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Estimation of Saturation Flow at Signalized Intersection under Mixed Traffic Condition in Ahmedabad City

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Abstract - *Traffic in India consists of both motorized as well as non-motorized vehicles. Heavy traffic growth rate in recent years has imposed congestion on the urban roads. In Indian scenario due to a huge difference in the income, different types of vehicles are sharing the same road without any physical segregation. Intersections are nodal points in the road network and their efficiency of operation greatly influences the entire network performance. This study finds the effect of traffic flow characteristics at the signalized intersections and with reference to non-lane-based traffic condition prevailing in India. Saturation flow is useful to determine the capacity of the intersection and signal design. Videography technique will be used to collect traffic data at signalized intersections of Ahmedabad city for the analysis. Intersection are selected based on heavy vehicular flow and congestion etc. After data extraction saturation flow model will be develop for mixed traffic condition. Analysis of composition of vehicles of different categories like 2W, 3W, CS, CB, LCV, BUS, HCV, arrival rate and percentage right turn will be observed with respect to discharge rate in terms of passenger car per unit. The regression analysis will be used to generate the models for base saturation flow.*

Key Words: **Saturation Flow, Vehicle Composition, Discharge Rate, Regression Model**

1. INTRODUCTION

Traffic flow is defined as the number of vehicles or pedestrians passing over a selected stretch or cross-section of a roadway during the unit time. The intersection is an area where traffic from different road streams meet, which after going through conflicting movements like merging, diverging and crossing choose the appropriate route and leave the conflict zone. Because of their influence each other, disturbance of pedestrians and bicycle to vehicles, and the loss of green time for beginning and clearance and so on, the capacity of intersections is much lower than that of their approach links. Thus, the intersections usually are the bottleneck of the network, the popular and immediate source of the traffic jam and traffic accidents. In Recent years, Ahmedabad is a major city which has a population of more than 6.5 million and busy traffic over the whole city areas also very large congestion on many intersections. In particular, the traffic volume during peak hours significantly increased in most of the city areas the urban traffic of India is heterogeneous in nature. It consists of fast-moving vehicles as well as slow moving vehicles. Because of the later type of vehicle, the capacity of the road is affected. The conflict, confusion, and irritation caused by this heterogeneous traffic result in a large number of accidents. This study analysed saturation flow at signalized intersection under mixed traffic condition in Ahmedabad city and the correlations between the saturation flow and % vehicle. This explains the need for the current study.

2. METHODOLOGY

In this study authors selected three intersections, which might represent major traffic volume in Ahmedabad city, paladi intersection, panchwati intersection, panjarapol intersection shown in fig.-1,2,3. Traffic data was collect during peak hour. Traffic volume has been counted using videography based on vehicle types, such as two-wheeler (2W), three-wheeler (3W), four-wheeler (4W), light commercial vehicle (LCV) and heavy commercial vehicle (HCV). Traffic volume data was converting into PCU.After data collection Data is extracted manually using Avidemux (version 2.6) Software. The Classified Volume Count of each Intersection was carried out in the software. The different types of vehicle were counted for 15 Green Cycles at an interval of 5 seconds for each intersection. The vehicles were also classified on the basis of their manoeuvring; i.e. straight going or right turning. After Estimation of Saturated Flow Time Using ANOVA.Details of Selected Intersections in table no:1

Fig -1: Arial photograph of paladi intersection

Fig -2: Arial photograph of panchwati intersection

Fig -3: Arial photograph of panjarapol intersection

Table -1: Details of Selected Intersections

Intersection	Total green time in seconds	Total Cycle Time in seconds	Width (m)
Paldi Cross Roads	40	125	10.5
Panchavati cross road	40	190	12
Panjarapole Cross Road	35	135	12

3. RESULT AND DISCUTION

Traffic Composition of different vehicle at various intersection shown in fig 4,5,6. After data analysis to find saturation flow using ANOVA. Analysis of variance is the useful technique when multiple sample cases are involved. The ANOVA technique enables researcher to perform simultaneous tests and considered to be an important tool of analysis. Using this technique, researcher can examine that the samples have been drawn from populations having same mean.

F= (between samples variance)/ (within samples variance)

ANOVA technique find the saturation flow and after Saturation Flow Model DevelopmentSaturation flow models are a systematic representation of the complex real-world traffic problems. Models are powerful tools for assessing the impact of traffic on real-world problems. They depict the on-field scenario as good as possible and forecast the future value accurately. Models are developed using regression analysis to find the equation for saturation flow. The LR model generated a statistical equation based on the input parameters i.e. saturation flow and %vehicle Saturation Flow. Equation of, S (PCU/hr/m) = $2.75P_{2w}$ + $5.73P_{3w}$ + $1.25P_{cs}$ + 54.899 P_{cb} - $12.704P_{lcv}$ + 27.31 P_{bus} + 25.71 P_{hcv} –$5.68P_{rt}$ (R^2 = 0.98811)

(T values for 2W, 3W, CS, CB, LCV, BUS, HCV, RT and width are 2.527, 4.01, 0.673, 1.64, -0.89124, 2.20, 1.176, 2.57, respectively at 95% confidence level)

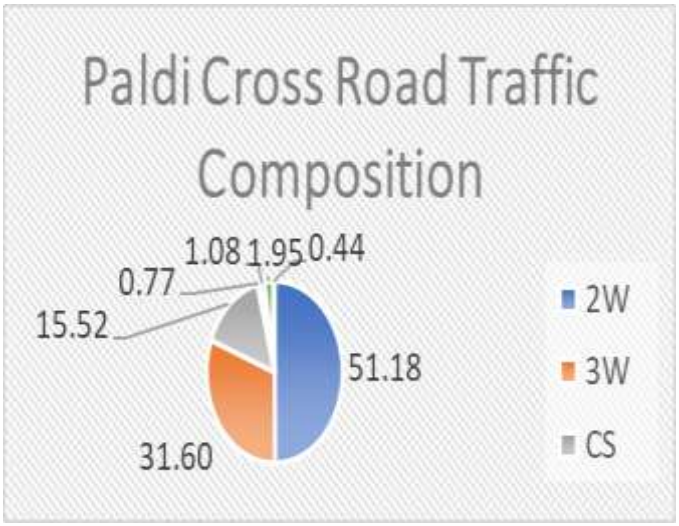

Fig -4: Traffic Composition at paladi Intersection

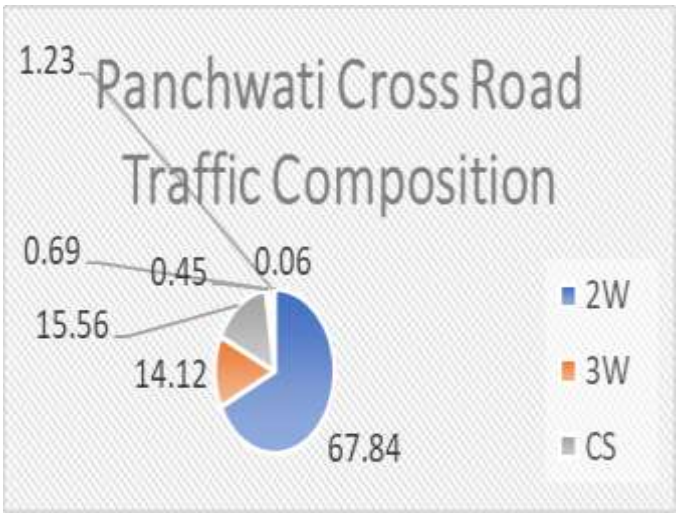

Fig -5: Traffic Composition at Panchwati Intersection

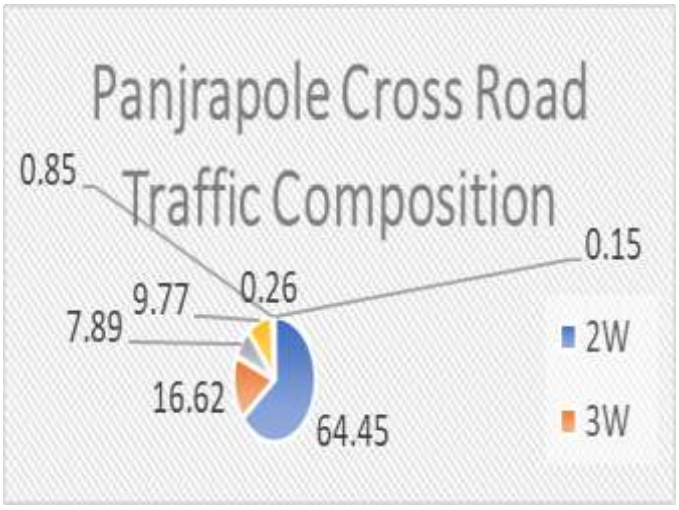

Fig -6: Traffic Composition at panjarapol Intersection

Data Analysis of Traffic Composition graph of vph and pcu of saturation flow vs percentage (%) of two-wheeler (2W), three-wheeler (3W), small car(cs), big car(cb), light commercial vehicle (LCV) and heavy commercial vehicle (HCV) also show correlation coefficient in chart 1 to 12.

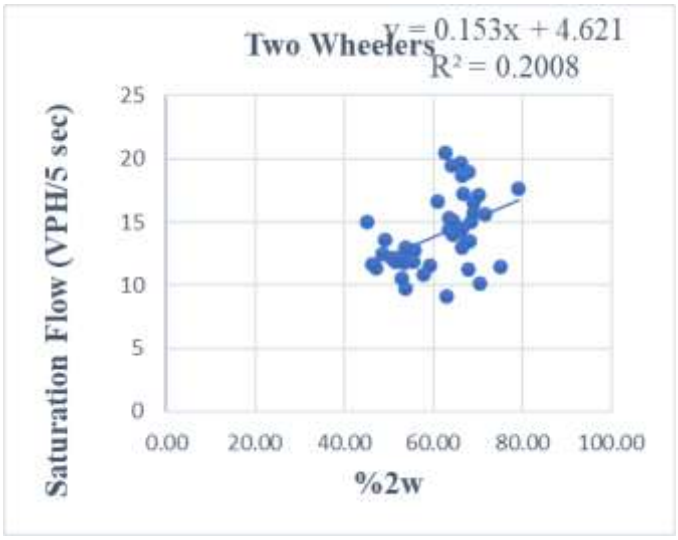

Chart -1: Correlation between saturation flow and %2w

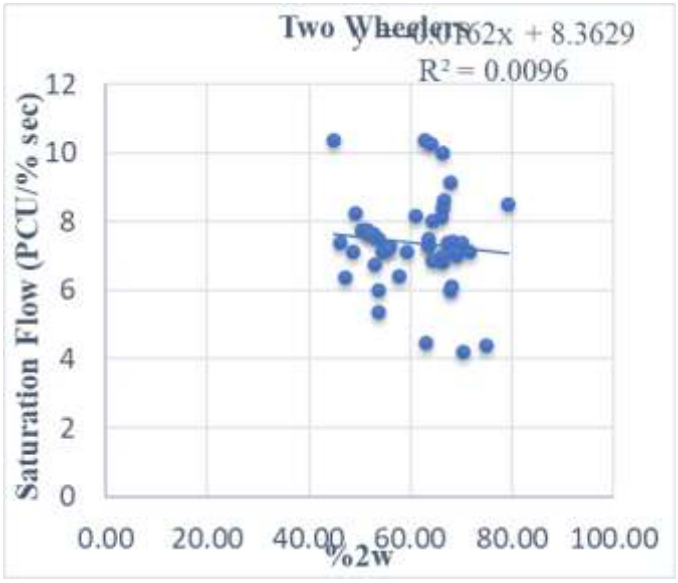

Chart -2: Correlation between saturation flow and %2w

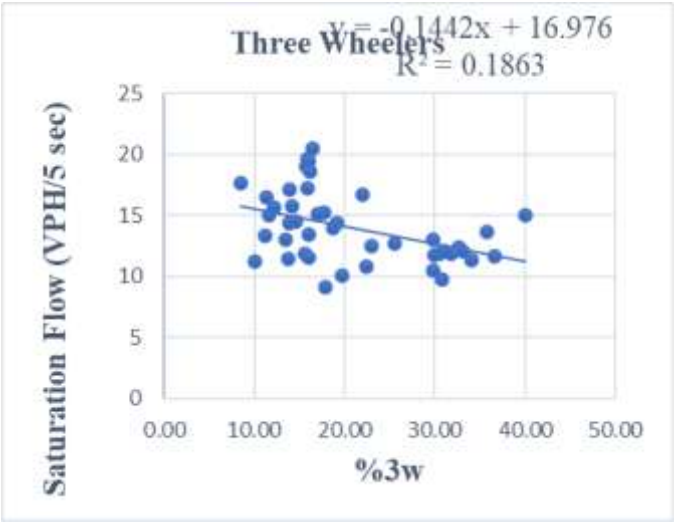

Chart -3: Correlation between saturation flow and %3w

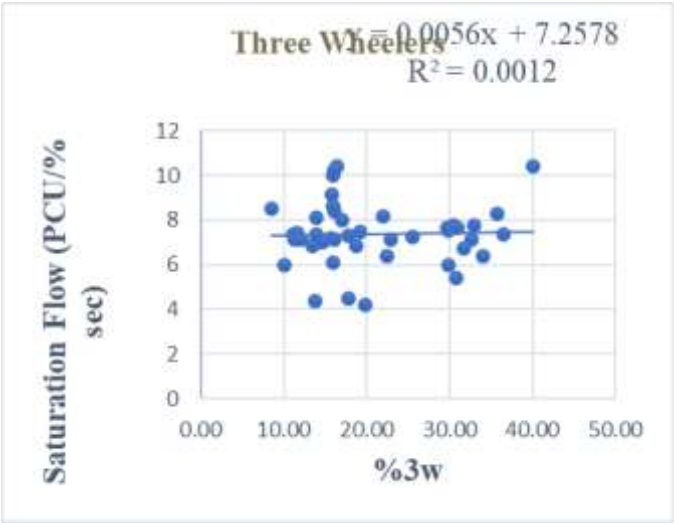

Chart -4: Correlation between saturation flow and %3w

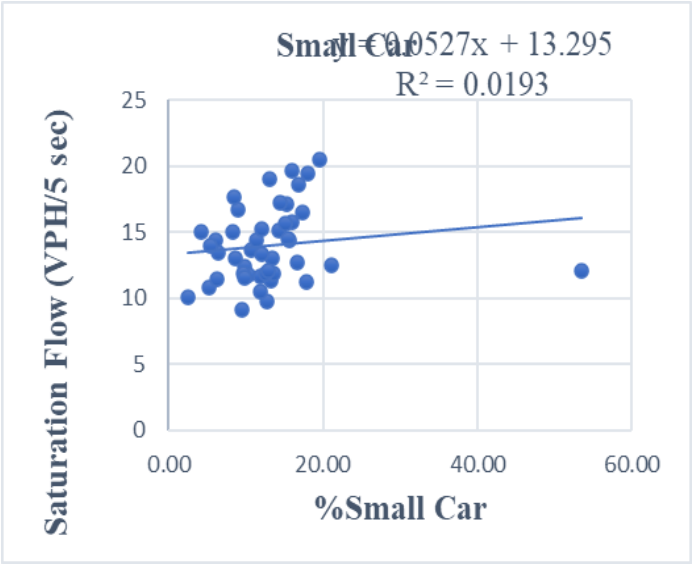

Chart -5: Correlation between saturation flow and %Cs

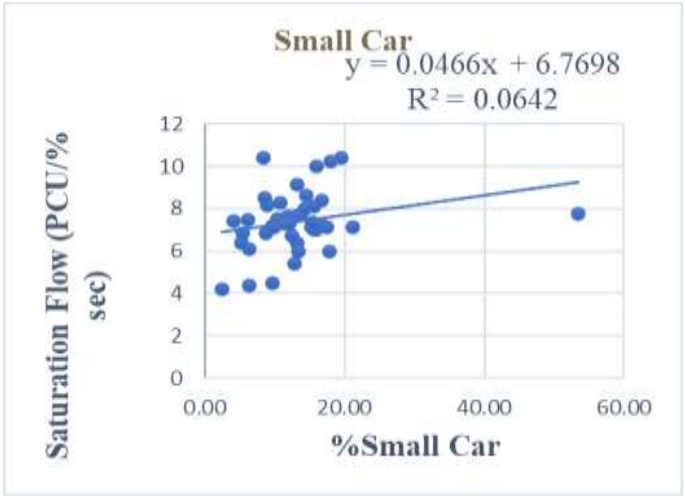

Chart -6: Correlation between saturation flow and %Cs

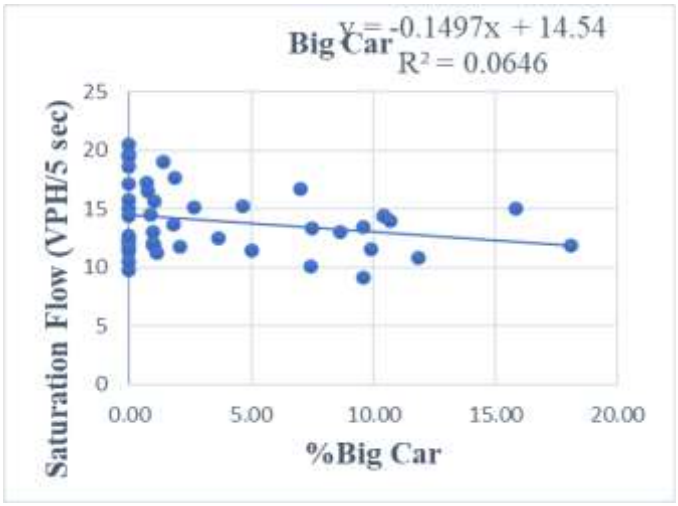

Chart -7: Correlation between saturation flow and %Cb

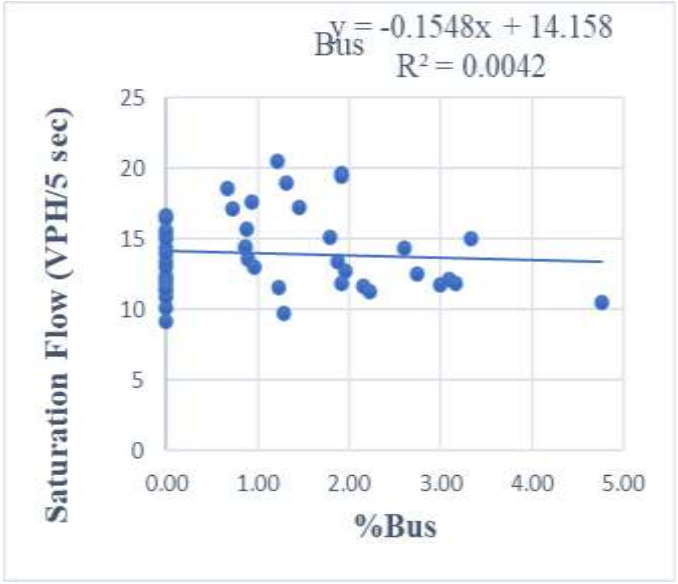

Chart -8: Correlation between saturation flow and %Bus

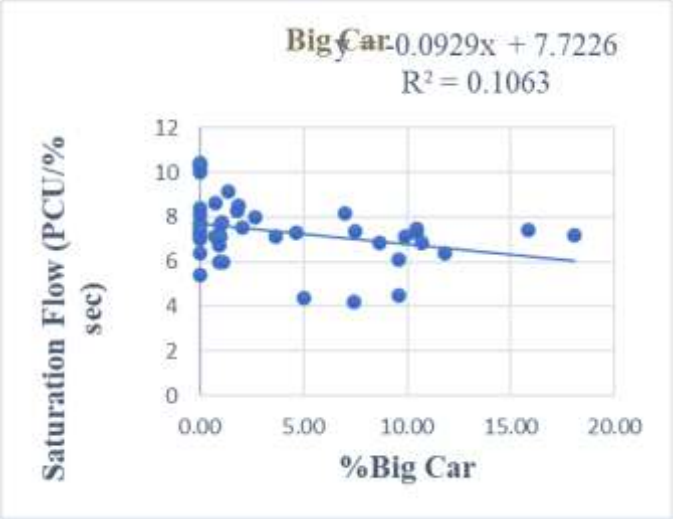

Chart -9: Correlation between saturation flow and %Cb

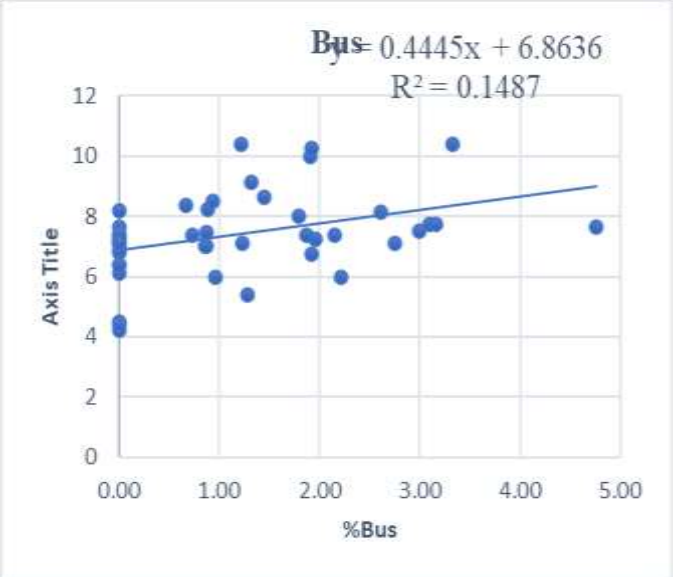

Chart -10: Correlation between saturation flow and %Bus

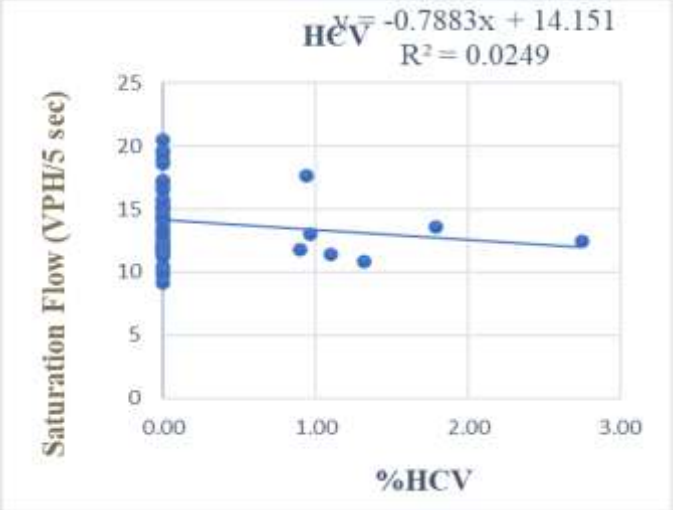

Chart -11: Correlation between saturation flow and %Hcv

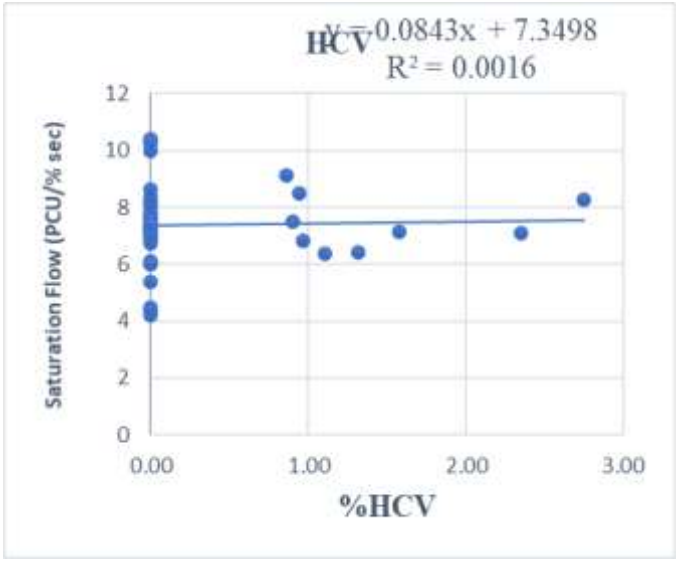

Chart -12: Correlation between saturation flow and %Hcv

4. CONCLUSIONS

Saturation flow is useful to determine the capacity of the intersection, signal design, etc. For doing so, traffic flow data of selected signalized intersections of Ahmedabad are collected using Videography during the peak hours. The data was collected from the nearby high-rise buildings. Based on the collected video, the data was extracted using Avidemux Software and the extracted data was directly inputted into Microsoft Excel. The overall traffic composition of TW, 3W, CS, CB, LCV, BUS and HCV is 61.16%, 20.78%, 13%, 3.74%, 0.79%, 1.15% and 0.216% respectively. It indicates that the proportion of two wheelers is maximum and leads to high heterogeneous traffic conditions. Analysis of Variance is used to determine the saturated green time of all the selected Junctions. The analysis of various composition with saturation flow shows the trend of various compositions. Saturation flow models are developed using regression analysis considering various variables. Three models were developed and on the basis of regression-statistics, model of PCU/hr/m is selected. The developed model predicts the saturation flow fairly. The predicted values very near to the observed values which showed that the model has fair accuracy and can be used to predict saturation flow. The t-statistics also supported the same. It also states that the right turning movement has a negative impact on the saturation flow.

5. FUTURE SCOPE

These regression model has been developed from Ahmedabad city (India) which is assumed to be similar to other parts of the country. These developed models can be applied in the other cities and checked for its usefulness. Saturation flow depends on various factors. In the present study, all intersections were selected having an almost flat surface. Saturation flow also gets affected by the parking facility near an intersection. Saturation flow also gets affected by the parking facility near an intersection. This factor should be studied and a new model should be developed taking into account maximum possible variables.

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