Nanotechnology Perceptions
ISSN 1660-6795
www.nano-ntp.com

Enhancing Urban Mobility: Impacts of Traffic Analysis and Mitigation Strategies at Intersections- A Case Study

Dr. Manjurali I. Balya[1], Dr. Vijendra M. Patel[1], Vipul D. Patel[1], Vijay P. Soni[2], Vijay C. Makwana[2], Harshad S. Bhutadia[3]

[1]Assistant Professors, Civil Engineering Department, Government Engineering College, Patan, Gujarat, India.
[2]Assistant Professors, Mathematics Department, Government Engineering College, Patan, Gujarat, India.
[3]Assistant Professor, Physics Department, Government Engineering College, Patan, Gujarat, India.
Email: manjuralimomin1@gmail.com

Traffic congestion is currently one of the most significant challenges in India. Rapid urbanization and the vehicle registration growth are increasing which results in increase of the traffic congestion. The present research paper is selected Savala Junction of Visnagar city as a case study which faces several major problems, viz. traffic due to uneven vehicle flow, inadequate parking facilities, no traffic signals, and encroachments. These issues lead to increased travel time for road users and a higher rate of accidents. Data for this study was collected through videography and subsequently analyzed. The aim of the study is to control the traffic congestion at the Savala junction and to provide the mitigation strategies to improve the situation of this junction.
Keywords: Urbanization, Traffic Congestion, Mobility, Junction.

1. Introduction

Presently the population of India increasing day by day. Current population of India with 1.22 billion people is the second most populous country in the world, while china is on the top with over 1.35 billion people. Past record show that India represents almost 17.31% of the world's population, which means one out of six people on this planet live in India. With the populations

growth rates at 1.58%, India his predicted to have more than 1.53 billion people by the end of 2030.

Visnagar is the one of the industrial city of Mehsana district of Gujarat State in India. The population of the city according to the census of 2011 is 63,072 which facing high traffic problem in CBD area. In Visnagar, Savala junction is the point which facing much traffic congestion, encroachment nuisance, congestion by Auto rickshaws etc. This is the location at which traffic from M.N. College road, Market road, Mehsana road, Ahmedabad road are meet.

The present research paper shows the existing problems at the junction faced by the peoples. The videography survey of morning peak (10:00 am to 12:00 pm) was carried out at this junction. The analysis of conducting traffic studies –Volume count direction wise and Mode wise has also carried out at Savala Junction. Intersection capacity, signal design, flyover traffic movement and pedestrian study are not included in present study.

2. Problem Summary

❖ Reasons for Congestion

➢ Migration rate is high.

➢ Rapid and uncontrolled construction development.

➢ Lack of frequency of public mass transit system for the villages around Visnagar city.

➢ Lack of traffic controlling system and lack of management by police and other authorities.

❖ Existing Problems

- Time and fuel consumption,
- Irregularity of traffic flow,
- Accident problems.
- Uneven Parking towards the road is affected to the movement of traffic. (Figure-1-2)
- Encroachment and Private Vehicles are at the side of road so Buses are stopping on the Road (Figure-3)

Figure- 1: Parking on Road

Figure-2: Parking on Turning

Figure- 3: Encroachments on the Roadside

3. OBJECTIVES OF THE STUDY

The major objective of the present research is to reduce congestion and control traffic at Savala Junction in Visnagar City. Another aim is to suggest mitigation strategies for the existing traffic problems at this junction.

4. LITERATURE OVERVIEW

Traffic analysis involves evaluating vehicular movement and interactions within a transportation network at junctions. The primary goals include optimizing traffic flow, reducing congestion, minimizing delays, and ensuring safety. Nuzhat et al. (2013) studied traffic data and analysed the stretch from Tejgaon to Shatrasta to determine spot speed and travel speed characteristics. Batra and Sarode (2013) monitored and investigated traffic patterns on Sadar Main Road and WHC Road by combining data collection methods of manual counting and video recording. Mankar and Khote (2016) collected data from field traffic surveys on chosen road sections, Hingna Road and Wardha Road, for traffic analysis. The present study analysed the existing problems faced by people at Savala Junction and proposed mitigation strategies that can be applied at the junction.

5. FIELD STUDIES

To capture the traffic characteristics of Savala Junction videography survey and manual count survey are carried out.

As a result of pilot survey we found morning peak hours of the day are higher at this junction so we have collected the morning peak period for videography. There are high rise building is selected for the videography so, traffic from all the side are include in the videography. The high resolution camera is also used for clear images. The survey had started on 02-11-2014 from morning 10:00am to 12:00pm. From the videography the vehicle count has carried out from the computer with the help of our classmates. In this survey we try to collect maximum no. of samples for every 5 minute. After collecting all data the total volume at this junction and direction wise traffic has been calculated. The traffic composition with direction wise is also carried out from the collected data.

6. STUDY AREA

Visnagar city is located in Mehsana district of Gujarat state. Present population of Visnagar city as per census 2011 about 63073. In Visnagar, many Industries, good educational facilities, medical facilities, better residential & commercial centers are available. Savala junction is the entry point of migrating people from outsides Villages. So traffic problems are more. In Savala Junction, there are three direction routes are merging as form Ahmedabad side, towards Tower side and towards Bus Stop of Visnagar Side. From all these three routes Ahmedabad side traffics are more at this Junction. The study area Visnagar city and Savala Junction is shown in figure-4 & 5.

Figure-4: Visnagar City

(Source: Google Map)

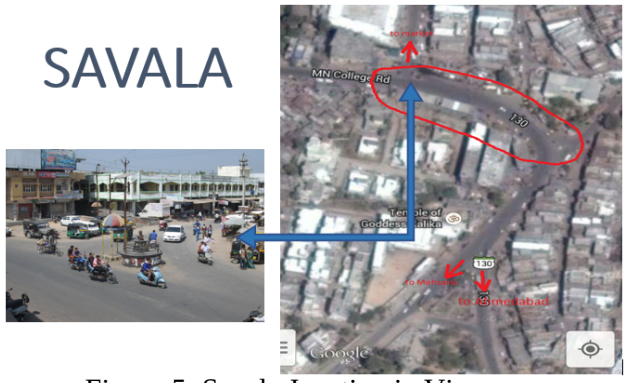

Figure-5: Savala Junction in Visnagar

(Source: Google Map)

7. ANALYSIS AND DISCUSSION

A. General

The data collected from the videography of various vehicle types having different sizes and characteristics has been converted into a standard equivalent unit called “Passenger Car Unit” (PCU). The Passenger Car Unit (PCU) Values (Rural Roads) as suggested in the IRC: 106–1990 “Guidelines for Capacity of Urban Roads in Plain Areas” have been adopted as given in Table-1.

Table-1: Passenger car unit values as per IRC: 106-1990

Mode	2W	3W	4W	Bus	LCV	Cycle	Tractor
PCU	0.5	1.2	1.0	2.2	1.4	0.4	4.0

B. Variation of traffic volume

1. Route: Ahmedabad - Bus depot.

In the morning peak hours, between 10:00am to 11:00pm the traffic from Ahmedabad to bus

station is higher and between 11:00am to 12:00 pm, the traffic from bus stand to Ahmedabad is higher. The variation of traffic to and from Ahmedabad to Bus Stop of Visnagar is shown in Figure-6.

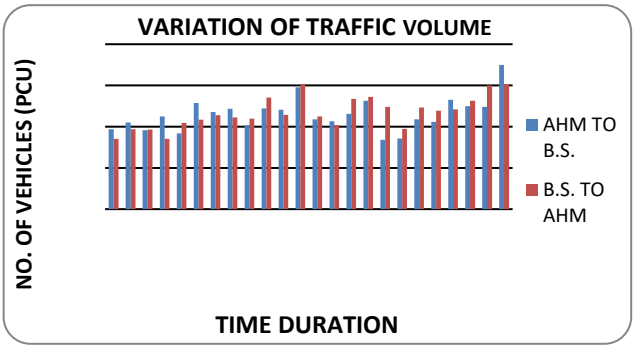

Figure-6: Variation of Traffic (To & From Ahmedabad-Bus Stop)

2. Route: Ahmedabad to Tower

The following figure-7 represents the variation of traffic volume of route Ahmedabad to Tower and Tower to Ahmedabad. The traffic volume is high between 10:30am to 11:30am in both directions.

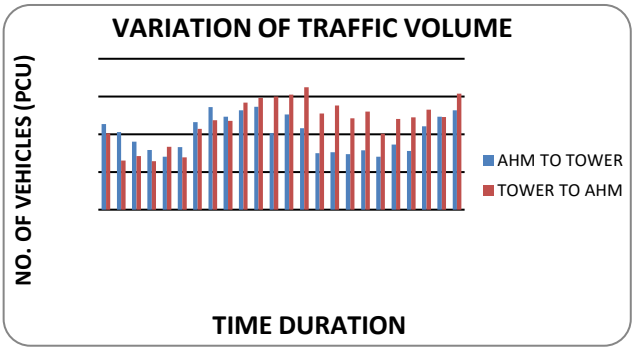

Figure-7: Variation of Traffic (To & From Ahmedabad-Tower)

3. Route: Bus Depot - Tower

The figure-8 represents the variation of traffic volume of route Bus Depot to Tower and Tower to Bus Depot. It is denoted that the traffic volume on this route is less than the other two routes.

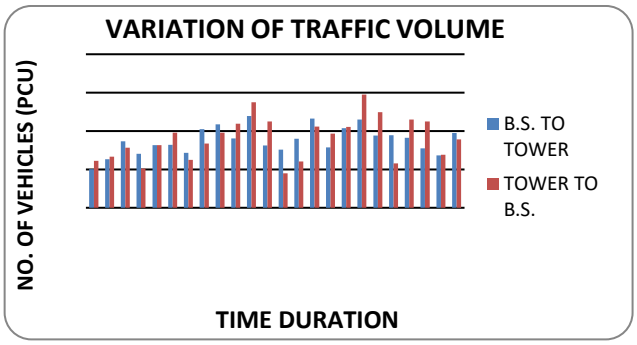

Figure-8: Variation of Traffic (To & From Bus Stop-Tower)

C. VEHICLE COMPOSITION (%)

1. Route: Ahmedabad to bus station.

In this graph, the vehicles are represented by the PCU (%). 2W covered highest mode of transportation. Car covered 15% and three-wheeler covered 25% of total volume of traffic. Cycles and tractors covered lowest mode of transportation.

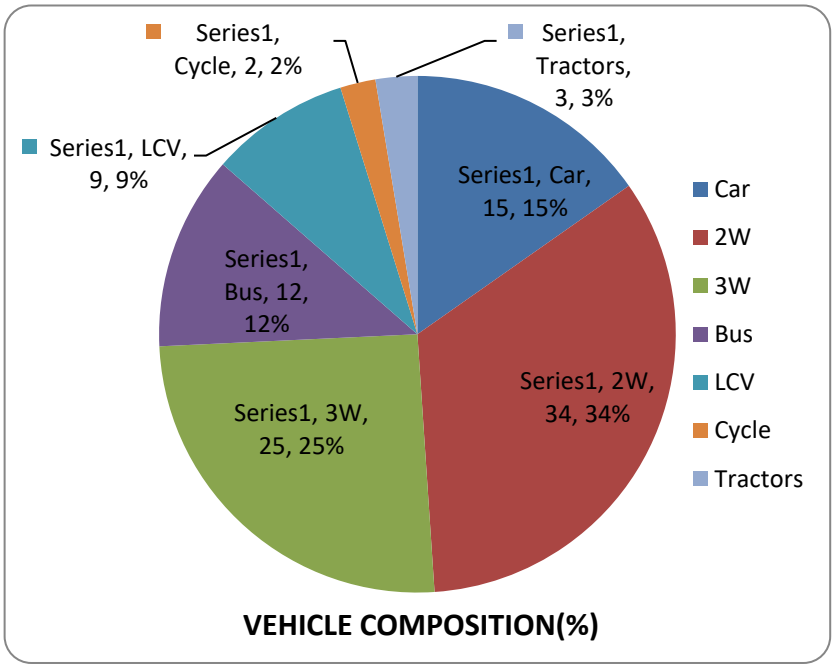

Fig.9 Vehicle Composition (Route: Ahmedabad to bus station)

2. Route: Bus station to Ahmedabad.

In this graph, the vehicles are represented by the PCU(%). 2W covered highest mode of transportation. Car covered 16% and three wheeler covered 26% of total volume of traffic. Cycles and tractors covered lowest mode of transportation.

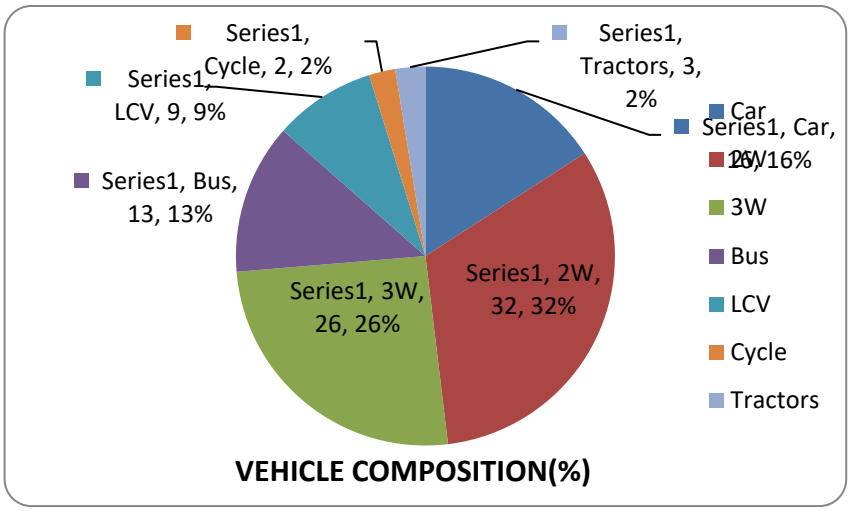

Fig.10 Vehicle Composition (Route: Bus station to Ahmedabad)

3. Route: Ahmedabad to Tower.

In this graph, the vehicles are represented by the PCU(%). Two wheeler covered highest mode of transportation. Car covered 13% and three wheeler covered 27% of total volume of traffic. Cycles and Bus covered lowest mode of transportation.

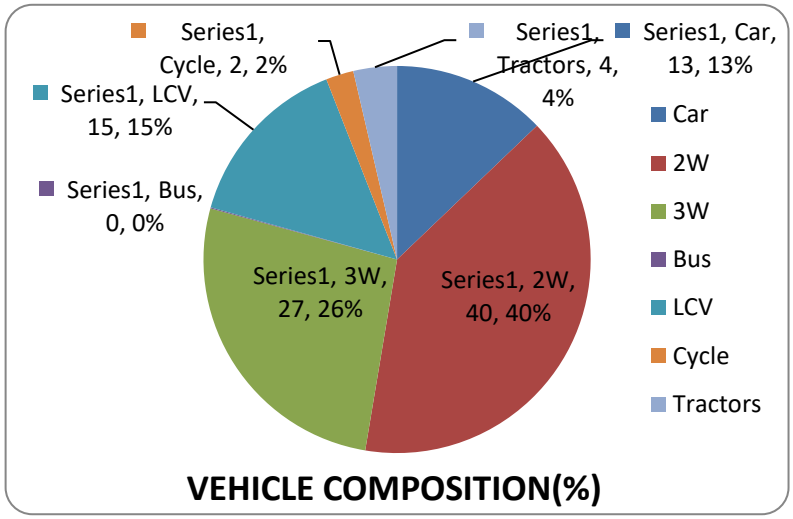

Fig.11 Vehicle Composition (Route: Ahmedabad to Tower).

4. Route: Tower to Ahmedabad.

In this graph, the vehicles are represented by the PCU(%). Two wheeler covered highest mode of transportation. Car covered 13% and three wheeler covered 30% of total volume of traffic. Cycles and Bus covered lowest mode of transportation.

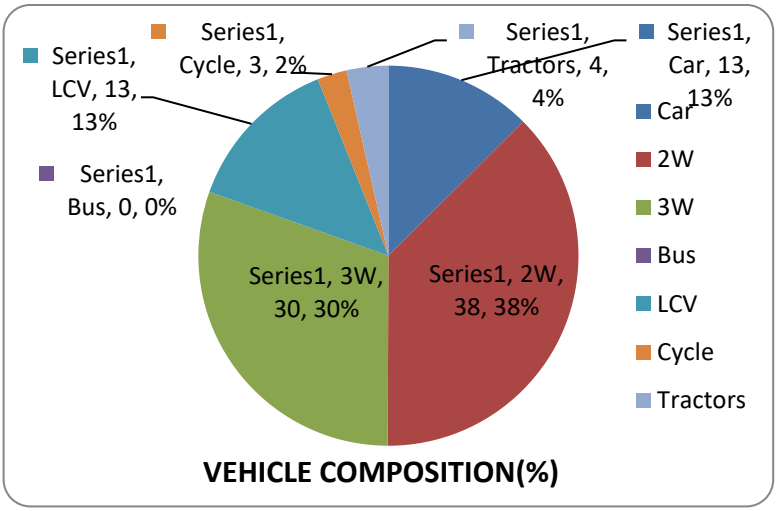

Fig.12 Vehicle Composition (Route: Tower to Ahmedabad).

5. Route: Bus Depot to Tower.

In this graph, the vehicles are represented by the PCU(%). Two wheeler covered highest mode of transportation. Car covered 17% and three wheeler covered 35% of total volume of traffic. Bus and tractors covered lowest mode of transportation.

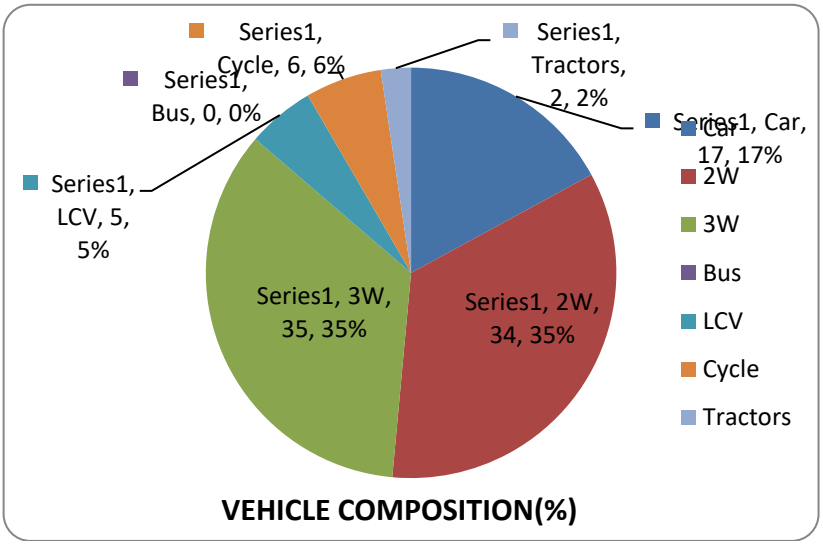

Fig.13 Vehicle Composition (Route: Bus Depot to Tower).

6. Route: Tower to Bus Depot.

In this graph, the vehicles are represented by the PCU(%). Two wheeler covered highest mode of transportation. Car covered 17% and three wheeler covered 35% of total volume of traffic. Bus and tractors covered lowest mode of transportation.

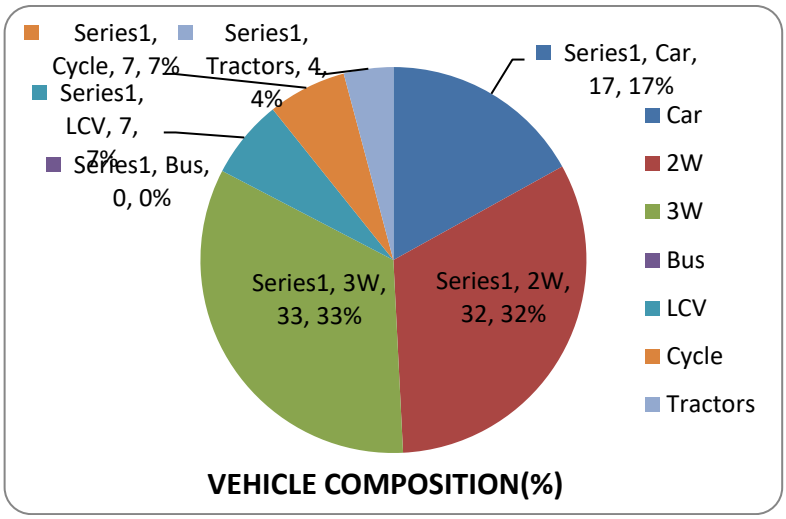

Fig.14 Vehicle Composition (Route: Tower to Bus Depot).

D. Directional Split (%)

In this graphs, the Directional Split is denoted in percentage (%) for the all routes. It is denoted that in which route how many vehicles (PCU) are passes in a particular time period.

1. Route: Ahmedabad - Bus depot

Nearly 50.44% of vehicles move on the route of Ahmedabad to Bus Depot & 49.56% of vehicles move on the route of Bus Depot to Ahmedabad. Figure-15 illustrates the directional distribution to & from Ahmedabad to Bus Stop of Visnagar.

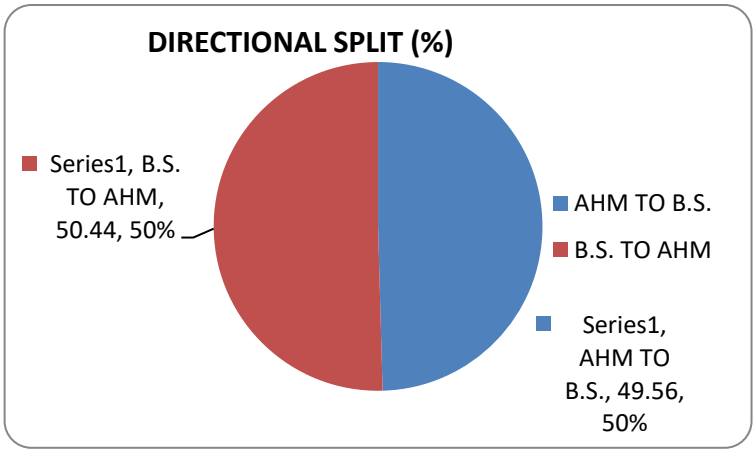

Figure-15: Directional Split (To & From Ahmedabad-Bus Stop)

2. Route: Ahmedabad to Tower

The figure-16 shows that 46% of vehicles move on the route of Ahmedabad to Tower & 54% of vehicles move on the route of Tower to Ahmedabad.

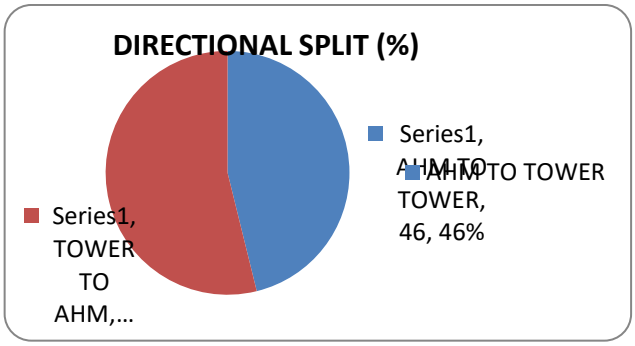

Figure-16: Directional Split (To & From Ahmedabad-Tower)

3. Route: Bus Depot - Tower

Figure-17 illustrates that nearly 51% of vehicles move on the route of Tower to Bus Depot & 49% of vehicles move on the route of Bus Depot to Tower.

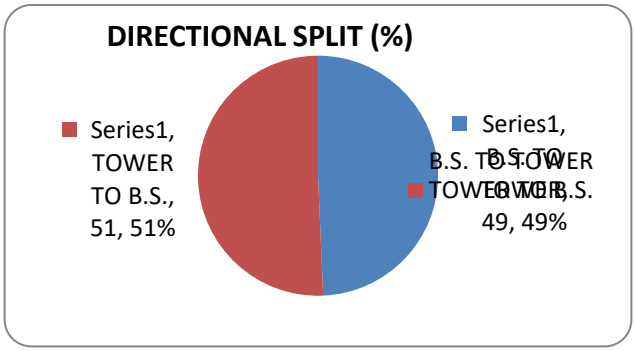

Figure-17: Directional Split (To & From Bus Stop-Tower)

E. Junction Effect of all Direction Routes

These graphs are denoted that how many vehicles (PCU-%) is passes through the all routes and affected on the junction by traffic volume. Highest traffic volume on route of Tower to Ahmedabad is 23%. Lowest traffic volume on route of Bus Depot - Tower is 7%. The junction effect of all three direction routes is shown in figure-18.

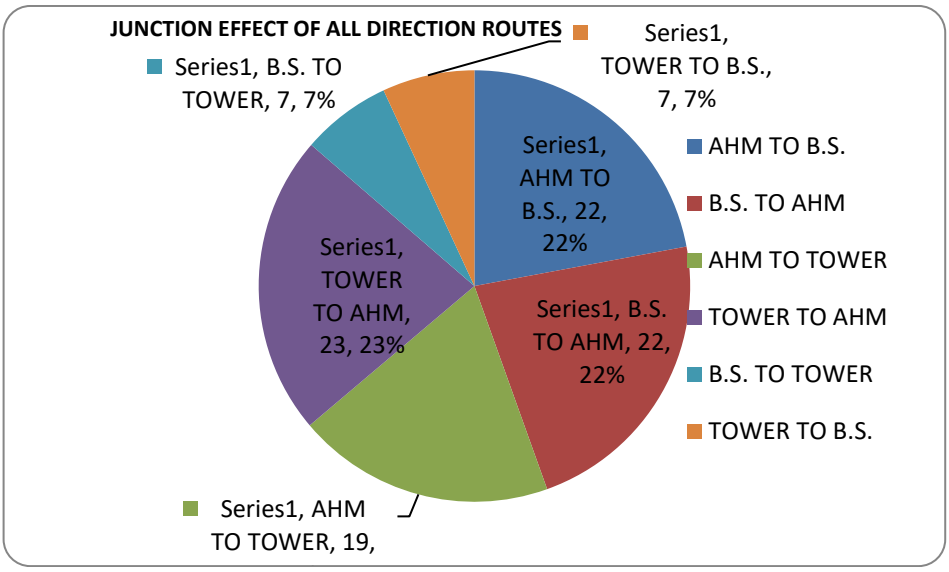

Figure-18: Junction effects of all Routes

8. PROPOSED MITIGATION STRATEGIES

A. Identification of Issues

✓ No Signal System

Signal system is not provided at Savala junction so that Traffic problems have been increased. By providing Traffic signals we can control Traffic problems and reduce the time consumption.

✓ Unmanageable Traffic Situation

Any of control systems that are not implemented for controlling traffic. At presently, the auto rickshaws and jeeps are parked and stopped anywhere on the road so, the traffic are not able to managed.

✓ Encroachment of Vendors and Vegetables Hand Carts

The vendors have been seated on the roadside and the hand carts of the fruits are standing on the side of the road. This is the major creation of the traffic at this junction. Due to this, the buses are not able to stop at the side of the bus stop because it is covered by these encroachments so buses are stopping on the road which is resulted in traffic congestion problems.

B. Mitigation Strategies

After identifying different issues at Savala junction, different proposals are made according to it, keeping all constraints in mind.

- The combination of Rotary and Signal is suited for current traffic operation of junction.
- By removing encroachment of vendors and fruits hand carts space on road will be increased.
- By providing sufficient space for bus stop.
- Providing proper parking for the private vehicles and rickshaws.

9. SUMMARY & CONCLUSION

Savala junction of Visnagar city is facing major traffic problem presently. At this junction, there are many encroachments like illegal parking of Auto rickshaws/2W/Jeeps, stopping bus on road, vendors and fruit handcarts etc.

In present study we have carried out the traffic analysis of the Savala junction and how to solve these traffic problems. From videography survey we have collected morning peak hour traffic as category wise. Junction effect from three different routes as Ahmedabad-Visnagar Bus Depot, Ahmedabad-Tower and Bus Depot-Tower have been found out from the collected data. The analysis shows that the directional distribution, traffic volume variations and junction effect are majorly on Ahmedabad-Visnagar Bus Depot route.

- The maximum traffic is occurring on Ahmedabad-Visnagar Bus Depot route as 44%.
- The minimum traffic is occurring on Visnagar Bus Depot-Tower route as 14%.
- The maximum traffic variation on route of "Ahmedabad-Tower route" as 46% of vehicles move on the route of Ahmedabad to Tower & 54% of vehicles move on the route of Tower to Ahmedabad.

References

1. Abrantes, P. A., & Wardman, M. R. (2011). Meta-analysis of UK values of travel time: An update. Transportation Research Part A: Policy and Practice, 45(1), 1-17.
2. Banik, B. K., Chowdhury, A. I., & Sarkar, S. K. (2009). Study of traffic congestion in Sylhet city. In Journal of the Indian Roads Congress (Vol. 70, No. 1).
3. Bindra, S. P. (1986). A course in Highway Engineering. Dhanpat Rai Publications.
4. Batra, U., & Sarode, M. V. (2013). Traffic surveying and analysis. In International Journal of Application or Innovation in Engineering & Management (IJAIEM), Special Issue for National Conference On Recent Advances in Technology and Management for Integrated Growth.
5. Dhamge, N. R., Patil, J., Dhakate, M., & Hingnekar, H. Literature Review for Study of Characteristics of Traffic Flow.
6. Dickens, M., & Neff, J. (2011). APTA 2011 Public Transportation Fact Book.
7. Frey, W. H., Liaw, K. L., Burtless, G., & Pack, J. R. (2005). Brookings-Wharton Papers on Urban Affairs: 2005.
8. Gavulová, A., & Pirník, R. (2011). Basic concept of the technical study of the traffic control system in Prešov. Transport, 12(4), 34-44.
9. Hashimoto, H., Uesaka, K., Momma, T., Matsumoto, S., & Owaki, T. (2012). New Development of Road Traffic Survey in Japan: From Once Every Five Years to 24/7. In 19th ITS World

CongressERTICO-ITS EuropeEuropean CommissionITS AmericaITS Asia-Pacific.
10. Mankar, P. U., & Khode, B. V. (2016). Capacity estimation of urban roads under mixed traffic condition. International Research Journal of Engineering and Technology (IRJET), 3(4).
11. Oza, V. V., Patel, H. D., Thakor, R. K., Balya, M. I., & Patel, V. A. Traffic Characteristics and Control at Savala Junction-Visnagar City.