Development Of Speed- Flow Curve For Arterial Road

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Abstract: Increasing vehicular growth requires adequate transportation facilities. For designing any road facility speed-flow relation is essential to get required designing speed. As urban roads carry different types of vehicles having different dimensions, shape, speed etc. Two arterial roads of Jamnagar city are selected for data collection. Traffic composition affects traffic flow parameters. In this paper, speed-flow curves are plotted using collected field data from the peak and non-peak hour. Space mean speed and classified volume counts are used for speed-flow relation.

Keywords: Traffic Composition, Traffic Parameter, Speed, Flow, Arterial Roads.

INTRODUCTION

Urban transportation is acting as a key to each economical communication in all urban communities all over the world. The increase in urban population growth tends to increase vehicular growth and travel demand. Vehicular growth requires adequate road facilities. Mainly traffic parameters are influenced by roadway characteristics, traffic composition etc. Speed-flow curve will provide maximum flow condition at optimum speed for any particular road. IRC has suggested the capacity of various roads for urban areas. For the development of speed-flow curve, space means speed and no. of pcu per unit time is used.

LITERATURE REVIEW

Birva Shah [1] has selected C.G. Road of Ahmedabad city of Gujarat state. The capacity is determined and compared with the IRC guidelines. She has concluded that the observed capacity is 16% higher than the specified in IRC guideline. Traffic composition and side friction also affect the capacity of the road. She also used VISSIM software for capacity which is also more than suggested by IRC.

Iin Irawati [2] has selected Mrageen city of Indonesia as his study area. He collected different data like total vehicles, amount of vehicles, road geometry, side friction etc. he used VISSIM software for delay analysis with and without side friction. He concluded that with side friction delay is 128.838 time per vehicle(s) and without side friction, it is 96.310 time per vehicle(s).

Chetan R. Patel & G.J.Joshi [3] had studied on six lane divided urban road in Pune and Patna city of India. Speed-flow density relationships were developed for both the roads and parameter for mixed flow condition are derived and compared with IRC. They have taken Dynamic car unit instead of Passenger car unit. Due to side parking, effective lane width decreases from 10.5m to 7.0m which results into decrement of 57% in capacity in Patna city.

Ahmed munawar [4] studied speed- flow relation using Indonesian highway capacity manual (1997). He uses formula and coefficients from IHCM.

Chandra S. [5] has considered the effect of lane width on capacity under mixed traffic condition in India, had concluded that speed is getting reduced due to a reduction in lane width.

IRC 106 has suggested recommended design values in pcu per hour for various categories of roads which are shown in the following table.

SR.NO.	TYPE OF CARRIAGEWAY	TOTAL DESIGN SERVICE VOLUME FOR DIFFERENT CATEGORIES OF ROAD		
		ARTERIAL	SUBARTERIAL	COLLECTOR
1	2-lane(one way)	2400	1900	1400
2	2-lane(two way)	1500	1200	900
3	3-lane(one way)	3600	2900	2200
4	4 lane undivided (two way)	3000	2400	1800
5	4 lane divided (two way)	3600	2900	-
6	6 lane undivided (two way)	4800	3800	-
7	6 lane divided (tow way)	5400	4300	-
8	8 lane divided (two way)	7200	-	-

STUDY AREA

Jamnagar is a city located on the western coast of India in Gujarat state. Currently, its headquarters for administration in Jamnagar district. After Ahmedabad, Surat, Vadodara and Rajkot, Jamnagar is a 5th largest city in Gujarat state. The modern look of the city was initially given by the Jam Saheb Shri Ranjitsinhji during his reign in1920s, the city was thereafter substantially developed by Jam Saheb Shri Digvijaysinhji in the 1940s. The city lies to the south of Gulf of Kutch and 337 kilometers west of the state capital, Gandhinagar. In Jamnagar, word's largest petroleum company Reliance Industry is located. Also, the Essar Oil refinery is located in nearby town of Vadinar. Most residents in Jamnagar are Gujarati and speaks the Gujarati language. For day to day communication, Kathiawadi language is used. The only Marine sanctuary in India is located near Jamnagar, on the coral reef of Pirotan. Various transport facilities viz. Airport, Rail, Road and Local are available in Jamnagar city.
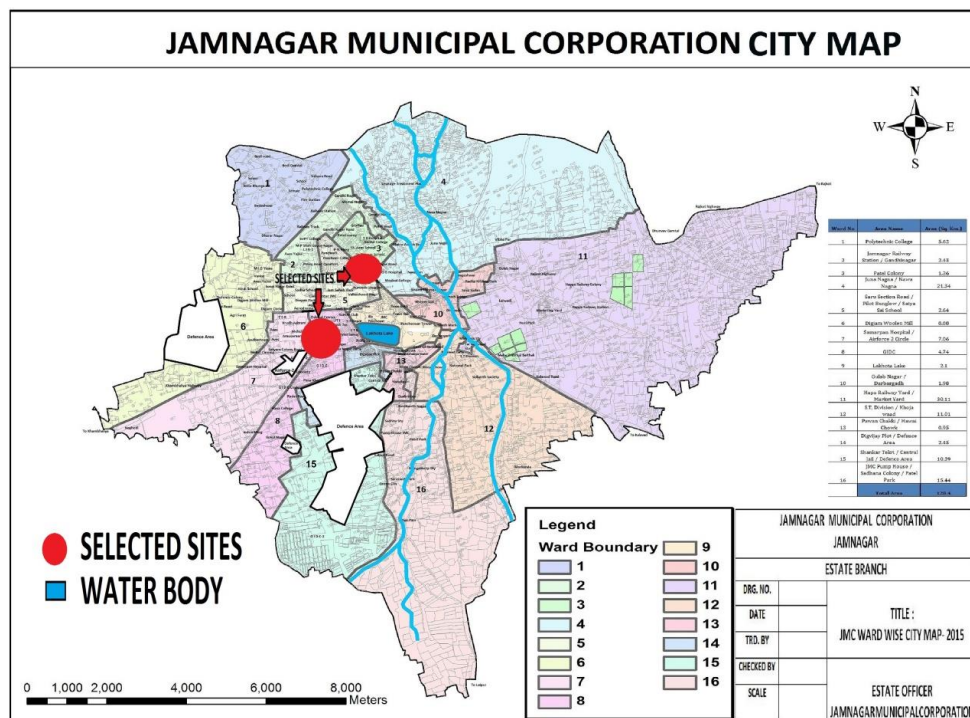
SR. NO.	ROAD NAME	CARRIAGEWAY TYPE	SHOULDER TYPE	LANE WIDTH	SHOULDER WIDTH	STRETCH LENGTH
1	Bedi Road	4 lane divided (two way)	Paved	3.5m	1.2m	2.3km
2	Aerodrome Road	4 lane divided (two way)	Paved	3.5m	0.5m	2.4km

DATA COLLECTION AND EXTRACTION

For geometric data collection, a preliminary survey was carried out with the help of measuring tape. For traffic parameters videography was selected as a primary method for data collection. But as videography, it does not represent data. So, actual data was collected in the laboratory in later hours. Videos were recorded with the help of maximum six cameras mounted on tripod stand which covered 100m stretch on both the side of the road for Aerodrome Road and maximum five cameras were used for Bedi Road. Two cameras on each side of road covering entry and exit line of selected section and remaining two covers the remaining portion of the section for extraction of side frictional events. Three sections were selected for data collection on each road. Both the ends were clearly marked with the help of lime powder so that exit and entry line for particular stretch can be clearly visible from the video. Data were collected for both peak and non-peak hours to cover all level of traffic. Following table illustrate dates and time for data collection process and the photo shows the camera and stand during data collection process.

Road Name	Section	Date	Time			Total hours
			Morning	**Afternoon**	**Evening**	
Aerodrome Road	1	7/12/2016	9:00 to 10:00 AM	1:00 to 2:00 PM	5:15 to 6:15 PM	3
	2	7/12/2016	9:00 to 10:00 AM	1:00 to 2:00 PM	5:15 to 6:15 PM	3
	3	3/4/2017	9:00 to 10:00 AM	1:15 to 2:15 PM	5:30 to 6:30 PM	3
Bedi Road	1	28/12/2016	8:30 to 9:30 AM	1:00 to 2:00 PM	5:15 to 6:15 PM	3
	2	28/12/2016	8:30 to 9:30 AM	1:00 to 2:00 PM	5:15 to 6:15 PM	3
	3	4/4/2017	-	1:00 to 2:00 PM	5:30 to 6:30 PM	2

Extraction of data from videography was done by playing and replaying video manually several time as parameters to be extracted are more in number. Parameters in data extraction include volume count for different categories of vehicles, the speed of individual vehicles, and side frictional event (as stated above). So it requires minimum twenty to twenty-five hours of laboratory for one hour recorded video. All data i.e. space mean speed for the individual type of vehicles and volume were extracted for the 20sec interval to get correct relation as possible.

DATA ANALYSIS

Traffic composition can be defined as a representation of % traffic of individual type of vehicle in total traffic. Following pie charts shows traffic composition for both roads.
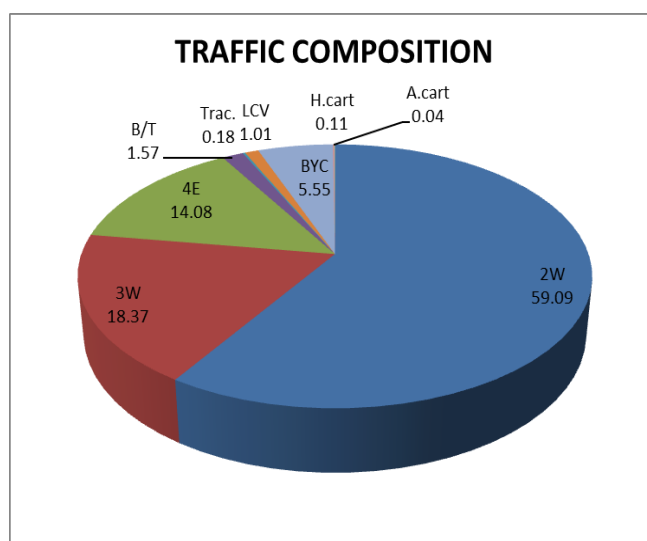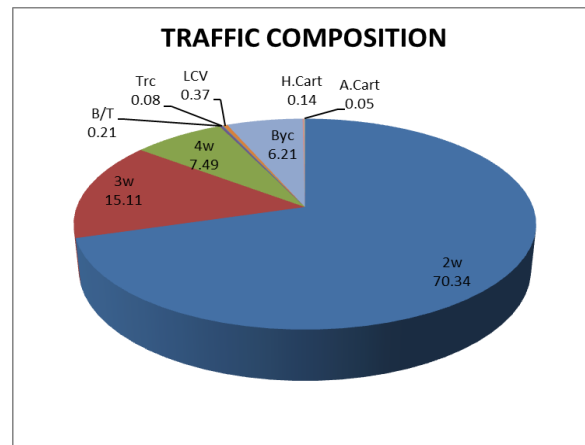

Figure 2: Aerodrome Road

Figure 3: Bedi Road

As it can be noted from above pie chart that major amount of traffic is composed of two wheelers, three wheelers, and four wheeler. So average space mean speed of these three categories of vehicles is used to plot speed- flow curve.

The speed-flow analysis began with the inspection of the speed flow plots for each site. The figure shows the plots for three sections surveyed on each road. The plot shows 20 sec speed-flow data collected for 3 hours in each section except section 3 of Bedi Road where only two hours of data have been recorded. The plot includes data of both direction flow separately so total 360 reading were plotted for one-hour data for one section of any particular road.
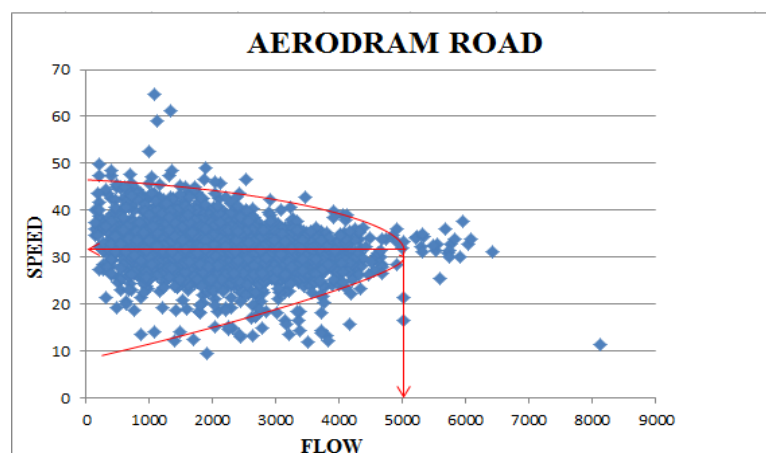

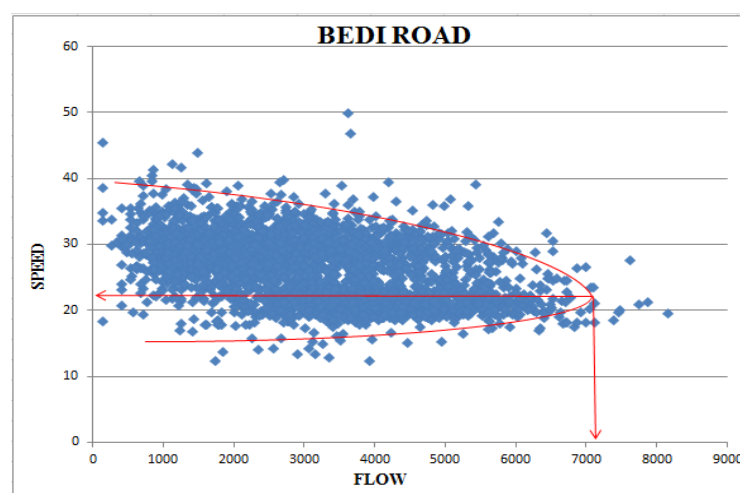**Figure 4 : Speed-Flow curve for Areodrome Road**

Figure 4 : Speed-Flow curve for Bedi Road

As it has been mention in above chart that speed is plotted on the Y axis and flow is on the X axis. Above plotted values were taken from 20 sec interval extraction and later it has been converted into one hour reading to check the maximum flow can be possibly present on selected roads with its optimum speed. PCU values of different types of vehicle are used from IRC 106 (1996).

CONCLUSION
From the prepared graph it can conclude that maximum possible flow with optimum speed is:
1. For Aerodrome Road 5033 pcu/hour with an optimum speed of 32kmph.
2. For Bedi Road 7120 pcu/hr with optimum speed of 22.7 mph.

Above stated results are on the basis of 20sec interval readings. Possible flow is much higher than the suggested recommended service volume by IRC 106.

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