Evaluation of Level of Service and Traffic Capacity for congested River Bridges of Surat City

Bhavin G. Bhoya[1] Prof. P. M. Shah[2] Dr. H. R. Varia[3]

[1]M. E. Student, Tatva Institute of Technological Studies, Modasa, Gujarat

[2]Lecturer & Head (I/C) in Civil Engineering Department, Government Polytechnic, Godhra, Gujarat

[3]Principal, Tatva Institute of Technological Studies, Modasa, Gujarat

ABSTRACT: India is developing country in the world. There are many complex problems related to transportation system is observed in the country. These include ever increasing population, vehicular growth and traffic congestion. Gujarat is the one of the top five fastest developing state of our country. Surat city is developing city. The city is 2nd biggest city in Gujarat and 9th biggest city in India. In Surat city- the fourth fastest developing city of the world-at many places the bottleneck conditions on the roads occurs due to limited availability of road space. Due to bottleneck condition at the bridges across Tapi river, traffic congestion is occurring. Out of the 10 bridges across the Tapi River in Surat city. some of the bridges which is connecting the commercial and residency area in the city are witnessing heavy amount of traffic during pick hours which leads to traffic jam and bottlenecks condition at some places. After reckoning survey the three bridges namely Sardar Bridge, Amroli Bridge and Savjibhai korat Bridge Are selected for Traffic flow capacity and level of Service analysis. Therefore, it is necessary to quantify the Traffic characteristics in existing traffic conditions on selected bridges and understand the responsible factors for suggesting improvement in existing Traffic congestion over selected bridges. In this study, it is proposed to find traffic flow capacity and Level of Service by measuring traffic speed, flow and density parameters on the selected bridges during peak hours. This may be helpful to check whether existing bridges are capable to handle existing as well as future increased traffic flow safety or not.

Keywords: Traffic Flow Capacity, Videography, Travel Time

I. INTRODUCTION

In developing country like India, Traffic congestion has been one of major issues that most metropolises are facing and thus, many measures have been taken in order to mitigate congestion. Identification of congestion characteristics is the first step for such efforts since it is an essential guidance for selecting appropriate measures. Basic knowledge of traffic flow characteristics like traffic volume under such Traffic conditions is fundamental traffic volume is basic variable in planning, designing, and operation of roadway systems. Congestion - both in perception and in reality - impacts the movement of people and freight and is deeply tied to the history of high levels of accessibility and mobility. Traffic congestion wastes time and energy, causes pollution and stress, decreases productivity and imposes costs on society.

Transportation plays important role in development and growth of any nation. Transportation is significant for trade, organization and social interaction, while consuming considerable time and resource. Transportation sector in India is a very extensive system, comprising different modes of transport like Road, Railway, Aviation, Waterway and Shipping, which facilitate easy and different conveyance of goods and people across the nation. The backbone of economic development of the India is largely depends on its transportation. Road transport is primary mode of transport which plays an important role in conveyance of goods and passengers and linking the centres of production, consumption and distribution.

A. Aim of Study

The aim of this study is to find traffic flow capacity and Level of Service by measuring traffic speed, flow and density parameters on the selected bridges across Tapi River during peak hours of Surat city. The study aims to Find Remedial measures for easing of traffic congestion at selected Bridges.

B. Objective

- To quantify Traffic capacity Parameters such as traffic volume, Taffic composition ,Traffic Speed and Traffic density and Travel time on the selected Bridges.
- To Find Level of Service of the selected bridges.
- To suggest remedial measures for reliving traffic congestion on the selected bridges

C.   Scope

This study is limited to selected Bridges of Surat city. This study may be helpful to ascertain whether existing bridges are capable to handle existing as well as future increased traffic flow safely and effectively or not. The study aims to Find Remedial measures for easing of traffic congestion at selected Bridges.

II.   LITERATURE REVIEW

Emmanue Segun Oguntade et. al. (2015) have been discussed about Queue performance parameters is inevitable for efficient and effective congestion control and traffic free networking system. This study assesses the efficiency and effectiveness of road traffic systems, using the Atlas Hotel road intersection, Gwagwalada, Abuja Nigeria as a case study. Queue theory analytic methodologies are applied and parameters such as average arrival and service rate are calculated based on the data obtained. It was concluded that with reference to the intersection studied, road traffic system performance within the Gwagwalada metropolis is stable as Level of Service is A with Average Control Delay (seconds/vehicle) ≤ 10 seconds per vehicle.

Amaliyar and Varia (2017) carried out the speed-volume relationship is used to find the capacity of Roads and obtained the speed flow density curves of selected stretches of Ahmedabad city. It is concluded that existing equation of traffic stream are suitable for this Heterogeneous traffic. According to their complete analysis they found the traffic stream parameters. They got standard relationship between traffic stream parameters and a equation for heterogeneous traffic of Ahmadabad city.

Todd Litman (2017) has been prepared this paper which defines types of generated traffic, discusses generated traffic impacts, recommends ways to incorporate generated traffic into evaluation, and describes alternatives to roadway capacity expansion. In this study, Roadway volume to capacity ratios are used to calculate peak-period traffic speeds, which are then used to calculate travel time and vehicle operating cost savings.

III.   METHODOLOGY
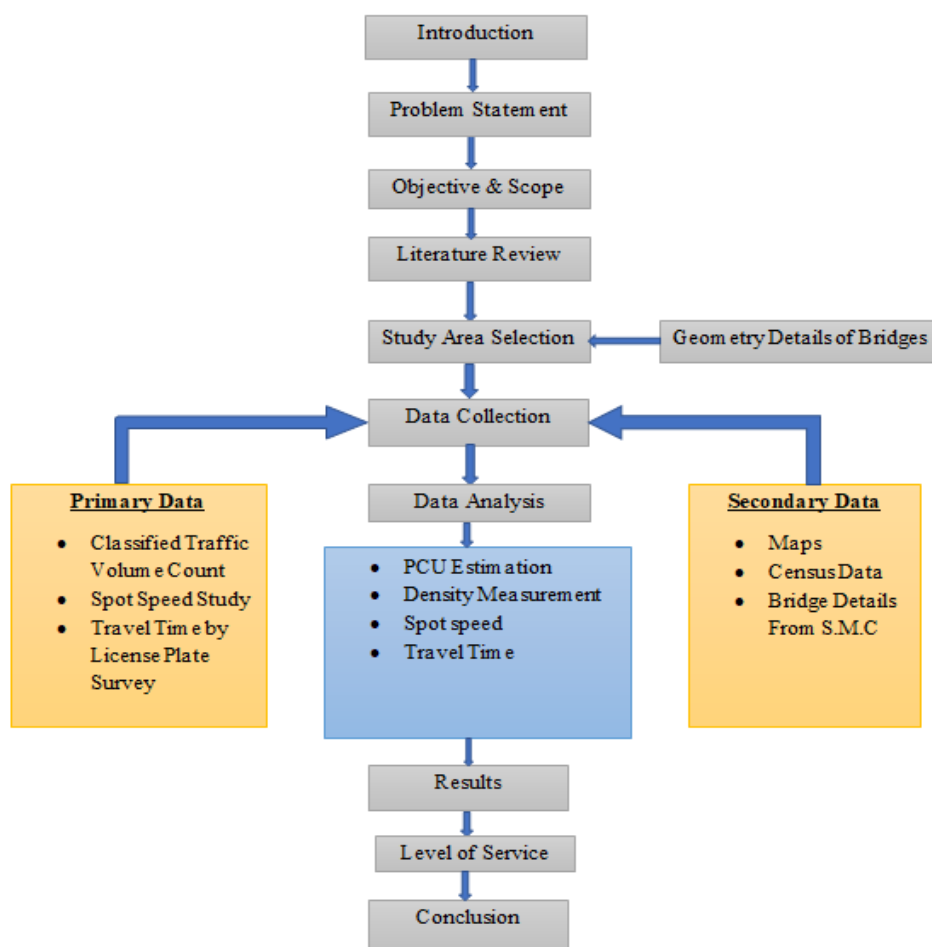
IV. FIELD SURVEY METHODS

1.**Traffic volume count survey (Videography):**

As it is more convenient and accurate method for Classified Volume Count, videography was commenced for the study. It do not require more man power and skilled person so it is carried out for this study

To study the fluctuation of traffic volume per 5min videography were conducted at selected bridges. Traffic Volume count survey carried out by videography on all selected Bridges during peak hour. The camera was situated on the footpath of side of lane with suitable visibility of lane. The height of camera may be a different for each road lane but not less than 1m on any lane.

2 Spot Speed Study Survey:

This survey carried out to collect and analyse the data using videography Method at selected Bridges. Spot Speed Study is the study of the speed of the traffic at one point on a traffic way. It consists of a series of observation of the individual speed at which vehicles are passing a point at a non-intersection location. These observations are used to estimate the speed distribution of the entire traffic stream at that location under the condition prevailing at the time of study.

3. Licence Plate Survey:

This method gives the information of travel time only. In this Licence Plate survey method used Videography. The timing and vehicle numbers are noted from Videos. From office computation of travel time of each vehicle can be found. Travel times by matching vehicle license plates between consecutive checkpoints with varying levels of instrumentation: Video cameras, portable computers.

V. STUDY AREA

Surat is an Indian port city previously known as **Suryapur**. It is the economic capital and former princely state in the Indian state of Gujarat. This city is 2nd biggest city in Gujarat and 9th biggest city in India. Surat is the 3rd "cleanest city of India" according to the Indian Ministry of Urban Development, and 4th fastest growing city of the world. Surat is famous for its food, textile, and diamonds. Surat polishes over 90% of the world's rough diamond.

It is the administrative capital of the Surat district. The city is located 284 km south of the state capital, Gandhinagar; 265 km south of Ahmedabad; and 289 km north of Mumbai. The city centre is located 22 km south of the Tapti River. A moat divides the older parts of the city, with their narrow streets and historical houses, from the newer suburbs.

Surat had a population of 4.5 million at the 2011 census, making it the second largest city in the state of Gujarat, after Ahmedabad. It is the eighth largest city and ninth largest urban agglomeration of India. Surat is the 34th-largest city by area and 4th-fastest developing cities in a study conducted by the City Mayors Foundation, an international think tank on urban affairs. The city registered an annualized GDP growth rate of 11.5 per cent over the seven fiscal years between 2001 and 2008. Surat was awarded "best city" by the Annual Survey of India's City-Systems (ASICS) in 2013. Surat is selected as the first smart IT city in India which is being constituted by the Microsoft City Next Initiative tied up with IT services majors Tata Consultancy Services and Wipro.

Selected Bridges for This Study are below

Amroli Bridge (655.20m)

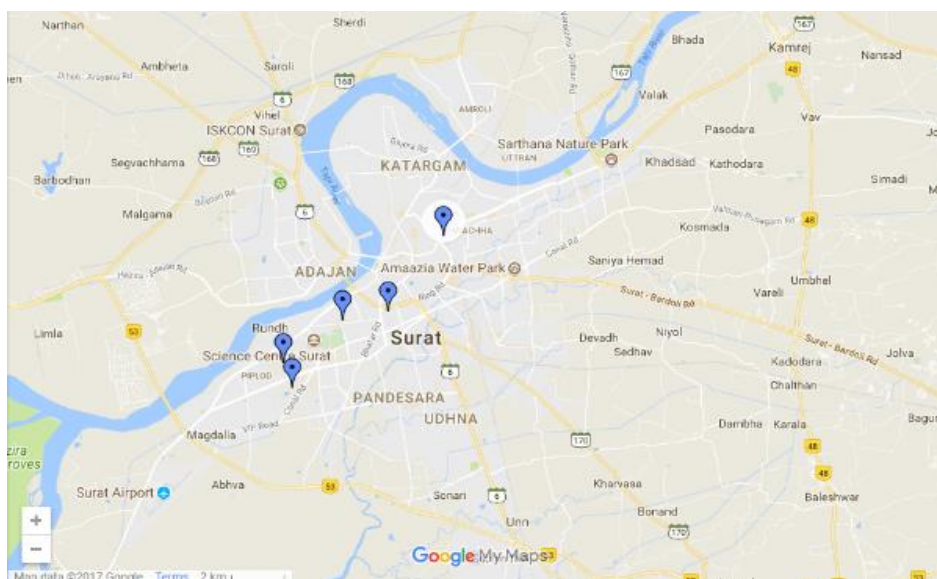Sardar Patel Bridge (772.23m)

Savjibhai Korat Bridge (544.6m)

Figure 1 map of Surat city

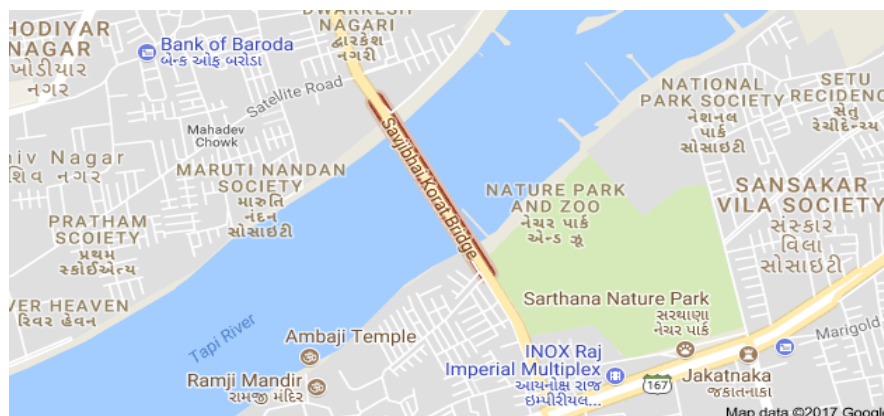**Figure 2 Amroli Bridge**

Figure 3 Sardar Bridge

Figure 4 Savjibhai Korat Bridge

VI. DATA COLLECTION AND ANALYSIS

A. Basic Analysis

Traffic Volume Count Survey has been done for all selected river bridges in surat city. This survey is done by the videography. The analysed data shows result for selected Bridges like below:

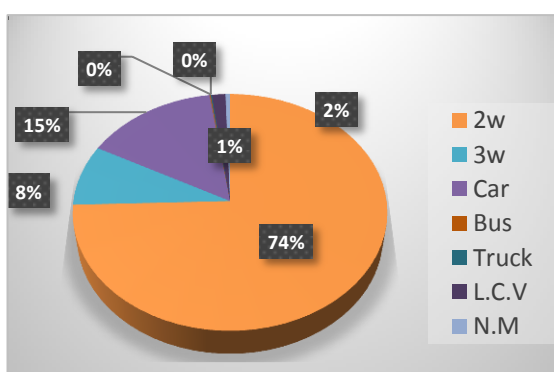1 Traffic flow Data Analysed for Savjibhai Korat Bridge

Figure 5 Cumulative Traffic flow:
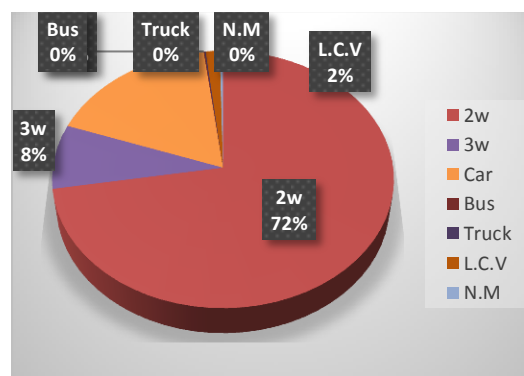
Nana Varachcha to Mota Varachcha

Figure 6 Cumulative Traffic flow:

Mota Varachcha to Nana Varachcha

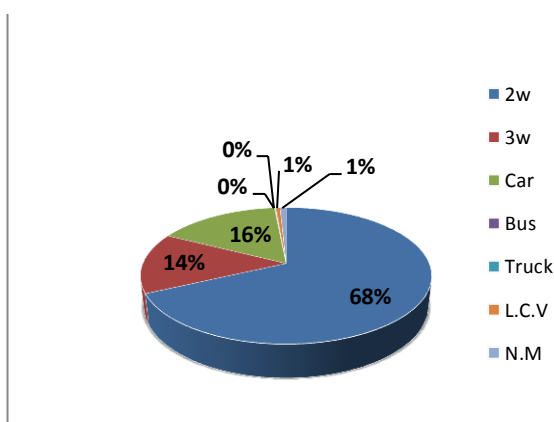2 **Traffic flow Data Analysed for Sardar Patel Bridge**

Figure 7 Cumulative Traffic flow:
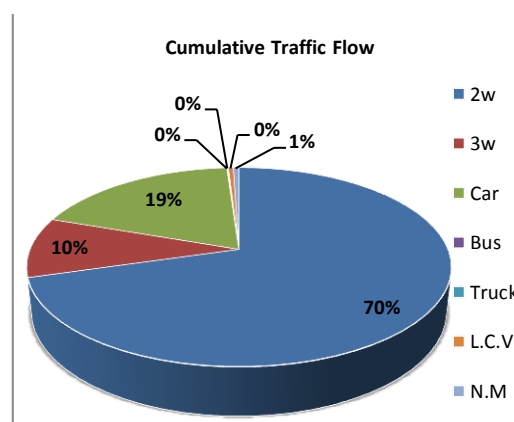
Athwa Gate to Adajan

Figure 8 Cumulative Traffic flow:

Adajan to Athwa Gate

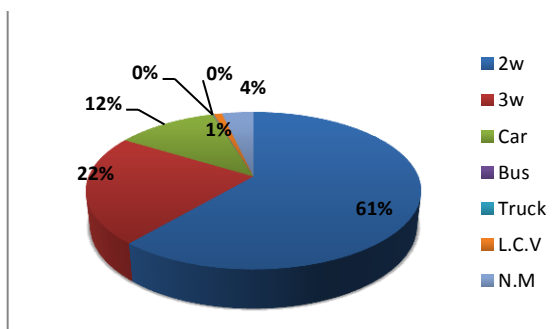**3 Traffic flow Data Analysed for Amroli Bridge**
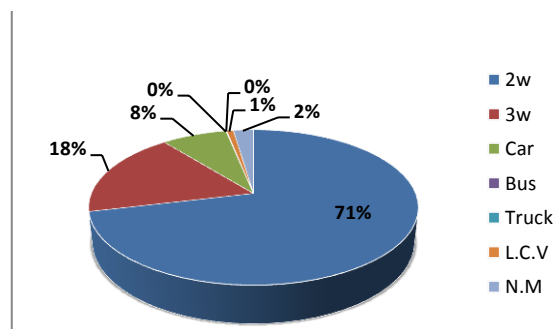

Figure 9 Cumulative Traffic flow:

Katargam to Amroli

Figure 10 Cumulative Traffic flow:

Amroli to Katargam

Results and Conclusion

Table 1 Results of Traffic Flow count

Bridge Name	Direction	PCU/hr
Amroli Bridge	Katargam to Amroli	37386.48
	Amroli to Katargam	46834.28
Sardar Patel Bridge	Athwa Gate to Adajan	54625.68
	Adajan to Athwa Gate	59116.8
Savjibhai Korat Bridge	Nana Varachcha to Mot Varachcha	15682.08
	Mota Varachcha to Nana Varachcha	23044.08

Table 2 Results of Spot- Speed and Density

Bridge Name	Direction	Avg. Spot-Speed (v) kmph	Avg. Density PCU/km (k)
Amroli Bridge	Katargam to Amroli	14.74	209.57
	Amroli to Katargam	14.70	260.44
Sardar Patel Bridge	Athwa Gate to Adajan	15.01	298.26
	Adajan to Athwa Gate	14.96	325.52
Savjibhai Korat Bridge	Nana Varachcha to Mot Varachcha	17.48	121.38
	Mota Varachcha to Nana Varachcha	17.48	119.98

Table 3 Results of Travel Time of Different Vehicles

Bridge Name	Direction	Veh. Type	Avg. T.T(min)
Amroli Bridge	Katargam to Amroli	2w	02:25
		3w	02:35
		Car	02:32
		Bus	02:42
		LCV	02:33
	Amroli to Katargam	2w	02:24
		3w	02:36
		Car	02:32
		Bus	02:43
		LCV	02:32
Sardar Patel Bridge	Athwa Gate to Adajan	2w	03:00
		3w	03:11
		Car	03:05
		Bus	03:25
		LCV	03:06
	Adajan to Athwa Gate	2w	03:00
		3w	03:10
		Car	03:06
		Bus	03:25
		LCV	03:06
Savjibhai Korat Bridge	Nana Varachcha to Mota Varachcha	2w	01:04
		3w	01:29
		Car	01:08
		Bus	01:40
		LCV	01:15
	Mota Varachcha to Nana Varachcha	2w	01:05
		3w	01:29
		Car	01:09
		Bus	01:39
		LCV	01:15

Table 4 LoS of Urban road based on Stream Speed, V/C Ratio and FFS

Level of Service(L.O.S)	Range of Average Stream Speed	V/C Ratio (Volume/ Capacity Ratio)	Percentage of Free flow Speed
LoS A	> 64	< 0.15	> 84
LoS B	64-58	0.15-0.45	84-76
LoS C	58-45	0.45-0.75	76-59
LoS D	45-31	0.75-0.85	59-41
LoS E	31-17	0.85-1.0	41-22
LoS F	<17	> 1	< 22

(Source: INDO-HCM-2018)

Table 5 L.O.S Calculation from table 4.

Bridge Name	Direction	Avg. Speed (v) kmph	Avg. V/C Ratio	L.O.S
Amroli Bridge	Katargam to Amroli	15.37	1.4	
	Amroli to Katargam	15.40	1.8	F
Sardar Patel Bridge	Athwa Gate to Adajan	14.67	2.1	
	Adajan to Athwa Gate	14.68	2.3	F
Savjibhai Korat Bridge	Nana Varachcha to Mot Varachcha	25.90	1.0	
	Mota Varachcha to Nana Varachcha	25.25	1.0	E

Conclusion

As per the IRC criteria urban roads are design for L.O.S category C. But in this case, observed L.O.S is found for Amroli Bridge and Sardar Bridge as category F and for Svajibhai Korat Bridge, L.O.S is found as category E. So, to improve the level of service of selected bridges certain remedial measures is required to be implement.

Some Suggested Measures are below:

Suggested Measures:
- Improvement of public transportation system
- Staggering working hours of public and private organisations
- Rescheduling of school timing
- Enforcement of traffic rules and Lane discipline
- Possibility of Traffic divert to alternate routes
- Expanding capacity of Existing bridge

References

[1] Amaliyar, A.A and Varia, H.R (2017). "Traffic Flow Modelling for Heterogeneous Conditions on Urban Road - A Case Study of selected stretches of Ahmadabad city", Civil Engineering Department, Volume 6, Tatva Institute of Technological Studies Modasa, Gujarat, India.

[2] Polly Trottenberg, Lori A. Ardito, Ryan Russo, Naim Rasheed, Ann Marie Doherty And Richard P. Roan (2014). "2014 New York City Bridge Traffic Volumes", Department of Transportation, New York, U.S.A.

[3] Gleave Steer Davies (2013). "Louisville-Southern Indiana Ohio River Bridges Traffic & Revenue Study", Kentucky Public Transportation Infrastructure Authority, U.S.A

[4] Sang-Hyo Kim, Won-Ho Heo, Dong-woo You and Jae-Gu Choi (2017). "Vehicle Loads for Assessing the Required Load Capacity Considering the Traffic Environment", School of Civil & Environmental Engineering, Yonsei University, Seoul 03722, Korea.

[5] E. Elangovan, D. Jebaselwin Gladson, Dr. K. Gunasekaran, S. Kalaanidhi And K. Karthiga (2015). "Study on Traffic Flow Characteristics using Probe Vehicles", Transportation Engineering, Anna University, Chennai.

[6] Litman Todd (2017). "Generated traffic and Induced Travel", ITE Journal, Vol. 71, No. 4, Institute of Transportation Engineers, Victoria, British Columbia.

[7] Amudapuram Mohan Rao And Kalaga Ramachandra Rao (2012). "MEASURING URBAN TRAFFIC CONGESTION – A REVIEW", IIT Delhi, Department of Civil Engineering, Hauz Khas, New Delhi - 110 016, India.

[8] Folake Akintayo and Oluwole Agbede (2012). "A Simple Traffic Flow Simulator for Two-lane Highways", University of Ibadan, Ibadan, Nigeria.

[9] Emmanue Segun Oguntade, Sunday Samuel Bako and Godwin Monday Mayaki (2015). "On Markovian Modelling of Vehicular Traffic Flow in Gwagwalada Metropolis, Nigeria", Matematika, 2015, Volume 31, Number 1, 77–91, Nigeria.

[10] Hasabnis A, Kanade S. N, Jadhav P. P, Hawanna P. K, and Alkunte C. V. (2016). "Traffic Congestion Problem At "Khadi Machine Square, Pune", IJSTE - International Journal of Science Technology & Enginee ring, Volu. 2, Pune, India.