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EFFECT OF MIXED TRAFFIC ON SATURATION FLOW AT SIGNALIZED INTERSECTION IN SUB URBAN AREA: A CASE STUDY

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Abstract: This study has been concerned to check and analyse the impact of varying composition of traffic flow on the saturation flow that discharges from a section and to find the credibility of PCU values given in IRC for Indian conditions (heterogeneous traffic) and are there chances for further modification. Saturation flow and green time ratio are the common factors on which the basic capacity of signalized intersections depends. Both factors are affected by geometric characteristics and traffic behaviour, operating conditions, environmental and other prevailing conditions. In order to design a safe and efficient intersection, so that the needs of the existing and future traffic can be met, it is necessary to have an idea of all kinds of affecting parameters for saturation flow. Traffic data was collected during peak hours on intersections in sub urban area i.e., Jamshedpur using manual count method and same is brought back and listed in tabular form in excel. The data so analysed includes traffic volume during saturation period, traffic composition in different cycles, equivalent hourly volume and estimation of saturation flow in pcu/hr/m width of lane at both the intersections. The graphs were plotted for variation of vehicle share and effective green time against saturation flow and an attempt was made to develop relationship between saturation flow and percent share of different vehicles at both the intersections. This study emphasizes the importance of estimating PCU values based on actual field studies at signalized intersections, as PCU values are found to vary significantly in most cases when compared to PCU values provided in IRC: SP-41.

In India, the Transportation System is characterized by inadequate roadway infrastructure and the lack of operational expertise. At present, the economic development of India has brought opportunities and tasks to the urban development authority for proper managing of the urban transportation system. The major challenge in the urban transportation system and management is to evaluate the roadway capacity of roads. It is required to increase the capacity, pavement strengthening and improvement of riding quality with safety measure on the major urban arterial roads as per present need. On analysing saturation flow with respect to effective green time at intersection it could be found out that there will be irregular pattern of increase or decrease in saturation flow. This indicates a result of mixed traffic on saturation flow, whereas in homogeneous traffic, saturation flow generally increases with increase in effective green time.

Index Terms **– Saturation Flow, Signalized Intersection, PCU, Homogeneous Traffic**

1.INTRODUCTION

In developing countries like India, road traffic is more likely to be mixed or heterogeneous. Several types of vehicles, varying both in static and dynamic features, ply on the roads. Signal controlled intersection is one of the basic forms of traffic control measure which is used in both, developed and developing nations, to ensure safety and movement efficiency in the intersection area. Geometric parameters, operating conditions, traffic compositions and various other factors affect the saturation flow at the signal-controlled intersections. The conditions in developed nations are quite distinct from those at similar intersections of developing nations. This study has been taken up to study and analyze the outcome of varying composition of traffic flow on the saturation flow that discharges from an approach. The fundamental capacity of signalized crossings is determined by two factors saturation flow and green time ratio. Both factors are affected by geometric characteristics and traffic behavior, operating conditions, environmental and other prevailing conditions. In order to design a safe and efficient intersection, so that the needs of the existing and future traffic can be met, it is necessary to have an idea of all kinds of affecting parameters for saturation flow.

An Intersection is a location where two or more than two roads meet or cross, providing a space for traffic to flow in both directions. They are inevitable and are divided into two categories: at-grade and grade-separated junctions. An intersection is a location where two or more roads meet or cross, providing a space for traffic to flow in both directions. They are inevitable and are

divided into two categories: at-grade and grade-separated intersections. In developing countries like India most of the intersections are at-grade intersections as the latter is expensive even though they have better safety and least delay when compared to the former. They can also be categorised depending on the sort of traffic management practiced on each approach or the number of roads that meet at a single point.

On the basis of type of control being exercised on each approach, these are classified as follows:

• Uncontrolled intersections: These intersections do not have stop signs or traffic signals and left turning vehicles are always free to move.

• Signal controlled intersections: These are mostly provided in urban areas and control the traffic by using signal lights.

• Roundabouts: They are a special type of construction which forces the vehicle to move in a circular path around the central island of intersection.

• Yield controlled and stop-controlled intersections: They employ the yield signs and stop signs on the approaches.

On the basis of number of approach roads, the intersections are classified as 3- legged, 4-legged and multi-legged intersection.

Saturation flow rate estimation at signalised junctions has always been an important consideration for a traffic engineer. Saturation flow and allocated green time are the two fundamental parameters to calculate or measure the intersection capacity, signal timings, delays and level of services at intersections. Insufficient green time allocation, supply of very long cycle durations, or incorrect saturation flow rate are all indicators of poor signal timing. Saturation flow rate is not a universal constant, it varies with countries, cities, driver behaviour and traffic composition, whereas, allocated green time depends on number of lanes, traffic demand and phase configurations. In the developing countries, signalized intersections and mixed traffic conditions show a crucial role in the uninterrupted operation of both urban and arterial roads. The number of pedestrians and cars handled at an intersection is determined by the traffic management system, environmental factors, driver behaviour, and the roadway's physical and operational parameters.

2. RESEARCH METHODOLOGY

It will be critical to locate and observe crossings that represented the many criteria required for the analysis for the goals of this study. When choosing intersections, the following criteria must be considered:

1. For typical junctions, the gradient should be as flat as possible.
2. There should be three-lane approaches accessible.
3. Through traffic queues must be lengthy sufficient to allow for the measurement of saturation flow rates (a minimum of 8 vehicles were expected per cycle)
4. There should be no parking or bus stops within a few feet of the intersections.
5. There should be a small number of non-motorized vehicles and a small number of large vehicles.
6. Intersection geometric should be uniform to ensure that excessively skewed approaches were not included.
7. Pedestrian activity should not adversely impact the flow of vehicles.

Intersections having sufficient number of vehicles to dissipate during the green time will be chosen for the data collection. The peak hour timings of the intersections will be observed and noted. The videos would bring back and will compared with the above criteria to select suitable intersections for the study.

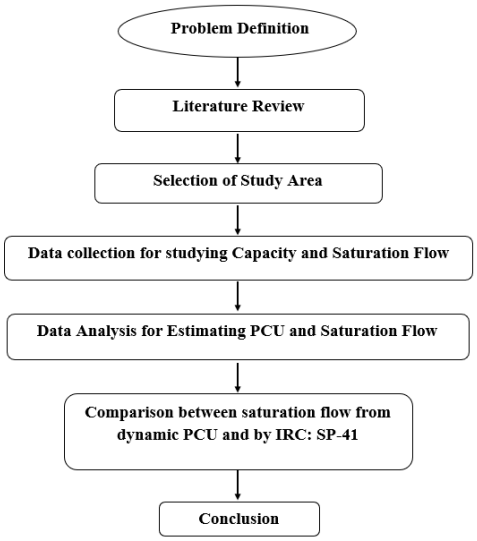
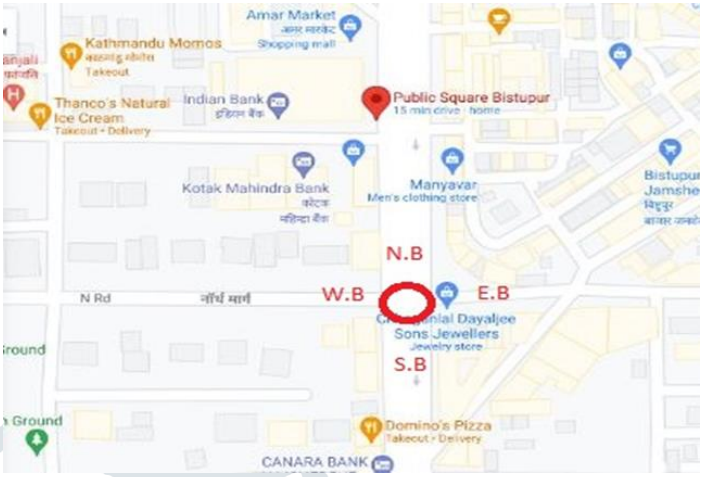


Figure 1: Research Methodology

3. STUDY AREA

Bistupur Chowk Jamshedpur: Bistupur is a suburb and business district. Bistupur is one of the major commercial areas of Jamshedpur in Jharkhand, India. It is one of the oldest places in Jamshedpur with several historical landmarks and heritage buildings.



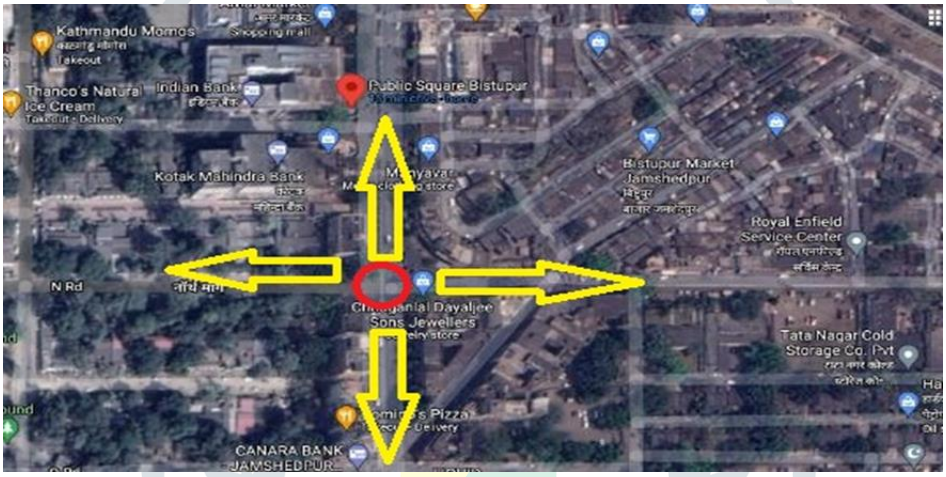


Figure 2: Study Area

4. DATA COLLECTION AND DATA ANALYSIS

Data will be collected during peak hours at signalized intersections with heavy volume of traffic between 8 am to 12 noon. All observations will be taken in good weather conditions and during weekdays. Manual count technique was used for the data collection. Intersections having significant vehicles per hour of green time was selected. The signal phases and cycle timings were noted down based on field observations.

Following data are collected for measurement of saturation flow at various Intersections:
a. Inventory Data
b. Signal Timings
c. Traffic Volume
d. Traffic Composition

Inventory data are collected and presented in Tabular form. The width of all approaches of intersections, no. of lanes, the width of footpath and width of the median are measured. The observations of signal timings are recorded manually. The traffic volume and vehicular composition are recorded manually.

4.1 Data extraction

Once data collection will be done, the collected data will be brought back to the office, to find the data required for the analysis. The parameters that will be needed for carving out the final results will be listed. The data extraction will be done and listed in tabular form. This helps to maintain accuracy in the data analysis.

The following information will be extracted from the data collected from the field: -
1. The signal phases and cycles, and length of cycle with individual times.
2. Number of vehicles crossing the stop line in two to three lanes having clear left, through and right turns.
3. The headway between the vehicles of different categories as soon as they start with change of green signal phase.
4. Identification of effective green time on each approach.

4.2 PCU values

The PCU of a vehicle type is a complicated parameter that is affected by geometric elements such as approach, traffic, and stream movements. Many scholars have developed ways to calculate the PCU of a vehicle type, and the PCU values of a vehicle type used in different parts of the world vary greatly. For the purposes of this study, the PCU of a vehicle type was derived from IRC SP 41:1994, which is easily relevant to Indian situations at signalized junctions. Table 3.1 lists them all.

Table 1 Passenger Car Unit values for rural/urban conditions IRC SP 41:1994

VEHICLE TYPE	PCU as per (IRC SP 41:1994)
Passenger car, tempo, auto rickshaw	1.0
Cycle, Bike/scooter	0.5
Bus, lorry, tractor trailer unit	3.0
Cycle rikshaw	1.5
Horse driven vehicle	4.0
Bullock cart (big) Bullock cart (small)	8.0 6.0

The following are some of the ways for determining passenger car units (PCU):
- Chandra's method
- Modified Density Method
- Headway Method
- Multiple linear regression approach
- Simulation approach
- Relative delay technique

Depending on the circumstances, such as traffic volume, vehicle speed, lane width, and other external factors, it may be reasonable to utilize different numbers for the similar vehicle type.

4.3 Type of Analysis Done:

During the course of this study various types of analysis are done such as:
1. Traffic volume.
2. Traffic composition in different cycles.
3. Equivalent hourly volume.
4. Saturation flow in effective green time.
5. Variation of saturation flow with respect to effective green time.
6. Variation of saturation flow with respect to vehicle share.

4.4 Estimation of Saturation Flow for Through Movement

The saturation flow (SF) for each cycle was calculated using Equation 4.1 (below). The SF in PCU for each cycle was calculated by multiplying the classified vehicle count for vehicles clearing the junction approach during saturated green time by their respective PCU values.

$$SF = [\Sigma niPCUi]*3600/gs \quad (3.1)$$

Where,
SF = saturation flow (pcuphg)
ni = number of vehicle category i
PCUi = PCU value of vehicle category i
gs = saturated green period (s)

For different type of vehicle, the PCU values are found from IRC: SP-41. Every cycle, the mixed traffic flow was translated to an equivalent number of cars, which was subsequently transformed to hourly flow numbers. This algorithm was used to calculate saturation flow in each cycle at various intersection approaches.

4.5 Methods for estimating saturation flow

Followings are the methods for measurement of saturation flow.

(1) Headway method:

The normal progress between vehicles coming from the line and passing the stop line is assessed utilizing this technique. To diminish the impact of vehicle inactivity in the early seconds of the leg's green time, vehicles in the first line are skipped when they arrive at the stop line.

(2) Regression technique:

It is used to develop an equation for estimating saturation flow considering various parameters like green time, number of vehicles, lost time etc.

(3) Transportation Research Laboratory method:

Vehicles are counted in saturated green spans utilizing this technique. The saturation flow is determined by dividing the quantity of vehicles in the effective green time by the span length. **(4) Road Research Laboratory Method:**

This is a manual data gathering approach for estimating saturation flow. In this method, green and amber time has to be divided into the short interval. The vehicles, whose rear wheels pass the stop line in the short duration, are counted. The flow in the interval, which is free from the lost time are averaged to get saturation flow. In this method, the classifying of vehicles during counting is difficult. It requires more manpower.

(5) Recorder Method:

In this process, vehicular data is noted either on paper chart or paper tape is driven at a constant speed during the green time. It requires manual analysis for measuring the time interval and flow during the green time.

(6) Time Lapse Photography Method

This is an old technique, extensively used for getting pictorial description within the camera view at an instant of time. The individual vehicles moving on the consecutive frames are compared and counted. The markings along the carriageway are provided at equidistant for determination of vehicle position. The disadvantage of the method is an inability to run more than four picture frames per second.

4.6 Result to be find out:

Variations in Saturation Flow

1. variation with respect to vehicles share

Once the traffic volume, composition and saturation flows are estimated, the next step taken will be of examining the pattern of change in saturation flow with respect to the percent share of different category of vehicles.

2. variation with respect to effective green time

Variation in saturation flow in relation to the effective green time will also be examined and plotted

Table 2: Roadway condition and operational data

Intersection	Traffic Approach from	Width (m)	Cycle Time (s)	Green Time (s)	Amber Time (s)	Red Time (s)
Bistupur Chowk (Jamshedpur)	North bound (Public Square)	6.2	109	45	4	60
	South bound (diagonal road)	6.2	109	45	4	60
	East Bound (Chhaganlal Dayaljee)	8.3	109	30	4	75
	West Bound (G Town Ground)	8.2	109	30	4	75

Table 3: Traffic volume of traffic going from Northbound through Bistupur chowk

Cycle no.	Effective Green Time	Car	2W	3W	Bus	LCV	Truck	Bicycle
1	49	16	30	4	1	0	0	5
2	49	21	28	4	2	0	1	6
3	49	18	38	2	0	1	0	4
4	49	11	36	8	0	0	0	6
5	49	16	29	6	0	0	1	8
6	49	20	37	3	2	2	0	2
7	49	24	34	4	0	0	0	3
8	49	14	35	3	1	0	1	2
9	49	18	24	1	0	1	0	4
10	49	12	27	4	0	0	0	6
Total no. of vehicles		**170**	**318**	**38**	**6**	**4**	**3**	**46**

Table 4: Total no. of vehicle at intersection

S.No	Car	2W	3W	Bus	LCV	Truck	Bicycle
1	170	318	38	6	4	3	46
2	174	288	30	5	3	2	30
3	116	212	20	2	2	2	20
4	125	217	18	3	4	3	15
Sum	**585**	**1035**	**106**	**16**	**13**	**10**	**111**

Table 5: Percentage of types vehicle share at different approach of intersection

Intersection	Traffic approach from	width (m)	Traffic composition						
			Car %	2W %	3W %	Bus %	LCV %	Truck %	Bicycle %
Bistupur Chowk	Northbound	6.2	29.059	54.358	6.495	1.025	0.683	0.512	7.863
	Southbound	6.2	32.706	54.135	5.639	0.939	0.563	0.375	5.639
	East Bound	8.3	31.016	56.684	5.347	0.534	0.534	0.534	5.347
	Westbound	8.2	32.467	56.363	4.675	0.779	1.038	0.779	3.896

Table 6: Average Travel time

Traffic Movements	t_c (car) (sec)	t_i					
		Two-Wheeler	Three-Wheeler	LCV	Bus	Truck	Bicycle
(N to S) & (S to N)	10.67925	9.09825	11.408	14.505	18.341	19.6775	12.80467
(N to E) & (S to W) (W to N) & (E to S) LEFT TURNING	7.92425	4.55825	6.026	5.857	7.866	7.692	4.6145
(E to W) & (W to E)	10.5605	8.45275	10.799	14.349	20.936	19.102	11.156
Average	**9.721**	**7.369**	**9.411**	**11.570**	**15.714**	**15.490**	**9.525**

Table 7: Dynamic PCU values

Vehicle	$\frac{t_i}{t_c}$	$\frac{A_c}{A_i}$	$PCU_i = \frac{t_i/t_c}{A_c/A_i}$	PCU as per IRC: sp-41
Car	1	1	1	1
Two-Wheeler	0.758	4.545	0.16	0.5
Three-Wheeler	0.968	1.204	0.80	1
LCV	1.190	0.421	2.82	1.5
Bus	1.616	0.218	7.41	3
Truck	1.593	0.305	5.22	3
Bicycle	0.979	6.66	0.14	0.5

Table 8: Equivalent Hourly Volume the intersections

Intersection	Volume (PCU/hr)
Bistupur Chowk	585 x 1 + 1035 x 0.16 + 106 x 0.8 + 16 x 7.41 +13 x 2.82 + 10 x 5.22 + 111 x 0.14 =1110.14 PCU/hr

Table 9: Saturation Flow Through Northbound traffic at Bistupur Chowk

Cycle no.	Effective Green Time	Estimated Saturation flow in pcu/hr	Estimated Saturation flow in pcu/hr/m lane width
1	49	2359.102	380.5003226
2	49	3641.143	587.281129
3	49	2135.02	344.3580645
4	49	1763.265	284.3975806
5	49	2334.857	376.5898387
6	49	3604.408	581.356129
7	49	2428.898	391.7577419
8	49	2564.816	413.68
9	49	1911.673	308.3343548
10	49	1495.837	241.2640323
Average saturation flow		**2423.902**	**390.9519**

Table 10: Saturation Flow Through Southbound traffic at Bistupur Chowk

Cycle no.	Effective Green Time	Estimated Saturation flow in pcu/hr	Estimated Saturation flow in pcu/hr/m lane width
1	49	1658.938776	267.5707703
2	49	2838.122449	457.7616853
3	49	2346.612245	378.485846
4	49	2793.306122	450.5332455
5	49	1941.061224	313.074391
6	49	2333.387755	376.3528637
7	49	2792.571429	450.4147466
8	49	2344.408163	378.1303489
9	49	1722.122449	277.7616853
10	49	1581.061224	255.0098748
Average saturation flow		**2235.159**	**360.5095**

Table 11: Saturation Flow Through Eastbound traffic at Bistupur Chowk

Cycle no.	Effective Green Time	Estimated Saturation flow in pcu/hr	Estimated Saturation flow in pcu/hr/m lane width
1	34	1370.117647	165.0744153
2	34	2658.705882	320.3260099
3	34	2570.823529	309.7377746
4	34	2244.705882	270.4464918
5	34	1607.294118	193.6498937
6	34	1802.117647	217.1226081
7	34	3357.529412	404.5216159
8	34	1581.882353	190.5882353
9	34	2293.411765	276.3146705
10	34	1948.235294	234.7271439
Average saturation flow		**2143.82**	**258.2509**

Table 12: Saturation Flow Through Westbound traffic at Bistupur Chowk

Cycle no.	Effective Green Time	Estimated Saturation flow in pcu/hr	Estimated Saturation flow in pcu/hr/m lane width
1	34	1700.470588	207.374462
2	34	3410.470588	415.9110473
3	34	2124	259.0243902
4	34	3101.294118	378.2065998
5	34	1747.058824	213.0559541
6	34	2030.823529	247.661406
7	34	2229.882353	271.9368723
8	34	2323.058824	283.2998566
9	34	3442.235294	419.784792
10	34	1755.529412	214.0889527
Average saturation flow		**2386.482**	**297.2776**

Table 13: Average Saturation flow at different intersection

Intersection	Traffic Approach from	Saturation Flow (pcu/hr)	Saturation Flow (pcu/hr/m lane width)
Bistupur Chowk (Jamshedpur)	North bound	2423.902	390.9519
	South bound	2235.159	360.5095
	East Bound	2143.82	258.2509
	West Bound	2386.482	297.2776

The SF in PCU for each cycle was calculated by multiplying the classified vehicle count by the individual PCU values for the vehicles clearing the intersection approach during the green time. For alternative approaches, the data for the bistupur intersection was compiled and shown in Tables.

4.7. Variation in Saturation Flow

4.7.1. variation with respect to effective green time

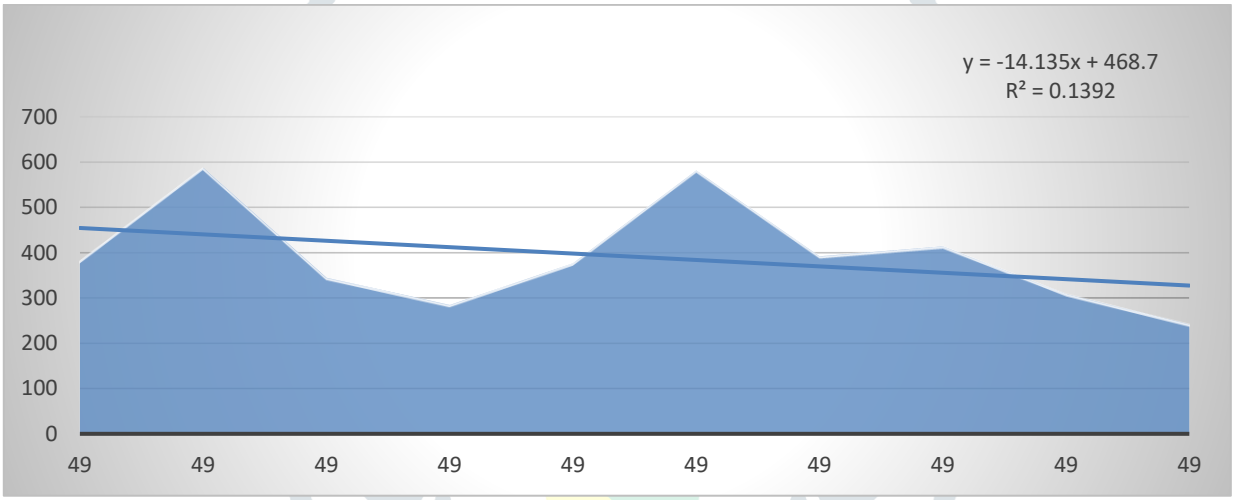


Figure 3: Saturation flow v/s effective green time for North bound approach

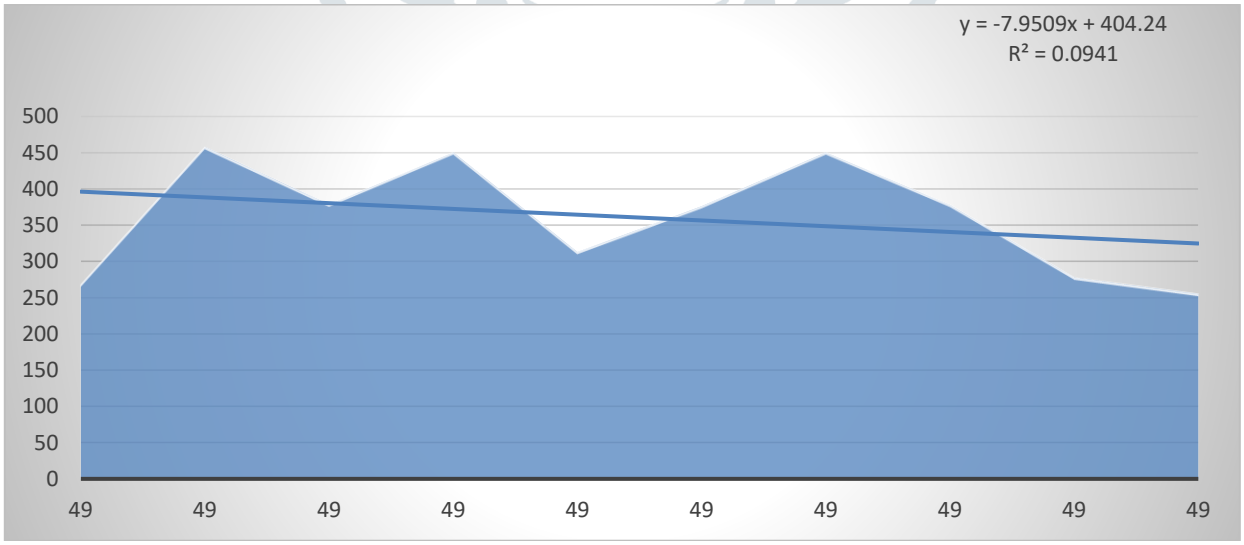


Figure 4: Saturation flow v/s effective green time for South bound approach

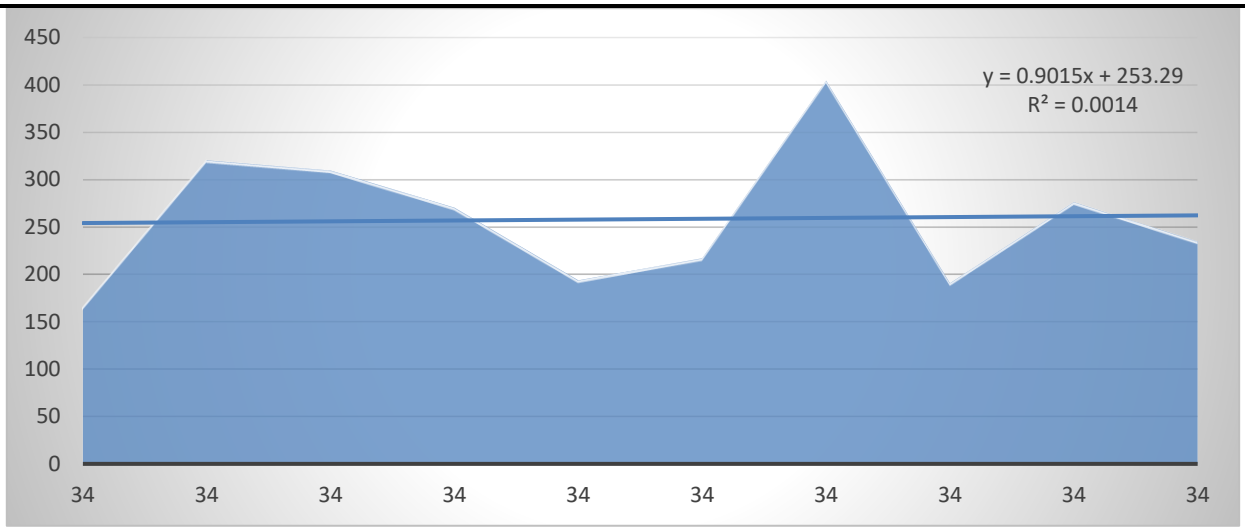


Figure 5:. Saturation flow v/s effective green time for East bound approach

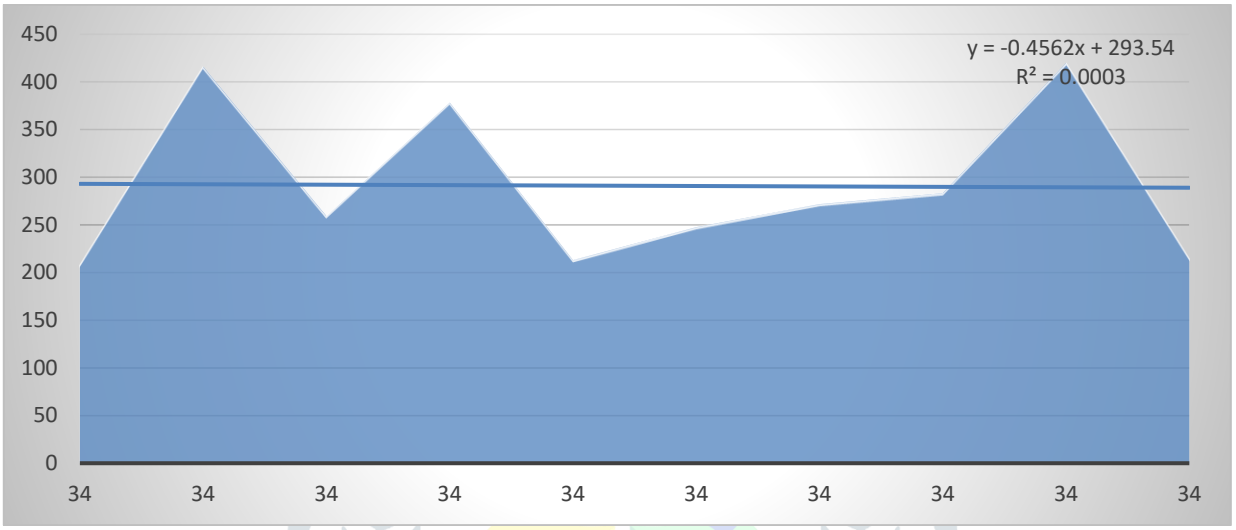
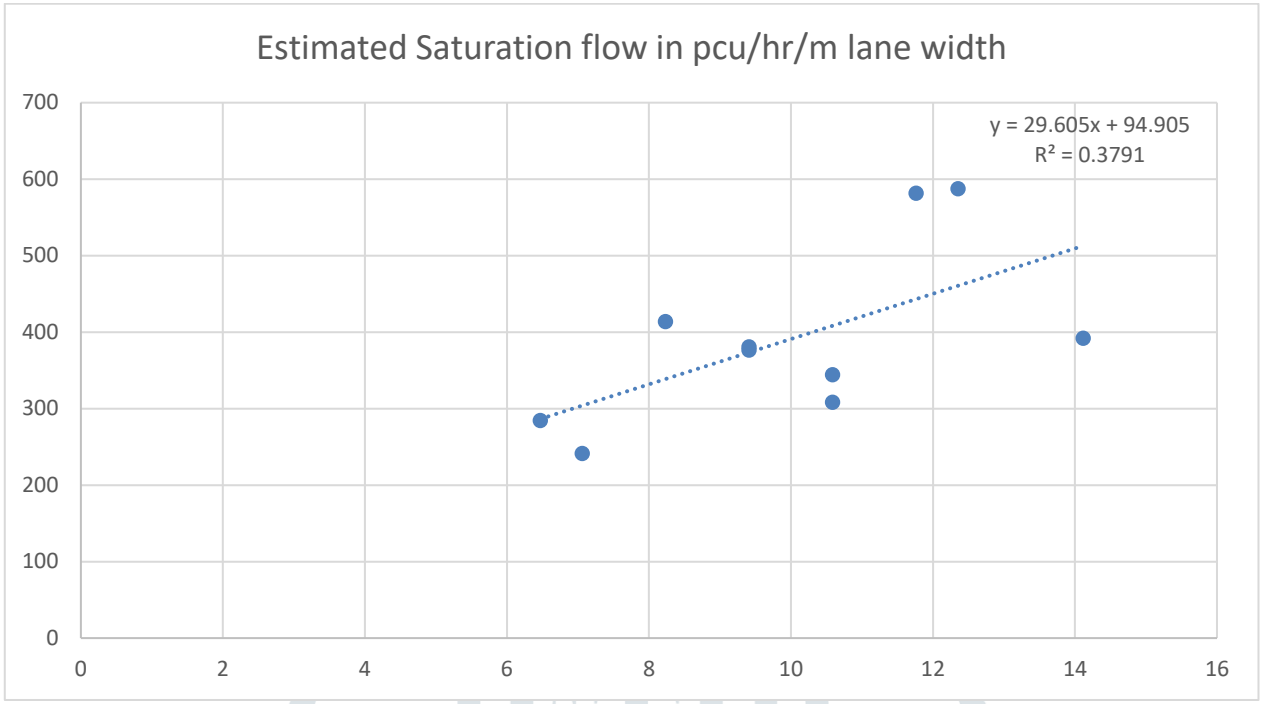


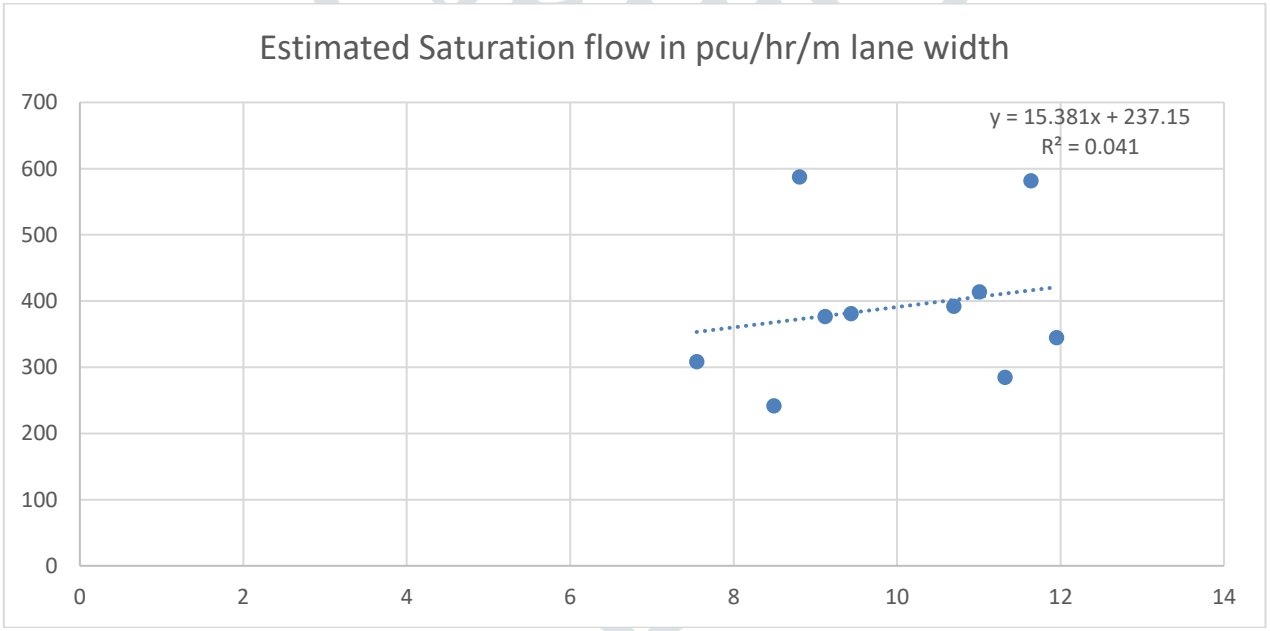
Figure 6:. Saturation flow v/s effective green time for West bound approach

On analyzing saturation flow w.r.t effective green time at Bistupur Chowk it was noted that there is no regular pattern of increase or decrease in saturation flow. This indicates the effect of mixed traffic on saturation flow, whereas in homogeneous traffic, saturation flow generally increases with increase in effective green time. The effect on saturation flow is due to heterogeneous traffic, less headway, long cycle length and passengers not following proper lane system.

4.7.2. VARIATION WITH RESPECT TO VEHICLE SHARE

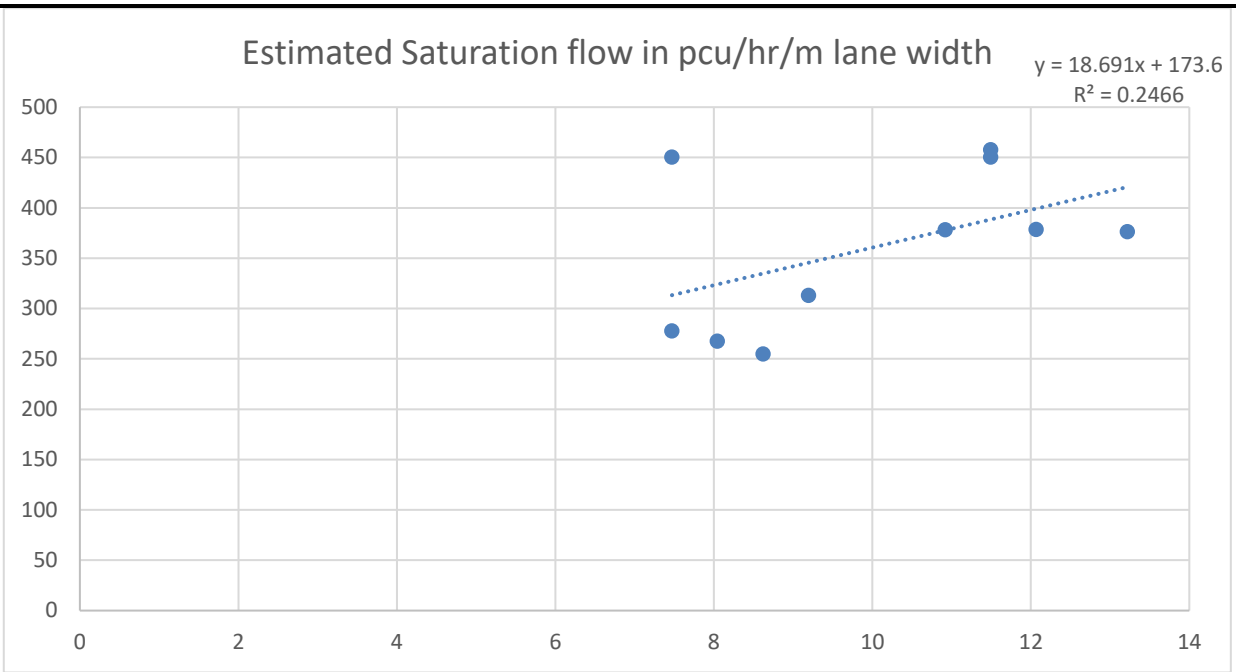


(a)With respect to cars

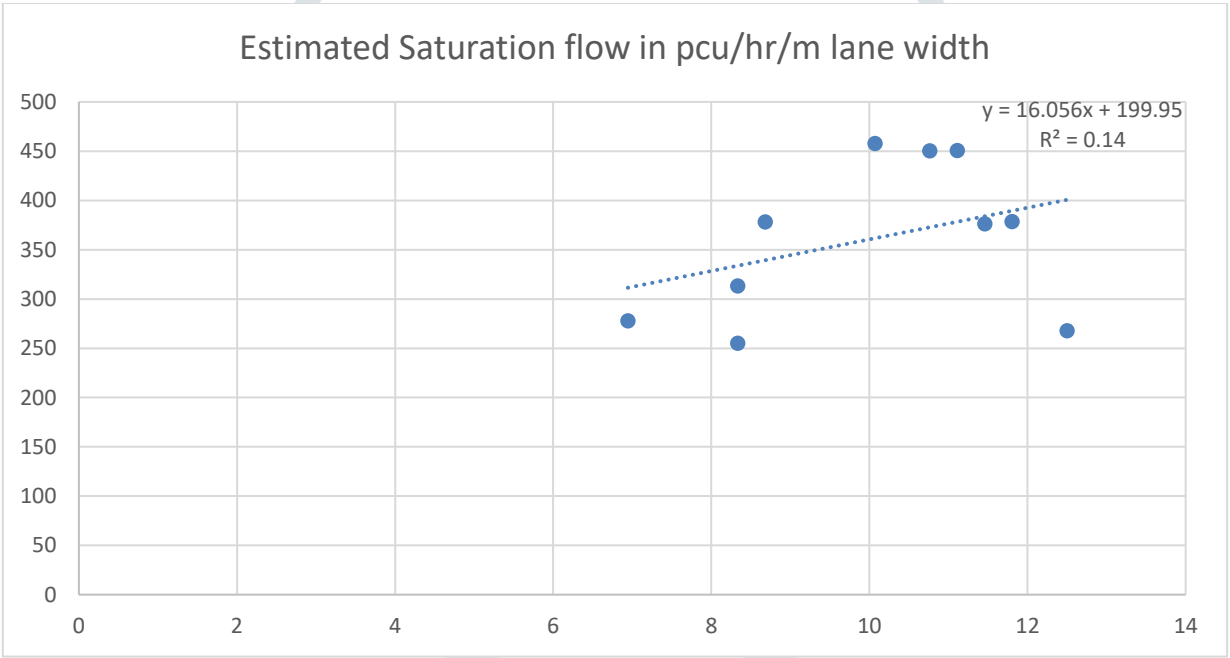


(b)With respect to 2W

Figure 7. Saturation flow v/s vehicle share for NB approach at bistupur chowk

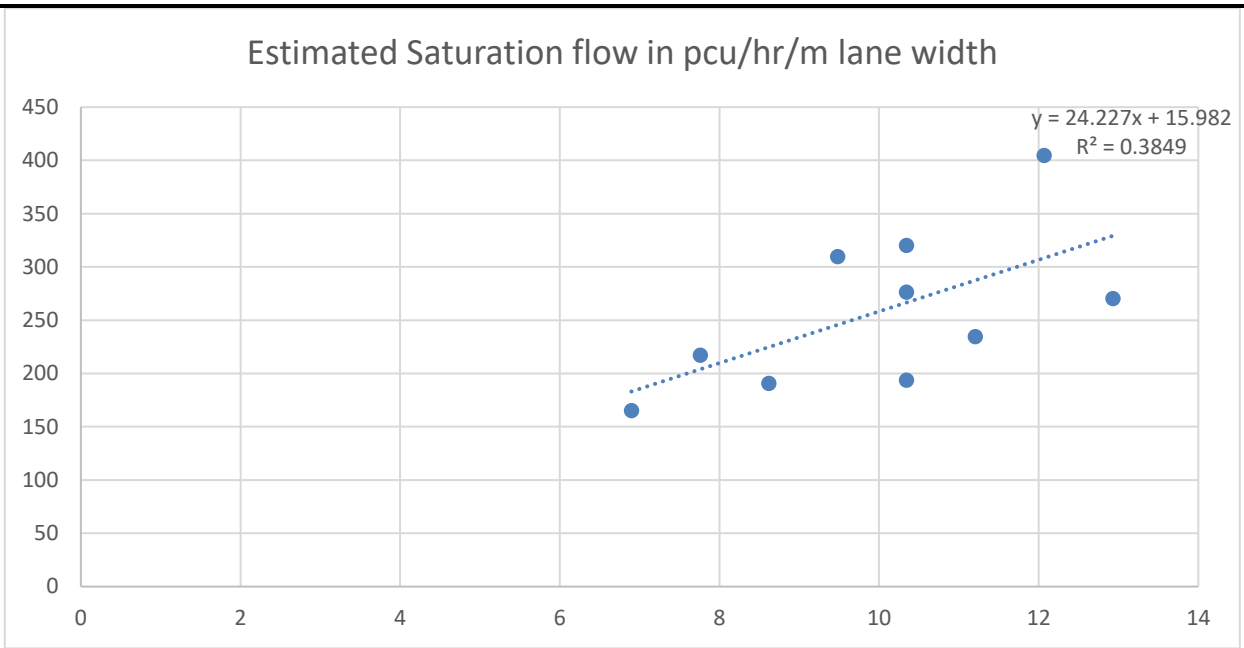


(a) With respect to cars

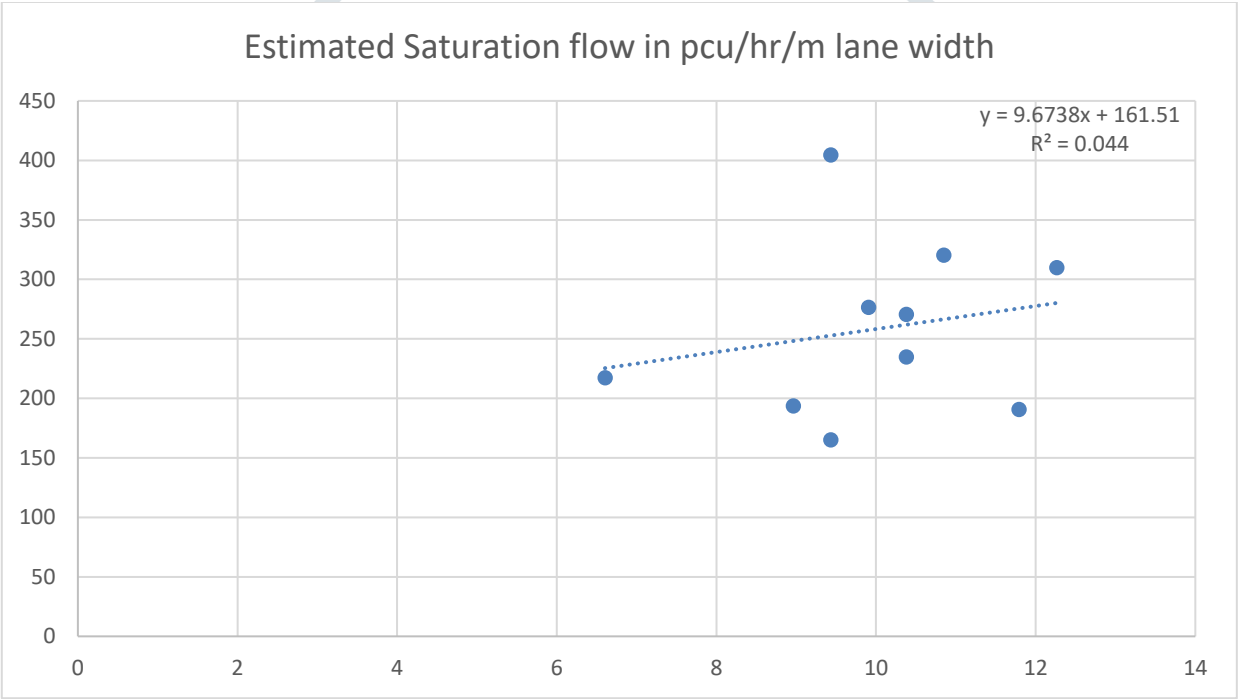


(b) With respect to 2W

Figure 8. Saturation flow v/s vehicle share for SB approach at bistupur chowk

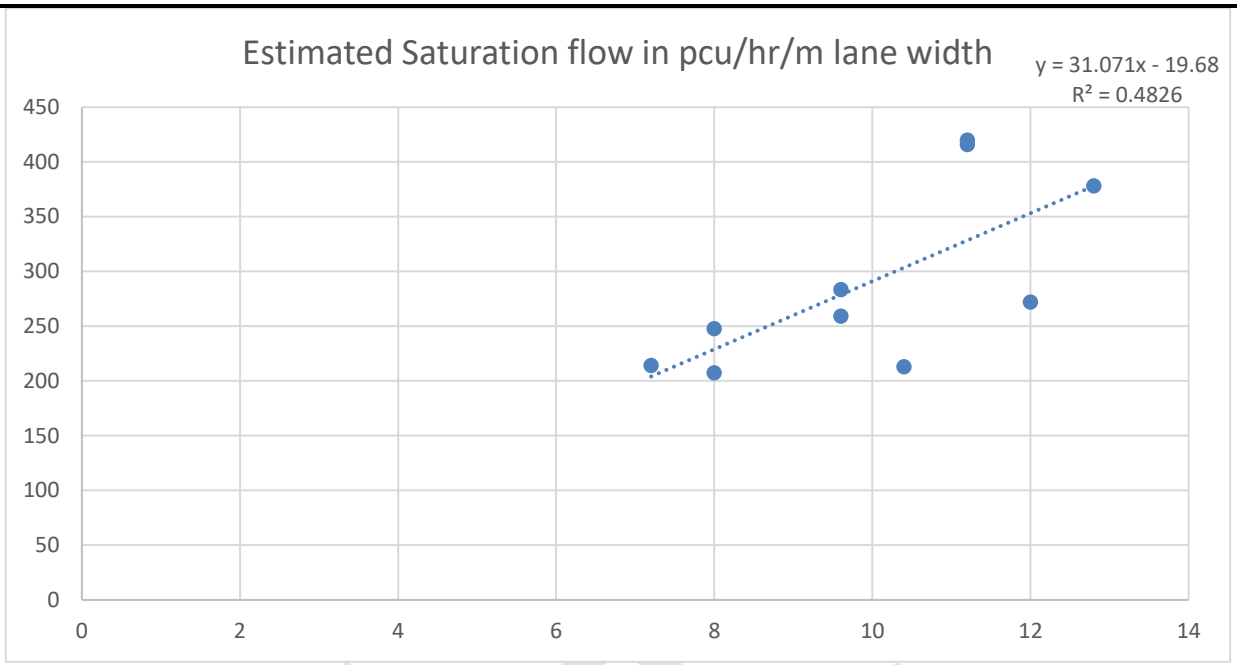


a) With respect to cars

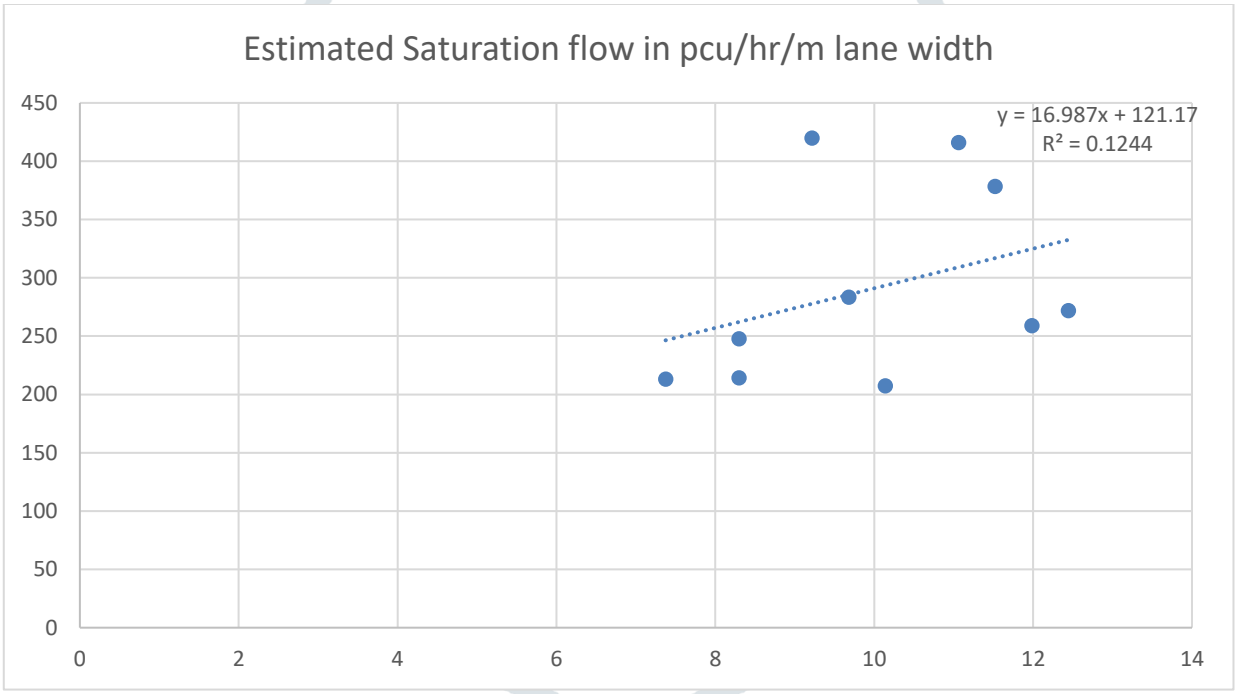


(b)With respect to 2W

Figure 9: Saturation flow v/s vehicle share for EB approach at bistupur chowk



(a)With respect to cars



(b)With respect to 2W

Figure 4.16. Saturation flow v/s vehicle share for WB approach at bistupur chowk

Once the traffic volume, composition and saturation flows are estimated, the next step taken was of examining the pattern of change in saturation flow with respect to the percent share of different category of vehicles. It was observed that the heavy vehicles like buses and trucks were moving in the median, middle and shoulder lane along with cars on Bistupur chowk. Motorized two wheelers were found occupying the service lane on the side of the road. Literature indicates that if the percent composition of one category of vehicle is equal to or more than 80%, then the traffic can be assumed homogeneous in nature. According to this the traffic at Bistupur chowk cannot be treated as homogeneous as there is not more than 80% of any one category of vehicle. The variation in saturation flows with respect to the percent share of different category of vehicles are shown in Fig 4.3 to 4.8 respectively for the intersections.

Table 14: Summary for the observed relationship between Saturation flow vs effective green time and % vehicle composition (car and 2W) in different approach

Intersection	Traffic Approach from	Saturation Flow Vs		Observed Relationship
Bistupur Chowk (Jamshedpur)	North bound (Public Square)	**Effective green time**		y = -14.135x + 468.7 R^2 = 0.1392
		Vehicle share	**Car (%)**	y = 29.605x + 94.905 R^2 = 0.3791
			2W (%)	y = 15.381x + 237.15 R^2 = 0.041
	South bound (diagonal road)	**Effective green time**		y = -7.9509x + 404.24 R^2 = 0.0941
		Vehicle share	**Car (%)**	y = 18.691x + 173.6 R^2 = 0.2466
			2W (%)	y = 16.056x + 199.95 R^2 = 0.14
	East Bound (Chhaganlal Dayaljee)	**Effective green time**		y = 0.9015x + 253.29 R^2 = 0.0014
		Vehicle share	**car (%)**	y = 24.227x + 15.982 R^2 = 0.3849
			2W (%)	y = 9.6738x + 161.51 R^2 = 0.044
	West Bound (G Town Ground)	**Effective green time**		y = -0.4562x + 293.54 R^2 = 0.0003
		Vehicle share	**car (%)**	y = 31.071x - 19.68 R^2 = 0.4826
			2W (%)	y = 16.987x + 121.17 R^2 = 0.1244

4.8. Saturation flow rate:

The saturation flow rate is the maximum rate of vehicle stream that can go through a crossing point for every unit time of effective green, estimated in PCU/hr or PCU/sec (S). As demonstrated by IRC-41, saturation flow(s) are depicted as far as Passenger Car Units (PCUs) each hour and with no left vehicles present.

S = 525 (W) PCUs per hr.

where W = width of approach road in m. This formula works for widths ranging from 5.5 to 18 meters, the values for a smaller width can be found in the table.

Width w in meter	3.0	3.5	4.0	4.5	5.0	5.5
Saturation flow(s) in (PCUs)/hr	1850	1890	1950	2250	2550	2990

Table 15: Comparison between saturation flow from dynamic PCU and by IRC:SP-41

Intersection	Traffic approach from	Saturation Flow Rate (as per IRC:SP-41)	Saturation Flow Rate (as per Dynamic PCU)	Saturation flow/hour/ Lane*
Bistupur Chowk	Northbound	3255	2423.902	390.9519
	Southbound	3255	2235.159	360.5095
	East Bound	4357.5	2143.82	258.2509
	Westbound	4305	2386.482	297.2776
Average		3793.125	2297.340	326.747

The saturation flow derived from the field investigation is lower than the saturation flow derived from the IRC SP-41 generalized formula. The intersection's saturation flow was examined, and it was discovered that it is not only dependent on approach width. As a result, the empirical formula proposed by IRC SP41-1994 of the Indian Road Congress is

ineffective for calculating saturation flow. The saturation flow was affected by the increasing traffic mix of two-wheelers and four-wheelers. As the percentage of two-wheelers increases, saturation flow per meter width tends to increase due to heterogeneity and the filling of two-wheeler gaps. Conversely, when the number of four-wheelers increases, the saturation flow tends to decrease due to increased homogeneity

4. CONCLUSIONS

- The study underlines the importance of estimating PCU values based on real field research at signalized junctions, as PCU values are shown to differ significantly in most circumstances when associated to PCU values specified in IRC: SP-41.
- The variance in the saturation flow can usually be explained by finding PCU by clearing time, but in some cases, the variation in the saturation flow during distinct saturated green phases of the same technique cannot be justified. This is due to the changing traffic mix during the several green phases of the signal. Thus, in this study, an attempt was made to explain the relevance of PCU values, and it was determined from the above restricted tests that PCU values are very delicate to provided geometric parameters such as approach width, traffic flow, composition, and stream speed.
- The saturation flow obtained from the field study, 2297.34 pcu/hr, is lower than the 3793.12 pcu/hr calculated using the generalized formula of IRC SP-41. The intersection's saturation flow was examined, and it was discovered that it is not only dependent on approach width. As a result, the empirical formula proposed by IRC SP41-1994 of the Indian Road Congress is ineffective for calculating saturation flow. The larger traffic mix of two-wheelers and four-wheelers had an impact on the saturation flow.
- Because of their small size, two-wheelers have a PCU value have found to be 0.16, which is less than 1.0, allowing them to form a compact pack and occupy less space while also causing less obstruction to nearby vehicles.
- The signal should be designed such that it allows maximum vehicles to cross the traffic at intersection safely. Congestion or delay at intersections rises as a result of improperly signalised intersections, causing driver discomfort, frustration, increased fuel consumption, and longer travel time. Saturation flow, delay and signal timings are the important factors in the study of signalized intersection. The accurate determination of saturation flow is necessary for calculating optimum cycle time.
- According to this analysis a lower percentage of two-wheelers lowered per lane saturation flow, whereas a higher percentage of heavy vehicles increased per lane saturation flow, according to a dynamic PCU for an arm. In fact, the dynamic PCU flow rate is substantially connected to the configuration of traffic at the approach during the green signal phase. During the saturation stage, a higher percentage of two-wheelers occupied small gaps, increasing the saturation flow rate.
- **Scope of Future work:**
- A review of previous studies shows that PCU values for various vehicle types determined using various approaches are dissimilar. A proper validation approach is necessary to determine the most accurate technique of PCU estimates acquired from multiple methodologies.
- VISSIM model can be used as a tool to stimulate transportation condition by comparative study of existing and proposed condition. Also, driver characteristic should be taken into consideration for estimation of PCU in future.

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