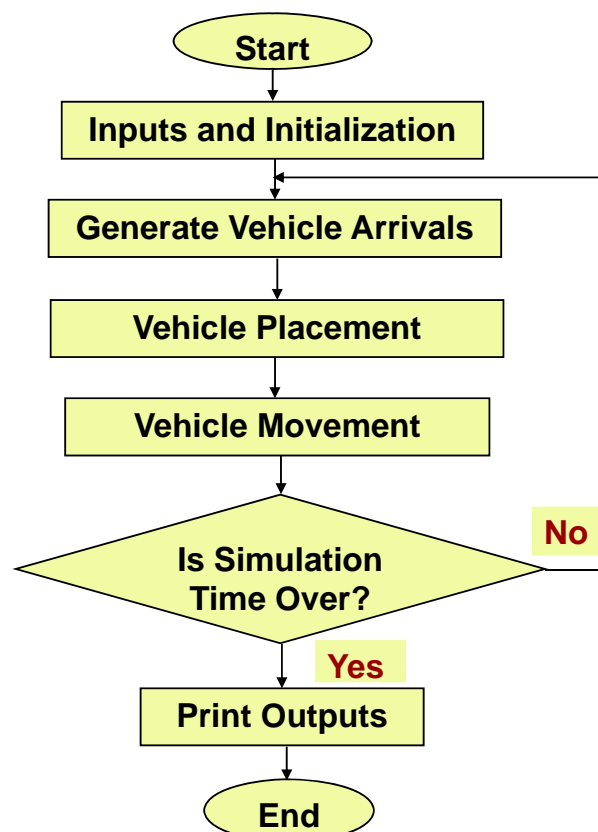
- ① To study the flow characteristics of heterogeneous traffic on selected urban roads with specific reference to bus movement,
- ② To modify and validate the recently developed heterogeneous traffic-flow model to suit the requirements of the present study,
- ③ To apply the validated simulation model to study the impact of exclusive bus lanes introduced on urban arterials, for a wide-range of traffic volume,
- ④ To check for the level of utilization of road space based on the number of persons making use of the available road space.

Heterogeneous Traffic Simulation Model

Simulation Framework

- Entire road space is considered as single unit.
- Vehicles are represented as rectangular blocks on the road space, the length and breadth of the blocks representing respectively, the overall length and the overall breadth of the vehicles.
- Position of vehicles on the road space is identified based on the coordinates with reference to origin.
- Interval scanning technique with fixed increment of time.

General Structure of the Simulation Model



Model Input

- Geometric details of simulation road stretch
- Traffic volume and composition
- Overall dimensions of different types of vehicles
- Lateral and longitudinal clearances between vehicles
- Free-speed data of different types of vehicles
- Type of headway distribution
- Acceleration / deceleration characteristics
- Reaction time of drivers
- Total simulation period

Model Output

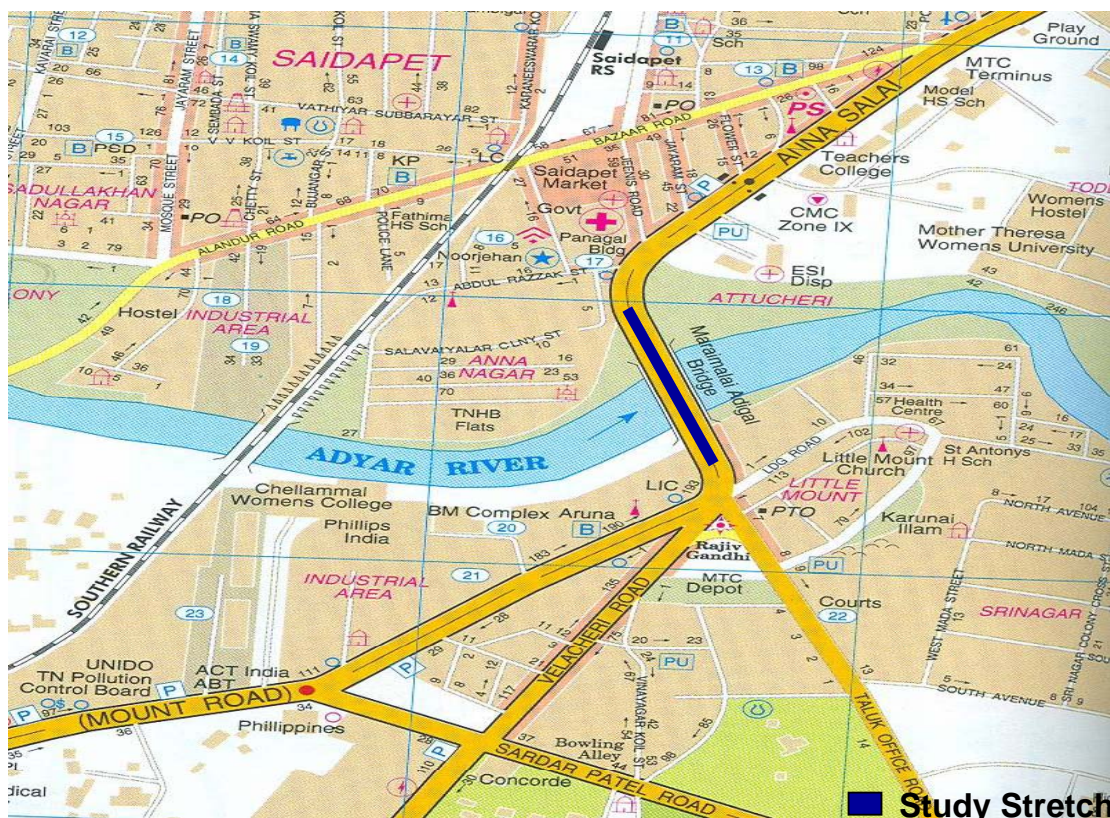
- Average speeds of vehicles over a given length of road
- Number of each category of vehicles generated
- Headway
- Number of vehicles present over a given road length at any point of time
- Number of overtaking maneuvers made by each vehicle.

Data Collection & Model Validation

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Study Stretch of Road



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Arial View of Study Stretch



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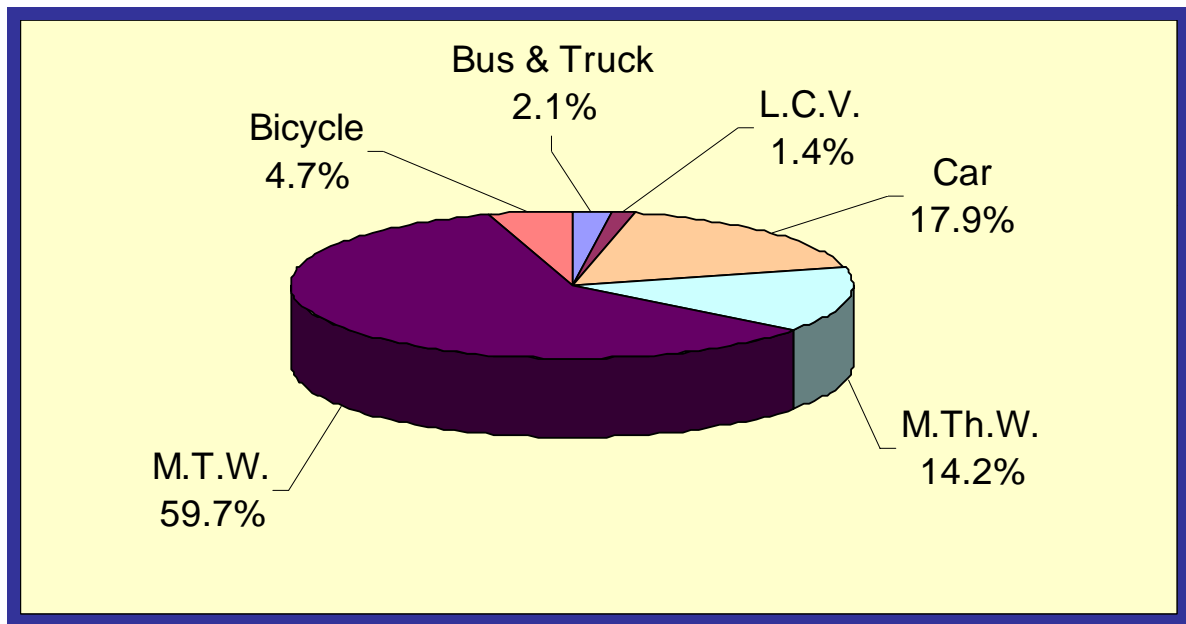
Traffic Flow at Study Stretch



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Traffic Composition at Study Road Stretch



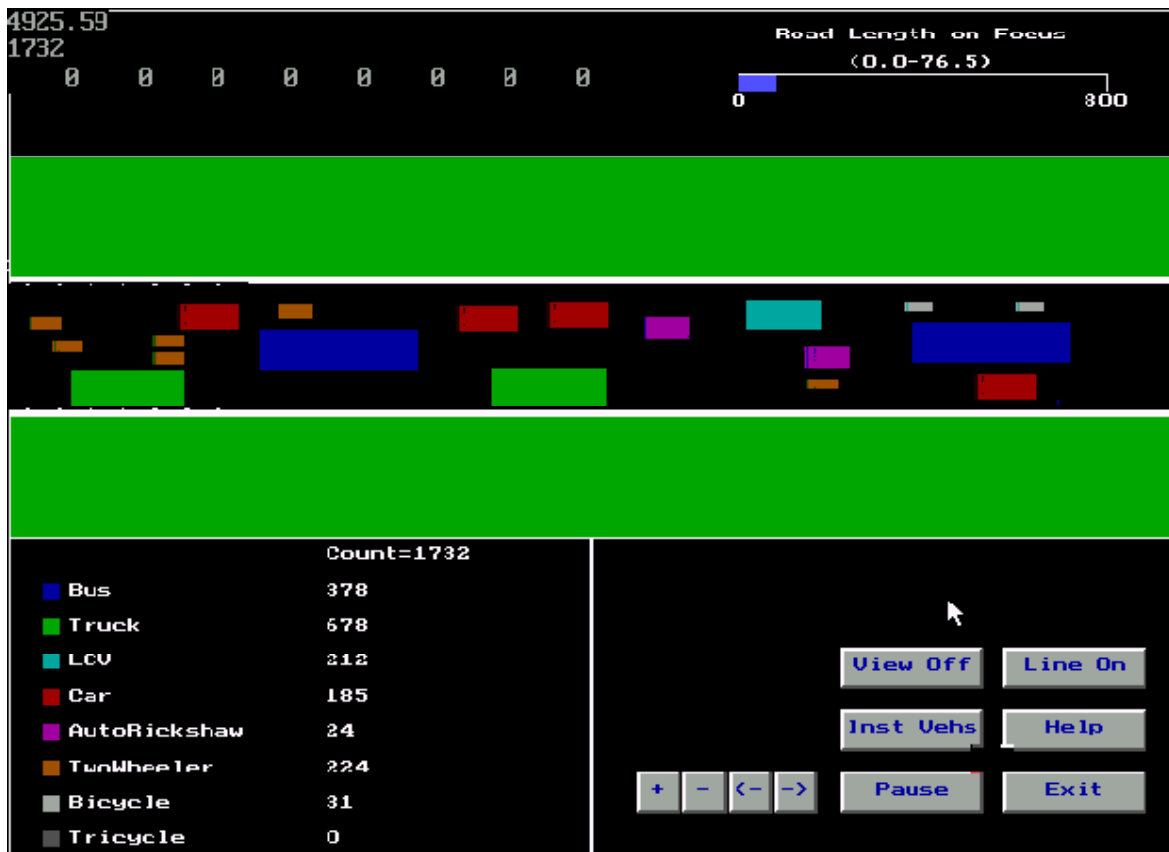
LCV- Light Commercial Vehicle, M.Th.W – Motorised Three Wheelers, M.T.W - Motorised Two Wheelers

Characteristics of Vehicles of the Heterogeneous Traffic

Vehicle Type	Dimensions (m)*		Lateral Clearance (m)		Free Speed (Km/h)	
	Length	Breadth	Min	Max	Mean	Std. Deviation
Bus	10.3	2.5	0.3	0.6	67	7
Truck	7.5	2.5	0.3	0.6	62	9
LCV	5.0	2.0	0.3	0.5	61	7
Car	4.0	1.6	0.3	0.5	72	7
M.Th.W.	2.6	1.4	0.2	0.4	48	8
M.T.W.	1.8	0.6	0.1	0.3	61	10
Bicycle	1.9	0.5	0.1	0.3	15	2

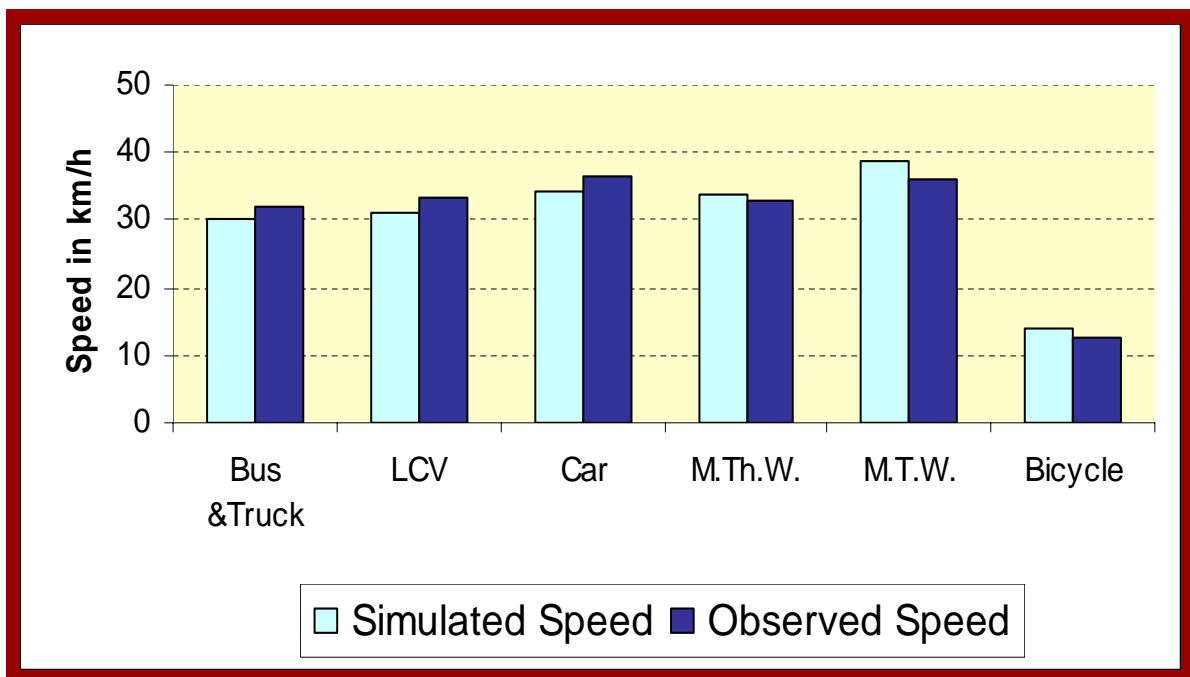
*LCV- Light Commercial Vehicle, M.Th.W – Motorised Three Wheelers, M.T.W - Motorised Two Wheelers, * Averages of the dimensions of different makes within a vehicle type.*

Snapshot of Simulated Traffic Flow



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Observed & Simulated Speeds



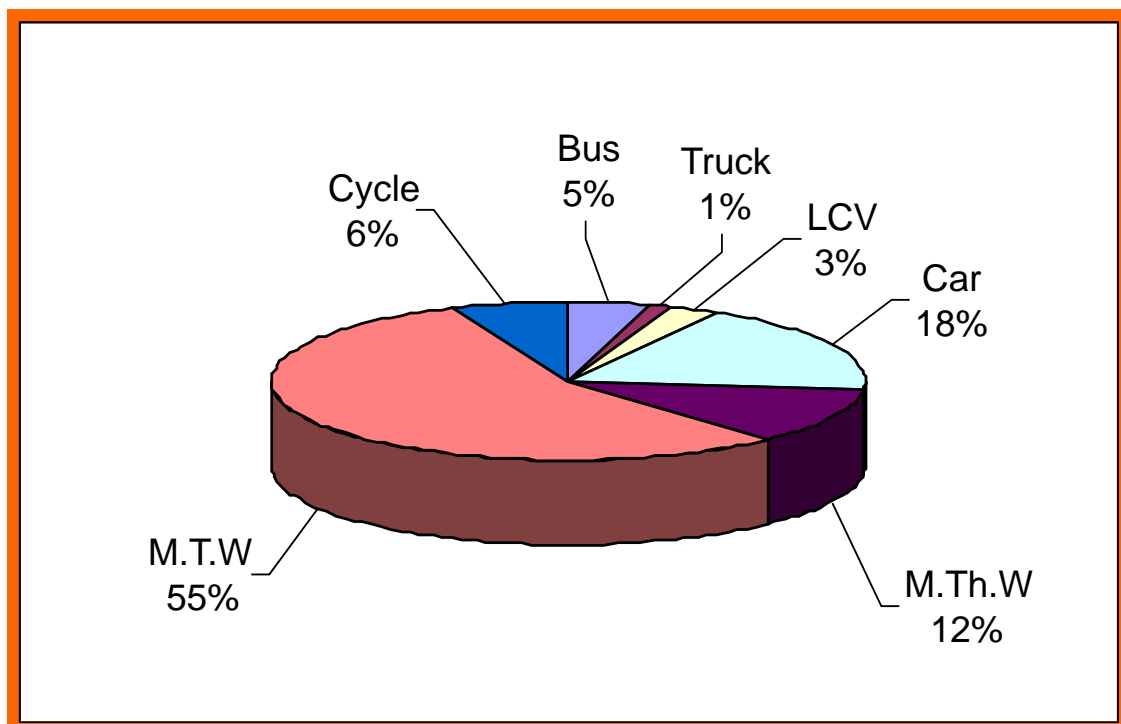
LCV- Light Commercial Vehicle, M.Th.W – Motorised Three Wheelers, M.T.W - Motorised Two Wheelers

Model Application: Impact Assessment of Exclusive Bus Lanes on Urban Road (11 m wide)

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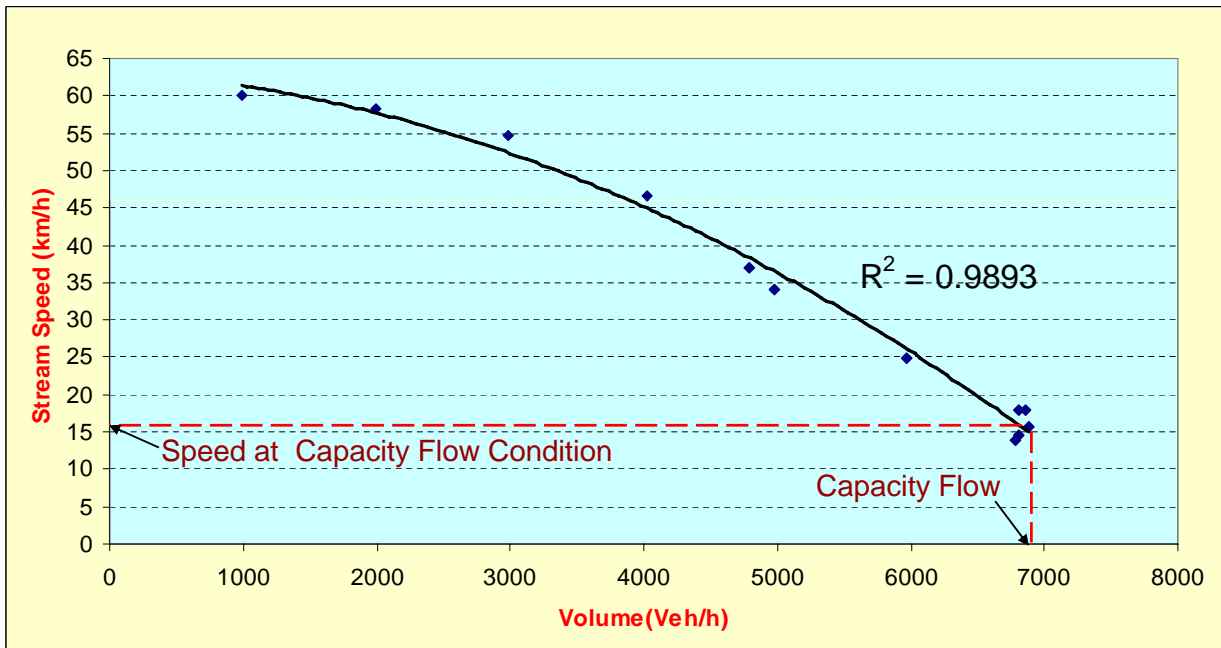
Representative Traffic Composition



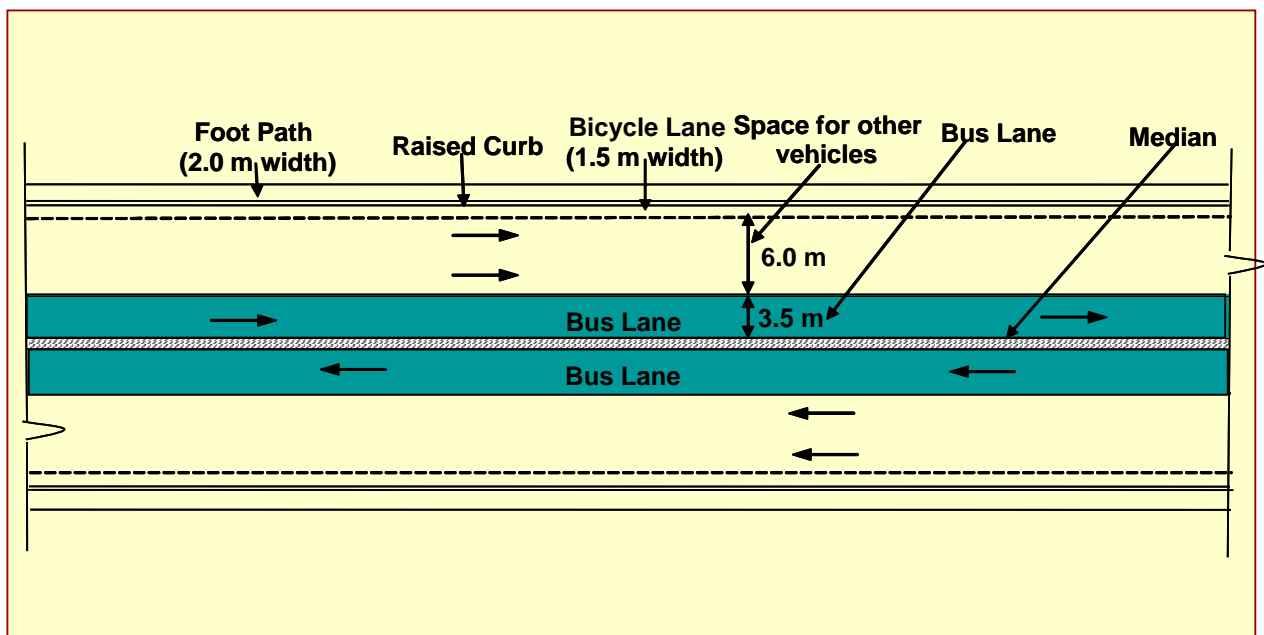
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Speed- Flow Curve for the Study Stretch



Schematic Layout of the Road Stretch with Exclusive Bus Lane (11m width)



Snapshot of Simulated Traffic Flow with Bus lane

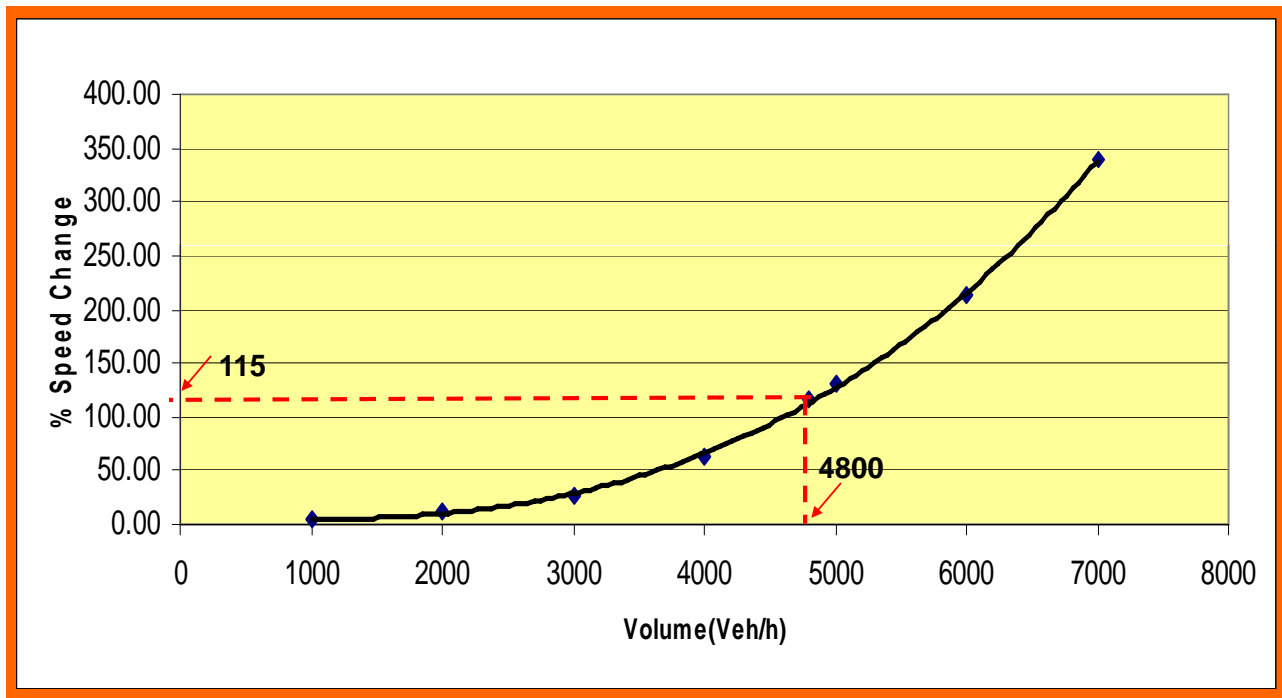


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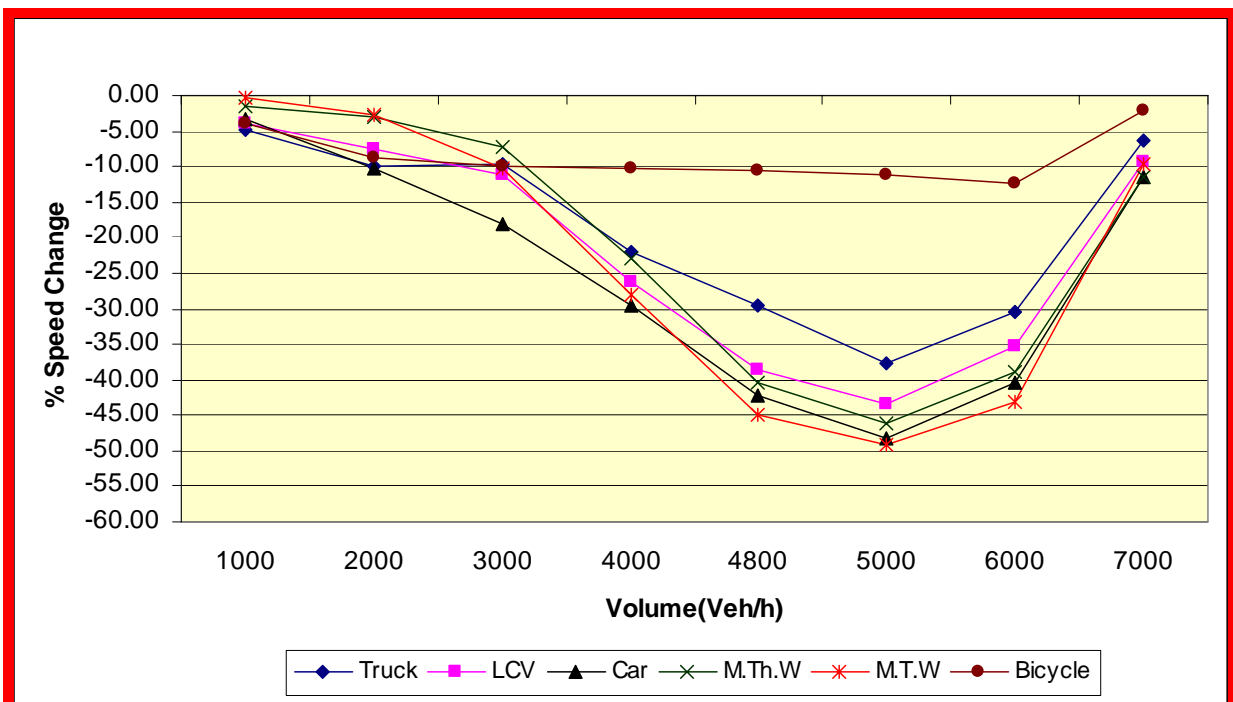
Speeds of Different Categories of Vehicles - With and Without Bus Lane

Traffic Volume (Veh/hr)	Road-way Condition	Speed Maintained by Vehicles in Kmph						
		Bus	Truck	LCV	Car	M.Th.W.	M.T.W.	Bicycle
1000	Without Bus Lane	63.5	55.6	60.8	72.8	48.9	62.9	14.5
	With Bus Lane	66.2	52.9	58.5	70.4	48.3	62.9	13.9
2000	Without Bus Lane	58.8	53.7	58.4	68.9	48.0	62.2	14.5
	With Bus Lane	65.9	48.4	53.9	61.9	46.6	60.6	13.3
3000	Without Bus Lane	51.2	45.8	51.1	60.9	46.1	59.4	14.5
	With Bus Lane	65.5	41.4	45.3	49.9	42.7	53.3	13.1
4000	Without Bus Lane	40.3	37.6	41.2	47.6	41.6	51.9	14.5
	With Bus Lane	65.2	29.3	30.4	33.6	32.0	37.3	12.9
4800	Without Bus Lane	30.3	28.2	31.7	35.3	34.2	41.8	14.4
	With Bus Lane	65.1	19.9	19.5	20.4	20.9	22.9	12.9
5000	Without Bus Lane	28.3	26.8	28.9	32.7	32.0	37.9	14.4
	With Bus Lane	65.1	16.7	16.3	16.9	17.2	19.3	12.8
6000	Without Bus Lane	20.9	20.5	21.6	23.3	23.7	27.4	13.9
	With Bus Lane	65.4	14.5	13.9	13.9	14.5	15.5	12.2
7150	Without Bus Lane	14.7	14.6	14.9	15.2	15.3	16.5	12.5
	With Bus Lane	64.5	13.7	13.5	13.4	13.5	14.9	12.2

The Rate of Increase in Speed of Buses Due to Bus Lane

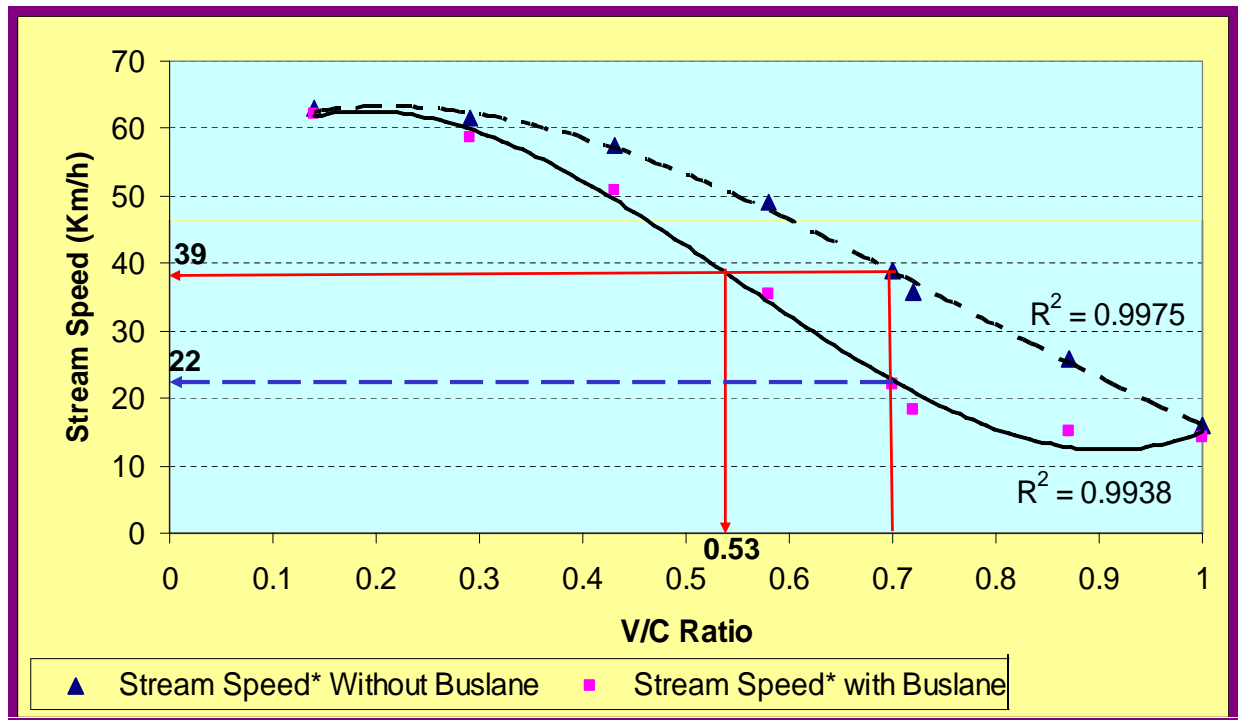


The Rate of Reduction in Speeds of Other Vehicles Due to Bus Lane



LCV- Light Commercial Vehicle, M.Th.W – Motorised Three Wheelers, M.T.W - Motorised Two Wheelers

Traffic Stream Speed on Roadway with and Without Bus Lane



*Stream of all motorised vehicles except buses

Justification for Exclusive Bus Lane

Car Versus Bus

70 People are carried by



Either 35 Cars

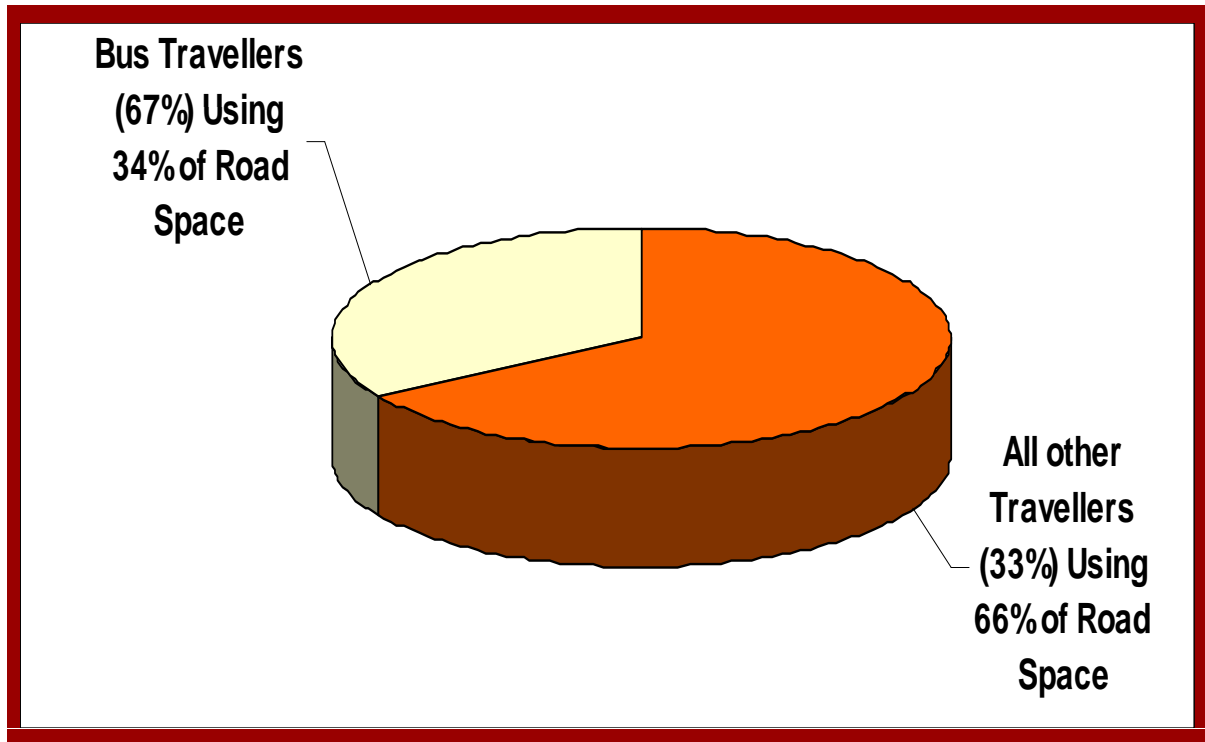
OR

Only 1 Bus

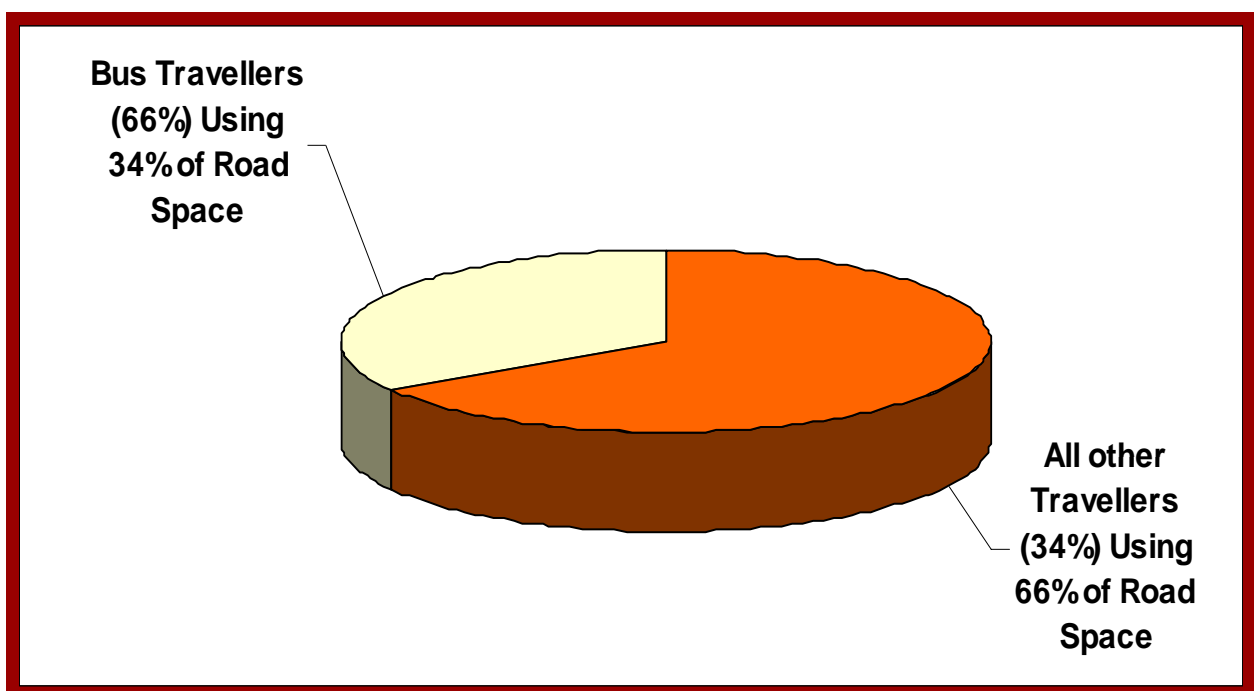
Average Vehicle Occupancy

S. No	Vehicle Type	Average Occupancy (Persons/Vehicle)
1	Bus	68.81
2	Light Commercial Vehicle (Passenger)	8.36
3	Car	2.54
4	Mototised Three Wheeler	2.98
5	Mototised Two Wheeler	1.32
6	Bicycle	1.14

Road Space Allocation at LoS 'C'



Road Space Allocation at Capacity-Flow Level



Road Space Utilization

Traffic Flow Condition	Type of Travellers	Number of Persons per hour (per direction)	Allotted Road Width in m	Road Space Utilisation in Persons/m/h
Flow at LoS 'C'	Bus travellers	15276	3.5	4,365
	Users of other passenger vehicles	7516	6.9*	1,089
Capacity-Flow Level	Bus travellers	19611	3.5	5,603
	Users of other passenger vehicles	9941	6.83*	1,456

* Excluding the proportionate road space used by goods vehicles

Findings

- The simulation model of heterogeneous traffic flow named, **HETEROSIM** is found to be valid for simulating heterogeneous traffic flow for the specific purpose of this study.
- It has been found through the study that for the assumed traffic composition, without any exclusive bus lane, the capacity of a 11m wide road (included 1.5 m wide bicycle track), for one way movement of traffic is about **6900 Vehicles per hour**.

Findings...

- If an exclusive bus lane is provided under the assumed roadway and traffic conditions, then, the maximum permissible volume to capacity ratio that will ensure a LoS 'C' for the traffic stream comprising all the other motor vehicles (except the buses), is about **0.53**.
- When an exclusive bus lane is provided, the mean running speed of buses can be up to **65 km/h** (depending on the bus stop spacing and the dwelling times, the corresponding mean journey speed may work out to be about 40km/h).

Findings...

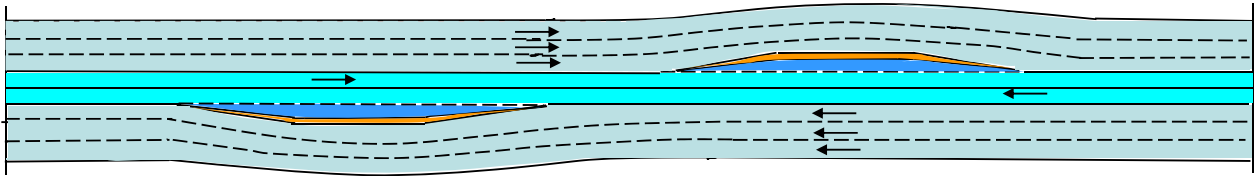
- The mean running speed of the stream of traffic comprising all the other motor vehicles (other than buses) enjoying LoS 'C', will be **39 km/h**.
- The percentage of road space allotted, in the road considered, to bus travellers (constituting 67% of the total travellers) and the travellers using other modes of transport (constituting only 33% of total travellers) are **34% and 66%** respectively for traffic flow at LoS 'C'.

Conclusion

- The results of the study indicate that it is possible to introduce exclusive bus lanes on selected urban roads in India to enhance the level of service of bus, without much of adverse impact on the level of service of other modes of road transport.
- The simulation model will be useful to create such data bases for a wide range of roadway and traffic conditions prevailing in India.
- The model will serve as an important decision making tool in managing the heterogeneous traffic on Indian roads and in several other developing countries, where similar traffic scenarios exist.

THANK YOU

Bus Lanes Provided at Median



Legend: ■ Bus Lane ■ General Traffic Lane ■ Bus Bay ■ Passenger Platform