

IMPROVEMENT OF TRAFFIC CONGESTION ON KOLLAM BYPASS (AYATHIL-KALLUMTHAZHAM)

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Abstract – Traffic congestion has been one of the major issues that most metropolises are facing in spite of measures being taken to mitigate and reduce it. The increase in number of vehicles mainly causes the problems like accidents, delays, congestion etc. This paper examines the traffic congestion and improvement of traffic congestion on Kollam bypass (Ayathil-Kallumthazham). The traffic congestion on both Ayathil and Kallumthazham junctions were examined and there has a lot of traffic problems identified there. Data regarding the signal study, traffic volume survey, peak hour determination and speed study are collected through direct field surveys. Analysis of the collected data revealed the improper design of the two junctions. Improper traffic signals, lack of width of pavement, improper parking of vehicles are the major factors contributing to traffic congestion. Various remedial measures are also proposed such as widening of pavement and providing roundabout.

Key Words: Traffic congestion, Traffic volume, Peak hour determination, Speed study, Roundabout.

1. INTRODUCTION

Traffic congestion is a condition on transport networks that occurs as use increases, and is characterized by slower speeds, longer trip times, and increased vehicular queuing. When traffic demand is more, the interaction between vehicles slows the speed of the traffic stream, this results in some congestion. As demand approaches the capacity of a road (or the intersection along the road), extreme traffic congestion sets in. [1]

When vehicles are fully stopped for periods of time, this is colloquially known as traffic jam or traffic snarl-up. Traffic congestion can lead to drivers becoming frustrated and engaging in road rage. Mathematically congestion is usually looked at as the number of vehicles that pass through a point in a window of time, or a flow. Congestion flow lends itself to principles of fluid mechanics. [2]

In the recent past, traffic congestion emerged as one of the main challenge for engineers, policy makers and planners in urban areas. Modern social and economic ownership, have established congestion as an inescapable reality of urban life. The growing impact of congestion is

seen in terms of deteriorating urban air quality besides other adverse effects on quality of urban living. One of the main facts that there is no single, broadly accepted definition of traffic congestion. Traffic congestion can generally be defined as excess of demand for road travel. Many professionals and organizations have defined congestion in different ways based on variety of criteria. There have been attempts to develop congestion measurement indices for heavily motorized countries. In less motorized countries, there are not many documented studies on how to measure congestion and plans for its mitigation. Identification of traffic congestion threshold is an essential requirement for defining the congestion and suggesting appropriate mitigation measures. [3]

The negative impacts of traffic congestion are; wasting of time of motorists and passengers. Delays which may result in the late arrival for employment, meetings, and education, resulting in lost business disciplinary action or other personal losses. Wastage of fuel, increasing air pollution and carbon dioxide emissions are caused due to increased idling, acceleration and braking. Wear and tear on vehicles due to idling in traffic and frequent acceleration and braking, leads to more frequent repairs and replacements. Stressed and frustrated motorists, encouraging road rage and reduce health of motorists. There are higher chances of collisions due to tight spacing and constant stopping and going. [4]

The traffic delay problems and its management plan studies at Port Blair city, India were carried out by Madhu Errampalli et al [5].

Neema Davis [6] discussed about congestion cost incurred on Indian roads as a case study in New Delhi. They conduct a preliminary investigation into the levels of congestion in New Delhi, motivated by concerns due to rapidly growing vehicular congestion I Indian cities.

Impact analysis of land use on traffic congestion using real-time traffic and POI were studied by Tianqi Zhang et al [7].

Sougata Maji conducted a case study about traffic congestion and possible solutions at Asansol city, India. [8].

In this paper traffic congestion at Kollam bypass (Ayathil-Kallumthazham), Kerala State, India is studied. Field studies such as signal study, traffic volume count, peak hour determination, and speed study were carried out. Past accident data were collected from DCRB and nearby police stations and analyzed it. Lack of width of pavement, improper signal system and improper parking of vehicles are the critical issues seen in the area. An attempt is also made to suggest remedial measures by widening of road pavement on Ayathil junction and provide a roundabout on Kallumthazham junction.

1.1 OBJECTIVE AND SCOPE OF WORK

- The main objective of this study is aimed at understanding the recurring urban congestion its measurement and mitigation.
- Identifying traffic congestion and bringing out possible remedial measure in the form of roundabout.

2. METHODOLOGY

2.1 FIELD SURVEY AND DATA COLLECTION

Kollam bypass is a part of NH-66 that bypasses CBD of Kollam city in Kerala. The busy 13.141 km long bypass starts at Mevaram in the south to Kavanad in the north, via Ayathil, Kallumthazham, Kadavoor and Kureepuzha in Kollam city. The Kollam bypass connecting Kavanad and Mevaram is witnessing substantial vehicular traffic including that of heavy ones avoiding the busy Kollam city. In this paper, we studied traffic congestion on two junctions such as Ayathil and Kallumthazham.

There are mainly four roads meet at Ayathil junction such as Ayathil-Kavanad, Ayathil-Mevaram, Ayathil-Kannanalloor and Ayathil- Kollam. A small bridge is passing across the two roads ie, Kannanalloor road and Kavanad road. Land marks in the junction are a hospital, 2 mosque, and cashew nut factory. In the Mevaram road there is an 8.6 meter wide road that connects to major roads. But there is no separate signal system for that road.

Also in Kallumthazham junction there are mainly 4 roads meet such as Kallumthazham-Kavanad, Kallumthazham-Mevaram, Kallumthazham- Karikkodu and Kallumthazham- Kollam.

Inadequacy of road width, improper signal system, deficiency of parking space, unauthorized trading along the road sides and lack of pedestrian width are also identified in these two junctions. The above mentioned reasons are attributed to the initiation and outgrowth of traffic issues, especially during peak hours. In order to identify the heavy traffic congestion on both the junctions direct field surveys

were carried out to collect the relevant data. Accident data were collected from DCRB and nearby police stations for last 4 years (2015-2018). The data were collected for the identification of the region most prone to accident. Study on signal system, traffic volume surveys, speed study and measurement of road width is also carried out.

2.2 DATA ANALYSIS AND INTERPRETATION

2.2.1 SIGNAL SYSTEM ANALYSIS

The signal system causes long queues on both the junctions causing inconvenience to motorists during office hours. In Kallumthazham junction there is a wide variation between red time and green time. The red time is greater than green time. In Kallumthazham-Mevaram road the red time is 102 seconds and green time is only 13 seconds. The improper signal system causes heavy traffic congestion on both the junctions.

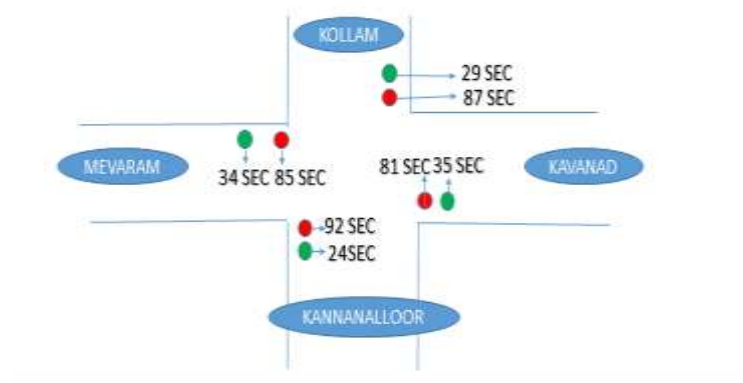


Fig-1: Ayathil junction

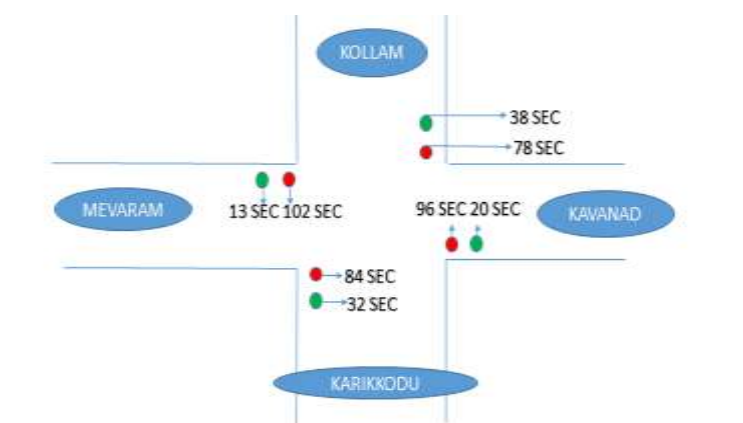


Fig-2: Kallumthazham junction

2.2.2 PEAK HOUR DETERMINATION BY TRAFFIC VOLUME SURVEY

Traffic volume is defined as the number of vehicles passing through a section on a particular time. Traffic volume studies were conducted to determine the number, types and movements of vehicles at given location. These data helps to identify critical flow time periods, determine the influence of large vehicles or pedestrians on vehicular traffic flow, or document traffic volume trends. The length of sampling periods depends on types of count may be conducted during the peak flow period.

Traffic volume survey was carried out on both Ayathil and Kallumthazham junction. The video graphic surveying of vehicles at the junctions was done at the peak hours, ie 8.30 am-10.30 am and 4.30 pm- 6.30 pm. Hence the number of two wheelers, three wheelers, four wheelers, buses and other vehicles (trucks, lorries etc.) were counted and noted. By using this traffic volume count peak hours were determined. In morning survey the peak hour was obtained as 8.30-9.30 am and in evening it was 4.30-5.30 pm.

Table -1: Peak hour determination on Ayathil junction.

Time	PCU
8.30-8.45	1802
8.45-9.00	1410
9.00-9.15	1416
9.15-9.30	1189
9.30-9.45	1062
9.45-10.00	758
10.00-10.15	907
10.15-10.30	768

Table -2: Peak hour determination on Ayathil junction.

Time	PCU
4.30-4.45	914
4.45- 5.00	985
5.00-5.15	838
5.15-5.30	848
5.30-5.45	726
5.45-6.00	1049
6.00-6.15	837
6.15-6.30	767

2.2.3 SPEED STUDY

Speed is an important transportation consideration because it relates to safety, time, comfort, convenience and economics. Here we were adopted Direct timing method. Two reference points are marked on pavement at a suitable distance apart and an observer starts and stops and accurate stop watch as a vehicle crosses these two marks. From the known distance and measured tie interval speeds are calculated.

$$\text{Speed} = \text{Distance} / \text{Time}$$

The distance was taken as 100m. From the data analysis, we could understand that on approaching the junction, the speed of vehicles is lowered which means that there is heavy traffic congestion over there.

2.2.4 WIDTH OF PAVEMENT

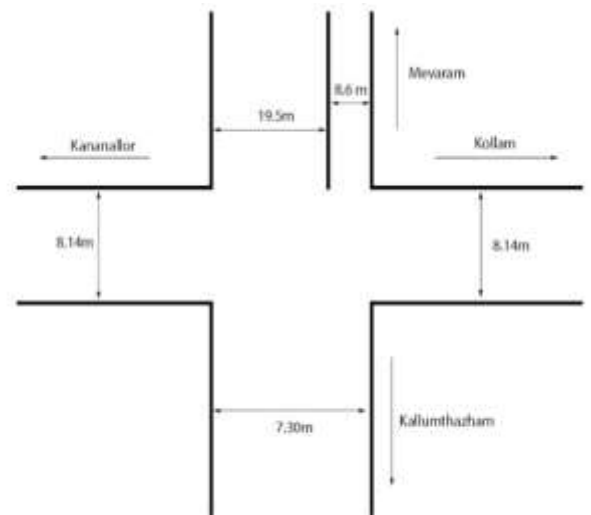


Fig-3: Ayathil junction

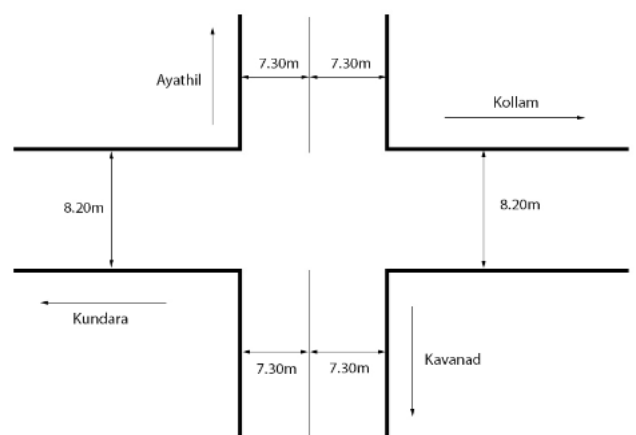


Fig-4: Kallumthazham junction

2.2.5 ANALYSIS OF ACCIDENT DATA

The accident details of last four years 2015- 2018 were collected from District Crime Research Bureau and nearby police stations under the study area. The type of vehicle involved,time and date, intensity of accident were also recorded. The data were collected for the identification of the region most prone to accident.



Fig-5: Percentage of accident based on time on Ayathil junction.



Fig-6: Percentage of accident based on time on Kallumthazham junction.

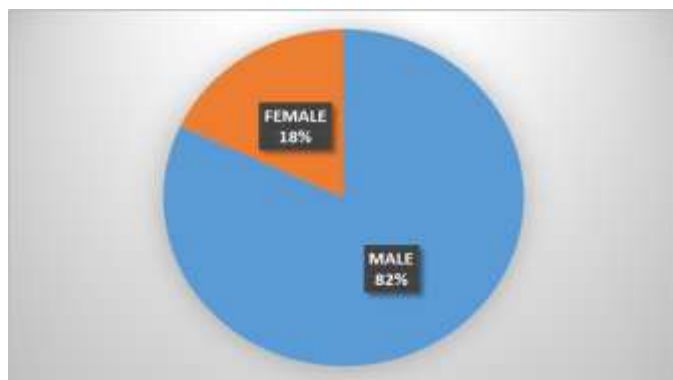


Fig-7: Percentage of accident based on gender on Ayathil junction.

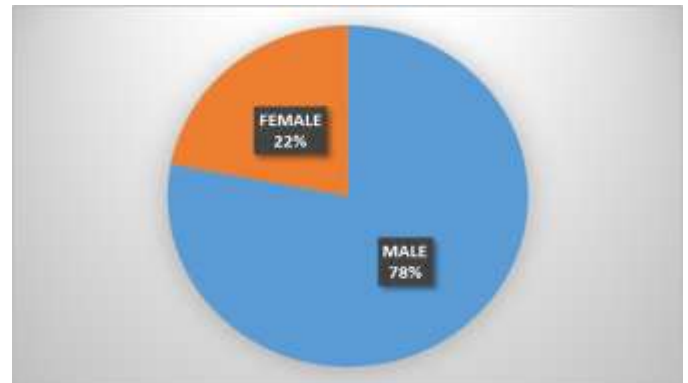


Fig-8: Percentage of accident based on gender on Kallumthazham junction

Existing data collected from the DCRB was correlated with the data collected from physical survey to identify accident prone region. It can be analyzed using Weighted Severity Index (WSI method).

$$WSI = (41 \times K) + (4 \times GI) + (1 \times MI)$$

K= Fatal

GI= Grievous Injury

MI=Minor Injury

Table-3: WSI values of selected regions

Name	K	MI	GI	WSI
Mevaram	1	9	23	142
Ayathil	3	7	80	450
Kallumthazham	1	2	33	175
Kavanad	6	6	33	384

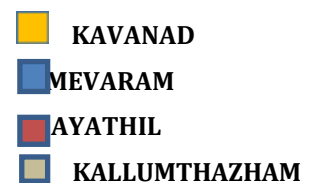
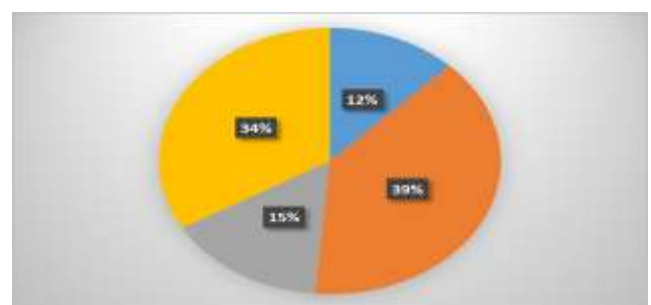


Fig-9: Accident distribution on various regions

3. IMPROVEMENT IN THE JUNCTION

Kallumthazham junction is congested because the design capacity of the road is much higher than that of the road design criteria. We are suggesting an intersection in junction in the form of a roundabout.

3.1 DESIGN OF ROUNDABOUT

Various parameters considered for the design of roundabout are;

3.1.1 Speed

Select as 30 kmph (IRC 65-1976(193)) for circular rotaries in urban area.

3.1.2 Circular Central Island

a) Traffic density exceeds 50 PCU/hr at all the intersecting roads.

b) All the roads have equal importance.

3.1.3 Radius of rotary roadway

$$R = \frac{v^2}{127F}$$

$$= \frac{30^2}{127 \times 0.47}$$

$$= 15.08 \text{ m}$$

3.1.4 Weaving angle

Select 16°

3.1.5 Weaving distance

Select 30m

Minimum 45m for 45kmph

Minimum 30m for 35kmph

Maximum = $(2 \times 30) = 60\text{m}$

3.1.6 Width of rotary roadway

$$W = \frac{(e_1 + e_2)}{2} = 3.5$$

$$= 10.5\text{m}$$

3.1.7 Radius of entrance and exit curves

a) Entrance (For 2 lanes)

As per IRC 25m-35m

Select 25m

b) Exit (For 2 lanes)

1.5 times the entrance radius

Select 37.5m

Say 40m

3.1.8 Angle of intersection

Entry angle = 60°

Exit angle = 30°

3.1.9 Minimum stopping sight distance for rotary

Select 30m

3.1.10 Minimum turning radius for junction

For $105^\circ - 18.30\text{m}$

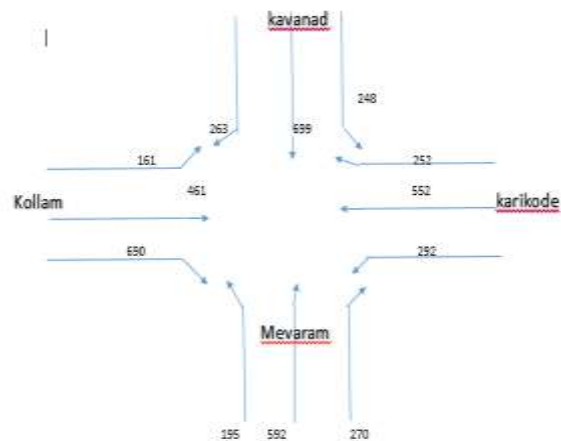


Fig-10: Traffic flow in Kallumthazham junction

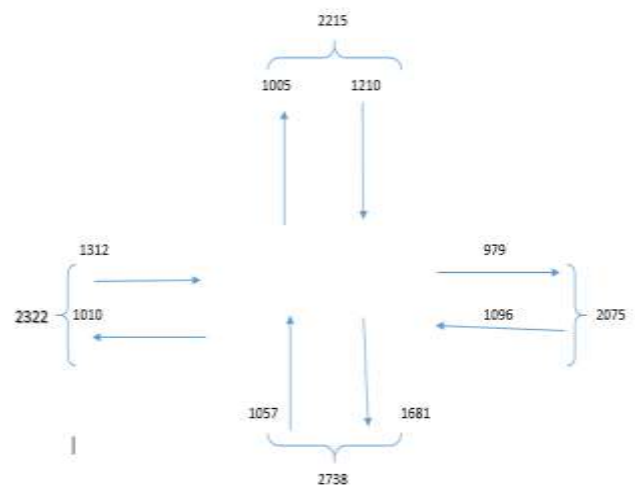


Fig-11: Traffic in terms of PCUs on each leg.

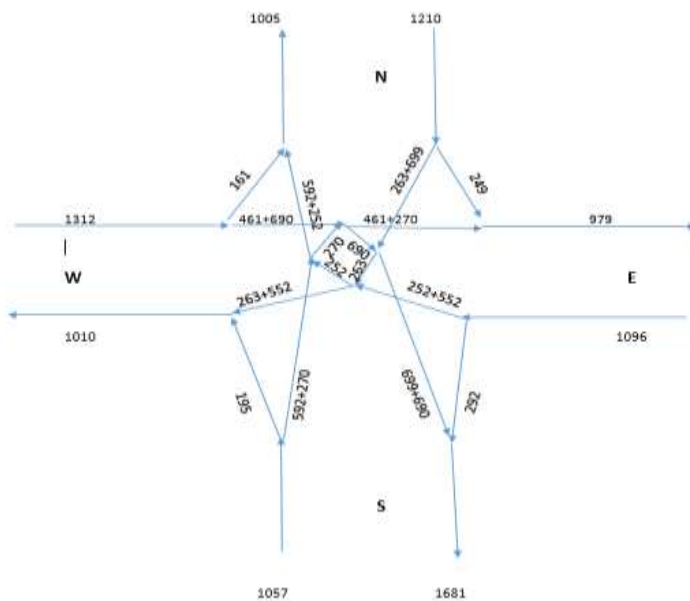


Fig- 12: Traffic intersection showing weaving

3.1.11 Capacity of roundabout

$$P = (b+c)/(a+b+c+d)$$

$$a = 161$$

$$b = 461+690 = 1151$$

$$c = 461+270 = 731$$

$$d = 270$$

$$P = 1151+731/161+1151+731+270 = 0.81$$

By IRC recommendation

$$l/w = 4$$

$$30/10.5 = 2.85$$

Hence take $l = 4w$

$$= 4 \times 10.5$$

$$= 42m \sim 45m$$

$$e = e1 + e2/2$$

$$= 7.3 + 7.3/2$$

$$= 7.3m$$

$$\text{Capacity, } Q_p = 280w[1+(e/w)][1-(p/3)]/[1+(w/l)]$$

$$= 280 \times 10.5[1+(7.3/10.5)][1-(0.81/3)]/[1+(10.5/45)]$$

$$= 2949.98$$

$$\sim 2950 \text{ PCU/hr}$$

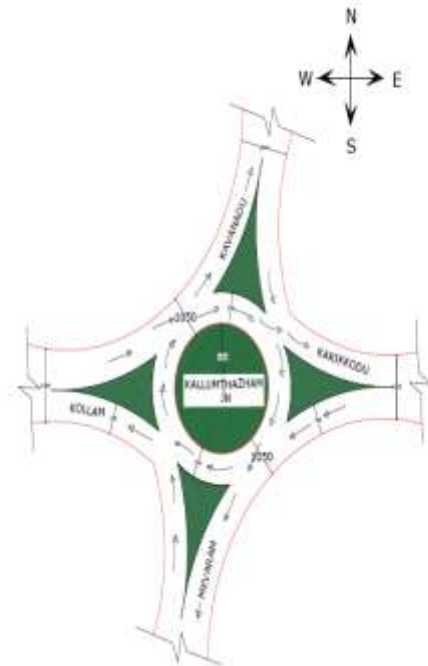


Fig-13: Detailed sketch of proposed roundabout

4. CONCLUSION

The various problems associated with the development of junctions were ascertained by conducting field studies. Traffic volume survey gives the conclusion that 2 wheelers are larger in number followed by 3 wheelers, 4 wheelers, buses and others. From the volume data, it was found that the most congested road of the junction is Kavanad - Mevaram road which runs through the National Highway 66. The morning peak was found to be 8.30-9.30 am and evening peak was found to be 4.30-5.30 pm which suggest that during office and school timing the traffic congestion is more severe which often leads to delay in day to day life. Accident analysis of Ayathil and Kallumthazham junctions were studied. Total of accidents was reported during the year 2015-2018 from DCRB is 149. The maximum number of cases was recorded for major injury followed by minor injury and fatal. The maximum number of accidents was reported in the month of July. The maximum number of accidents were recorded when men were driving the vehicle. Two wheelers were more prone to accidents due to reckless driving habits, over speed and ignorance. In Ayathil junction, the only possible remedy is to increase the width of road. Land acquisition from both sides is necessary. In Kallumthazham junction, the possible remedy is to provide an intersection in the form of roundabout. A circular roundabout of 30m diameter is recommended for the intersection. It is capable for accommodating 4182 PCU/hr.

REFERENCES

- [1] Harsha Priya K, K.V.R Ravi Shankar, C.S.R.K Prasad, T.S. Reddy (2013) Evaluation of area traffic management measures using microscopic simulation model. *Social and Behavioral sciences* 104, 815-824
- [2] Mohsin Manzoor Janwari, Geetam Tiwari, Sudershan K. Popli, M.S. Mir (2014) Traffic analysis of Srinagar city. *Transportation Research Procedia* 17,3-15
- [3] Wout Broere (2015) Urban underground space: Solving the problems of today's cities. *Tunneling and underground space technology* 55, 245-248.
- [4] Geetha Lal, Divya L.G, Nithin K J, Susan Mathew, Bennet Kuriakose (2016) Sustainable Traffic improvement for urban road intersections of Developing countries; A case study of Ettumanoor, India. *Global Colloquium in Recent Advancement and Effectual Researches in Engineering, Science and Technology* 25, 115-121.
- [5] Madhu Errampalli, Ravinder Kayitha (2016) Traffic Management Plan for Port Blair city, India. 11th Transportation Planning and Implementation Methodologies for Developing Countries, TDMPC, 2014, 10-12 Dec 2014, Mumbai, India 12,548-557.
- [6] Neema Davis, Harry Raymond Joseph, Gaurav Raina, Krishna Jagannathan (2017) Congestion cost incurred on India roads; A case study on New Delhi, Department of Electrical Engineering, Indian Institute of Technology Madras, Chennai.
- [7] Tianqi Zhang, Lishan Sun, Liya Yao, Jian Rong (2017) Impact Analysis on Land use on Traffic Congestion Using Real-Time Traffic and POI. *Journal of Advanced Transportation*, volume 2017.
- [8] SogataMaji (2017) Traffic congestion and possible solution: A Case study of Asansol. *Journal of Research Humanities and Social science*, volume 5, Issue 942-46.