

## **Traffic Speed Flow Model For The Mix Traffic On Vadodara Arterial Road**

Krishn Rathod<sup>1</sup>, Jayesh Juremalani<sup>2</sup>, Suresh Damodariya<sup>3</sup>

<sup>1</sup> M.Tech. Student, *Civil Department, Parul Institute of Engg. & Tech., Vadodara, Gujarat, India*

<sup>2</sup> Asst. Professor, *Civil Department, Parul Institute of Engg. & Tech., Vadodara, Gujarat, India*

<sup>3</sup> Reader, *Civil Department, Parul Institute of Engg. & Tech., Vadodara, Gujarat, India*

**Abstract**— *The traffic in mixed flow can be classified as fast moving and slow moving vehicles or motorized and non motorized vehicles in India. The vehicle also deviate in size manoeuvrability, control, static and dynamic characteristics.*

*The effect of curve on speed under the mix traffic condition is carried out in present study. Thus, the purpose of this study is to calculate the capacity of the urban arterial roads. The study and research consists of analyzing the arterial Vadodara roads which are divided in four lanes. A part for straight stretch, curve stretch also selected to study the reduction of the speed. By considering the straight road section, the speed flow model is developed.*

**Keywords**— *Urban Roads, Mixed traffic, Straight Section, Curve Section, Speed Flow Model.*

### **I. INTRODUCTION**

Urbanization – The population shift from rural to urban areas, “The gradual increase in the proportion of people living in urban areas”, which causes the travel patterns to be very complex. To investigate the operational characteristics of the mixed traffic flow consisting of different vehicles (large vehicles, cars and bicycles) and it is governed by different factors like side friction, composition present of non-motorized transport, the curvature of the roads, variation in volume, density and velocity etc.

Thus, the purpose of this study is to calculate the capacity of the urban arterial roads. The study and research consists of analyzing the arterial Vadodara roads which are divided in four lanes. A part for straight stretch, curve stretch also selected to study the reduction of the speed.

Here, the variation in speeds will be observed and the variation in curved portion compared to the straight portion will be noted. The classical speed flow relation for straight and curve has been carried out.

**Video graphic technique** is used to capture the data for four lane divided roads. It will be carried out between 7 AM to 9 PM. The capacity base on speed flow was determined for straight portion. The spot speed method is used to capture video graphics analysis on big screen and volume vehicle per hour and speed kmph and also time means speed converted in to space means speed to established speed, flow relationships.

Heterogeneous traffic composition is comprised by most of the Indian cities today. Metropolitan cities contain two wheelers and four wheelers excessively making them the maximum running vehicles today. The presence of vehicles of wide ranging static and dynamic characteristics defines the existing heterogeneous traffic on urban roads of developing countries like India. The unhampered movement of the vehicles which are running on road space is responsible for the lane concept and expression of flow values, based on standard lane width.

As a result, different types of vehicles share the same road space without any physical separation. Thus Vadodara city becomes the appropriate site for the study of the arterial roads because the urban arterial divided roads are the important traffic corridors as they carry high volume of traffic without lane discipline and separation.

Traffic flow become more complicated because of absence of hierarchical functioning of different categories of arterial road in metropolitan cities like Vadodara.

The study at present is aimed to get the case study of limited traffic flow characteristic of excess control urban arterials road for that fastest growing of Vadodara city. As mentioned above, this study is carried on urban arterial road in Vadodara city. Video Graphic Survey is used to carry classified volume count for 16 hours on arterial road. Also, Video graphic survey is carried out for spot speed study. This also means that the PCU factor microscopic traffic characteristics are out of the scope.

## **II. METHODS AND MATERIAL**

### **A. Objectives**

- 1) Analysis and study of the speed characteristic of arterial road.
- 2) Evaluation of the effect of curve on speed.
- 3) Study of speed flow relationship of arterial roads.

### **B. Literature Review**

**B. r. marwah & Bhuvnesh Singh (2004):** Have study LOS classification evolved in this study will be helpful to identify deficiencies of an urban road system and to plan for alternate improvement measures to attain a desired level of service. The study of the simulation results during analysis clearly demonstrates the capability of model simulate urban heterogeneous traffic flow condition.

**Kazushi SANO, Chu Cong MINH, Chu Cong MINH (2005):** The purpose of this study addresses a comprehensive analysis of motorcycle behavior and operation through videotaping of some roads that have significant motorcycle proportion. Statistical analyses of the empirical data were utilized to demonstrate the characteristics of motorcycle speed, time headway regarding to traffic flow. The present paper provides a basic understanding of characteristics of motorcycle traffic. The finding obtains from this research may be used to develop new procedures for Highway Capacity Manual (HCM), which adapt developing countries as well as provide the data needed to develop a motorcycle simulation model.

**Partha Pratim Dey, Satish Chandra and Gangopadhaya (2006):** Have study that Most of the studies in the literature indicate that speed on a highway flow the normal distribution. The present study indicates that the speed distribution may be unimodal or a bimodal curve depending upon the variation in the speed of different categories of vehicles moving on the highway. The mathematical equation are suggest for unimodal and bimodal speed distribution curves, and their parameter evaluated at 17 different section two lane roads in India. It is observed that the proportion of slow moving vehicles is not a true indication of bimodality in the speed data. The spread ratio define as the ratio of difference between 85<sup>th</sup> percentile and mean speed to the difference in mean stream speed and 15<sup>th</sup> percentile speed, is better correlated with the shape of the distribution curves. The speed follows the unimodal curve only when the spread ratio is in the range of 0.69-1.35.

**Jorge A. Laval and Carlos F. Daganzo (2006):** Have studied that it is postulated that lane-changing vehicles create voids in traffic streams and that these voids reduce flow. This mechanism is described with a model that tracks lane changers precisely, as particles able with realistic mechanical properties. The model has four easy-to-measure parameters and reproduces without re-calibration two bottleneck phenomena previously thought to be unrelated: (i) the drop in the discharge rate of freeway bottlenecks when congestion begins, and (ii) The relation between the speed of a moving bottleneck and its capacity.

**Arasan VT (2008):** Has studied the effect of traffic volume and road width on PCU values under Indian traffic conditions by using microscopic simulation technique. Authors have dealt with (a) impedance caused to traffic flow by the different categories of vehicles and (b) to study the effect of road width on PCUs of vehicles. Conclusions drawn by the study states that (i) PCUs of a vehicle significantly changes with change in traffic volume, (ii) PCUs values of any vehicle type increases with the increase in the width of road space, (iii) PCUs value of a vehicle type is a dynamic quantity and not a constant and (iv) PCUs value of vehicle type is dependent upon the percentage of that vehicle type in total traffic mix.

**Sven M. and Moor Bart D. (2008):** They explained that scientific field of traffic engineering encompasses a rich set of mathematical techniques, as well as different backgrounds. The paper provides an overview of what is currently the

state of the art with respect to traffic flow theory. Starting with a brief history, they introduced the microscopic and macroscopic characteristics of vehicular traffic flows and some performance indicators that allow assessing the quality of traffic operations.

**Hemang chaudhari (2010):** Have study the Lane choice behavior. To develop dynamic vehicle equivalent factors for heterogeneous traffic on arterial road. Case study Lucknow and Chandigarh city.

**Xiangjie Kong, Guojiang Shen , Feng Xia, and Chuang Lin (2011):** Have study presents a new two-direction green wave intelligent control strategy to solve the coordination control problem of urban arterial traffic. The whole control structure includes two layers the coordination layer and the control layer. Public cycle time, splits, inbound offset and outbound offset are calculated in the coordination layer. Public cycle time is adjusted by Fuzzy Neural Networks (FNN) according to the traffic flow saturation degree of the key intersection. Splits are calculated based on historical and real-time traffic information. Offsets are calculated by the real-time average speeds. The control layer determines phase composition and adjusts splits at the end of each cycle. The target of this control strategy is to maximize the possibility for vehicles in each direction along the arterial road to pass the local intersection without stop while the utility efficiency of the green signal time is at relatively high level.

**Marwah and Singh (2000):** Simulation studies of traffic flow on urban roads in Kanpur (India) using a two-lane one-way traffic simulation model. Absence of lane discipline in the heterogeneous traffic flow is accounted in the model by treating the entire road space as a single unit instead of a lane. The validation of the model, based on headway distribution and speeds of the different categories of vehicles, indicates that the model can satisfactorily replicate heterogeneous traffic flow on roads where vehicles move without lane discipline.

**The Highway Capacity Manual (HCM 2000):** Utilizes Passenger Car Equivalency (PCE) factors to estimate the effect of heavy vehicles on traffic stream flow behavior under free-flow condition. However, these factors have been (mistakenly) used by professionals to conduct analyses for all traffic conditions i.e. free-flow as well as forced-flow conditions. Recent empirical evidence suggests that the PCE factors for free-flow conditions largely underestimate the effect of heavy vehicles after the onset of congestion.

**Arasan VT. Tamizh and Koshy (2000):** The study proposed a modeling methodology adopted to simulate the flow of heterogeneous traffic with vehicles of wide ranging static and dynamic characteristics. The simulation framework for the traffic-flow model is prepared to consider effect of absence of lane discipline in mixed traffic flow conditions.

**Thamizh Arasan Venkatachalam and Dhivya Gnanavelu (2004):** Have study to check for the validity of the concept, the occupancy and area of area – occupancy of a homogeneous traffic stream were estimate the different length of detection zone through simulation experiment and the value were relate to the density of the steam. Author have been proved the area occupancy, rather than occupancy can be used as indicator of road traffic concentration at any flow level because of it a ability to accurately replicate the extent of usage of the road space.

### **III. METHODOLOGY**

Properly check out methodology for the study is essential to complete task according to objectives of the thesis. Fig. 1.1 shows various stages of the methodology adopted for the present study. The methodology adopted in the present study is illustrated step by step below. The first step is the identification of the problem followed by definition of the problem. The problem of traffic characterization and flow behavior for urban road is identified and defined considering two arterial and sub arterial roads midblock sections. Then the develop methodology in three way it means speed flow relationship, speed flow curve and Level of Service. And then collect data for speed and volume by using of 10 hours vehicles count and Inventory study.

The next step data analysis the speed volume and the capacity of level of service then implementation capacity value and also find curvature speed. Subsequently, Analysis of traffic data is carried out to study the vehicular speed profile, peak-off peak effects, and composition and flow rate variations. Based on this, vehicle equivalent factors are derived by considering 2-wheelers (2w) as well as 4-wheelers (4w) as reference vehicles. Also, regression models are developed for vehicular speed as well as stream speed based on correlation analysis. The traffic behavior is captured by developing Flow-Density-Speed models for selected road stretches considering different vehicle equivalent factors. Analysis of the

traffic characteristics and their behavior models is carried out with reference to the roadway and traffic conditions observed on the study stretches.

Finally the summary of the study carried out and the inferences drawn with respect to the study objectives are contained in the conclusions. To implement this methodology on a small network, a flow chart of detailed procedure is prepared and shown in figure 3.4. Site selection and data collection.

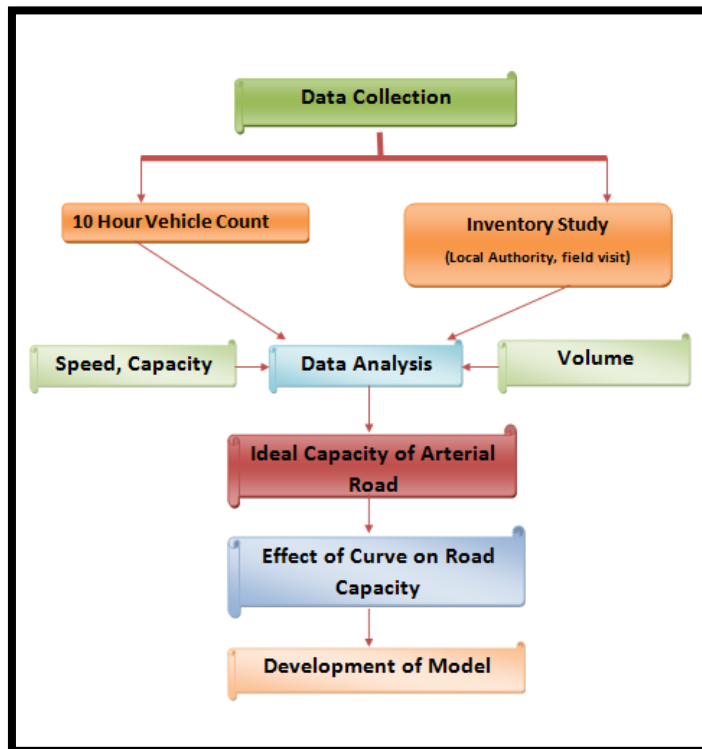


Fig:1 Flow Chart of Procedure

#### IV.STUDY AREA

The study is carried out on Fatehganj (fly over) recently named as Pramukh Swami Maharaj - Bridge urban arterial road Vadodara city is selected. It Starts from EME Circle to end of Pandya Bridge.. The Curve and straight portion selection for the video graphic survey for both direction.

**Types of road:** Arterial road (four lane divided road)

**Carriageway:** 7.50 m (one direction)

**Divider:** 0.7m



Figure 2: Study Area Google Map

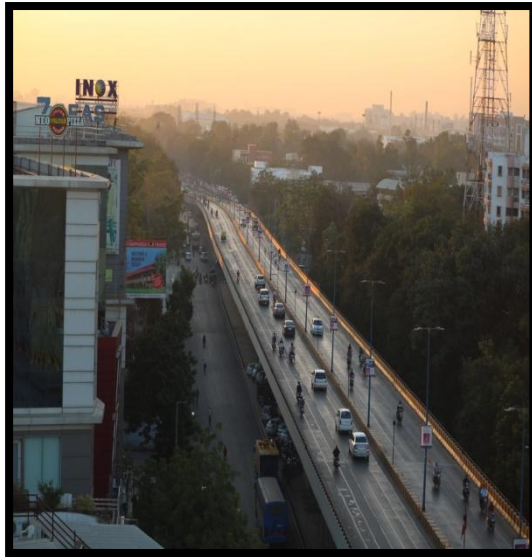


Fig 3: Straight Portion

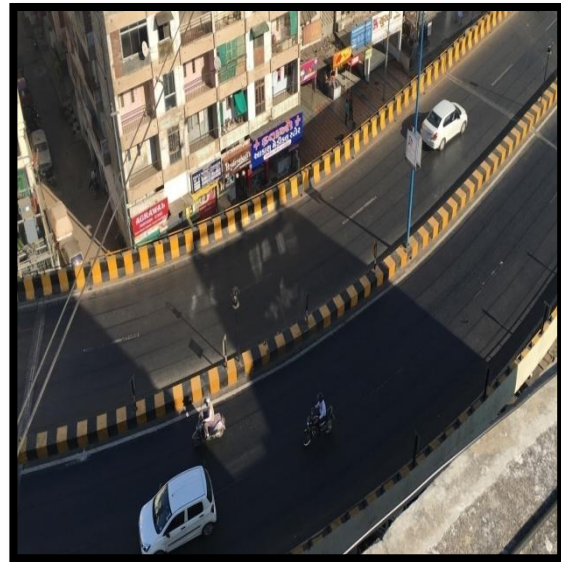


Fig 4: Curve Portion

## V. TRAFFIC SURVEYS

Inventory surveys are conducted for gathering primary information regarding road geometry including numbers of lanes, types of road, length etc. traffic volume over a wide range, which is an important input for planning of road networks and road traffic operation. The survey are conducted on normal working days during morning and evening peak as well as off peak hours covering wide range of traffic conditions and flow behavior.

The following traffic surveys are carried out

- Traffic Volume Count by Video graphics method
- Traffic Compositions
- Sport Speed Study

### TRAFFIC VOLUME COUNT SURVEY

Traffic volumes are conducted to determine the number, movements, and composition of vehicles at a given location. The data can help to identify peak traffic periods in the morning and evening duration. Both traffic volume and composition of the mixed traffic at the selected survey station has been carried through video graphic approach.

The videography is conducted on a working day. The selected time durations of peak and off-peak hours. 10-hour classified volume count is conducted from morning 9:00 am to evening 7:00 pm.

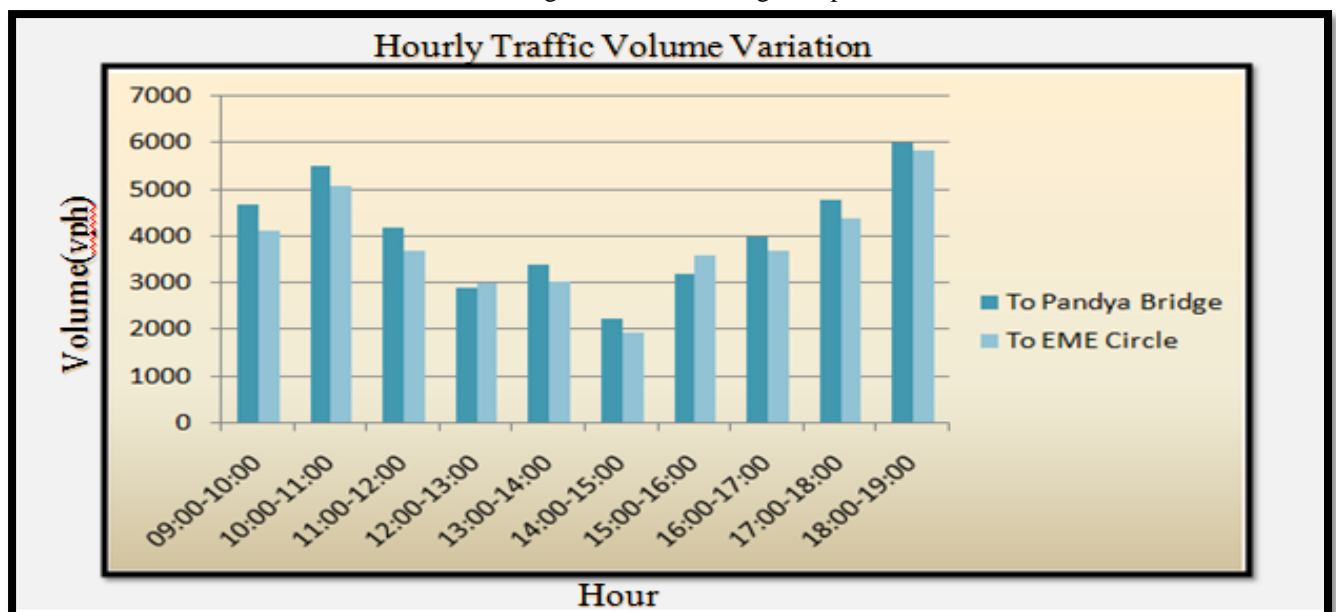


Fig 5: Shows Hourly Traffic Volume Observed on Pramukh Swami (Fly Over) in Both Directions at Vadodara

**VI. SPEED FLOW MODEL**

Traffic flow characteristics in macroscopic analysis on urban arterial road sections under heterogeneous traffic environment condition. Particular road segment selection for collection of traffic data. The videography survey is conducted on a working day for 10 hours on arterial Fatehganj Road (4 lanes) at Vadodara city. Based on 10 hour volume the peaks and off-peaks are identified for the study stretch and videography survey for peak and off-peak duration is carried out. The data is collected for every 5 minute and one minute interval during these periods. For development of Traffic Flow Models.

Speed flow model developed by using curve fitting technique. Speed flow model explain the traffic flow behavior with better value of  $R^2$  under the heterogeneous traffic condition. Co-efficient effectively explains the free flow and forced flow regime.

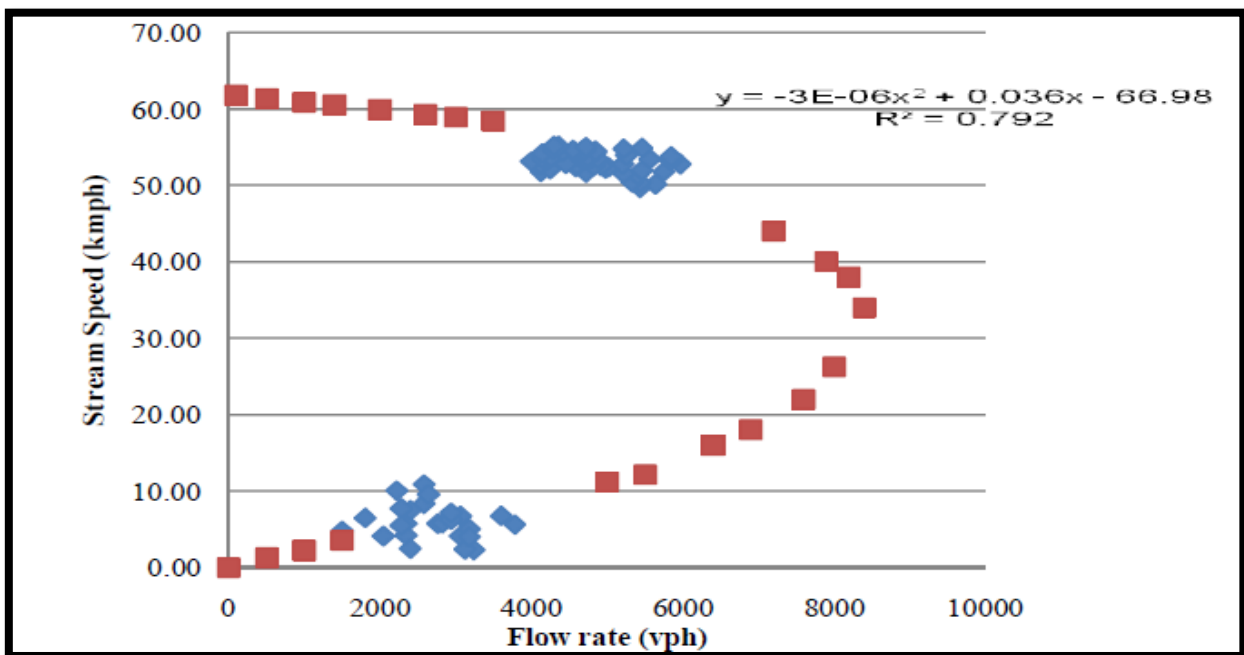
**A. Straight Portion**

Speed Flow model is derived which are linear in nature with good co-efficient of determination. Data of Stream speed (kmph) and flow rate (vph) are shown in Annexure. As shown in figure, Flow increases Speed decreases up to certain level then it becomes constant. Speed is found by following equation shown below.

$$V = -3E-06x^2 + 0.036x - 66.98 \quad \dots\dots\dots(1)$$

$$R^2 = 0.792$$

Equation created for Fatehganj (fly over) Vadodara city towards EME Circle, Pandya Bridge road for speed-Flow rate relationships that gives good co-efficient of determination that indicates traffic flow behavior is well explained by the model.



**Fig 6: Speed Flow Diagrams for Straight Portion**

**B. Curve Portion**

As shown in figure, Flow increases Speed decreases up to certain level then it becomes constant. Speed is found by following equation shown below.

$$V = -2E-06x^2 = 0.028x - 47.83 \quad \dots\dots\dots(2)$$

$$R^2 = 0.646$$

Equation created for Fatehganj (fly over) Vadodara city curve portion towards EME Circle, Pandya Bridge for speed-Flow rate relationships that gives good co-efficient of determination that indicates traffic flow behavior is well explained by the model.

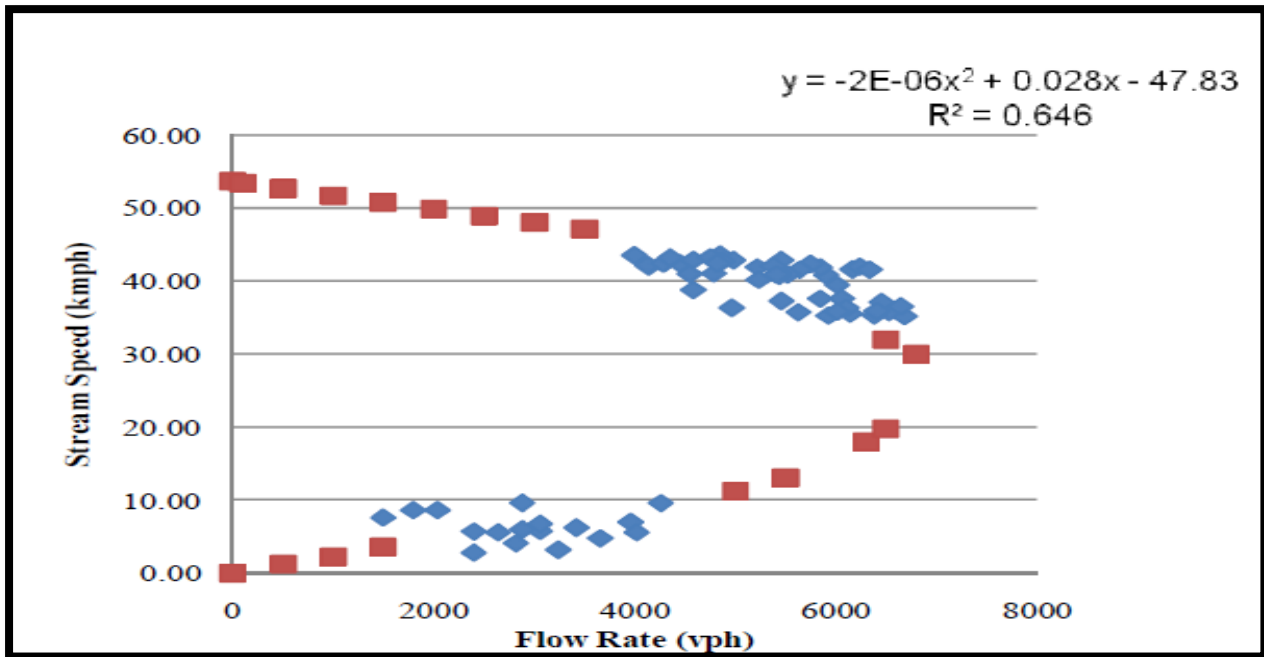


Fig 7: Speed Flow Diagrams for Curve Portion

## VII. CONCLUSION

The present study is carried out to estimate the capacity of four lane divided urban arterial road in Indian Context. Most papers referred in this context are focused on estimating speed and evaluating the effect on speed due to particular sections of the road. It has been observed that the speed may change according to roadway and traffic conditions. In India the urban roads faces wide variety of mixed traffic and disparity in their size, speed and technology.

The speed variation is also observed at curve portion which result in the reduction of capacity 20.24 vph and the speed reduction of 22.32% in 2w, 10.33% 3w, 8.52% 4w, 5.61% bus, 12.44% lcv/hcv, 14.61% truck, and the stream speed reduction of 17.16% is observed in Pandya Bridge direction and 14.44% in 2w, 7.03% 3w, 12.06% 4w, 16.17% bus, 21.60% lcv/hcv, 22.09% truck, stream speed 11.98% in EME Circle direction of Fatehganj Flyover (four lanes) Vadodara. This model decided the level of service. So, transport planner and engineer can plan and design such urban roads.

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