

# Evaluation of Level of Service for Various Junctions in Visakhapatnam

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## Abstract

Traffic congestion is the major cause that shows impact on the economy, environment and quality of life of the community.

This study generally develops an approach to analyse the traffic conditions at various junctions in Visakhapatnam. It is important to identify the reason for traffic congestion and to analyze traffic patterns so that most appropriate measures may be taken for each location to reduce traffic congestion and apply counter measures effectively and efficiently.

Three areas Jagadamba, Ramataalkies and Dabagardens were identified and traffic volume and spot speed studies have been conducted in this study. By using the free flow speed equation in Highway capacity manual (2000) which is based on various factors like lane width and peak hour factors at these junctions, the level of service is determined. In some roads in all the junctions, the level of service E and F was obtained due to geometric problems and heavy traffic during various occasions like weekends and festivals. Possible measures have been suggested depending on the existing conditions in the city.

**Keywords:** *Level of service, Peak hour factor, traffic volume, spot speed study, congestion.*

## 1. INTRODUCTION:

This project generally develops an approach to analyse the traffic conditions at various junctions in Visakhapatnam. The main reasons for traffic congestion are increased population, insufficient land availability, less knowledge of regulations and other issues. To analyse a particular area for traffic

congestion, it is necessary to know the volume of traffic that is coming on all roads and design speeds of that location. In this study, the level of services was determined for different locations in Visakhapatnam. The traffic volume studies and spot speed studies were conducted at every location. The data was collected during peak and off peak hours. The free flow speed is determined using Highway capacity manual. Peak hour factors are determined at every location.

After determining the above, the level of service was determined for all lanes. The suggestions have been discussed at the end of the paper.

## 2. BACKGROUND STUDY:

Arasan and Vedagiri (2010) estimated the probable modal shift by the user if there is a dedicated bus lane. The author studied the LOS of heterogeneous traffic condition through computer simulation.

Fang et. al. (2009) determined the LOS ranges from the speed-flow curves of different segments of an interchange by developing a simulation model using VISSIM software. He considered the density as classification index.

Robin Babit et al (2016) studied the Level of service at Chandigarh. The traffic volume count is performed for 5.5kilometers stretch and the peak hour volume is determined at peak hours in the evening 5 to 7PM. Using Highway capacity manual, the level of service is determined by considering the peak hour factors.

The main objective of this study is

- To identify the critical junctions.
- To conduct traffic volume studies at the identified junctions.
- To collect the geometrical data of the identified junctions and approach roads.

- Traffic survey analysis according to 15 minutes variation.
- Traffic survey analysis according to hourly variation.
- Identifying peak hour traffic volumes.
- Identify vehicular composition from all routes at the junction.
- To evaluate level of service and suggesting improvements

### 3. METHODOLOGY:

The steps followed in this study are:

1. Selection of study area.
2. Surveys conducted
  - a. Traffic volume study
  - b. Spot speed study
3. Calculation of peak hour factors
4. Determination of Free flow speed
5. Determination of Level of service

#### 3.1 Selection of study area:

The areas selected are Jagadamba, Ramatalkies and Dabagardens. The reason for selecting these areas is they have most congestion during peak hours than remaining junctions. These are unsignalized junctions. The maximum traffic congestion was due to shopping malls, theatres and educational institutions. The leaving time of colleges cause more traffic at Ramatalkies junction. Similarly, the leaving time of movie cause congestion at Jagadamba junction.

##### 1. Jagadamba Junction:

This is the one of the major junctions of Visakhapatnam. This centre forms the good old central shopping and entertainment hub of this port city. Because of many shopping malls and cinema theatres in that area there is a lot of congestion over there.



**Figure 1: Jagadamba Junction**



**Fig 2 Satellite view of Jagadamba junction**

##### 2. Daba Gardens Junction:

This is the area which is very near to railway station and RTC complex. Dabagardens is a neighborhood in Visakhapatnam. It is a hub for shopping malls, electronic shopping especially, shopping for cell phones, restaurants, educational institutes etc. LIC building is main landmark in this area. BSNL office is also situated here.



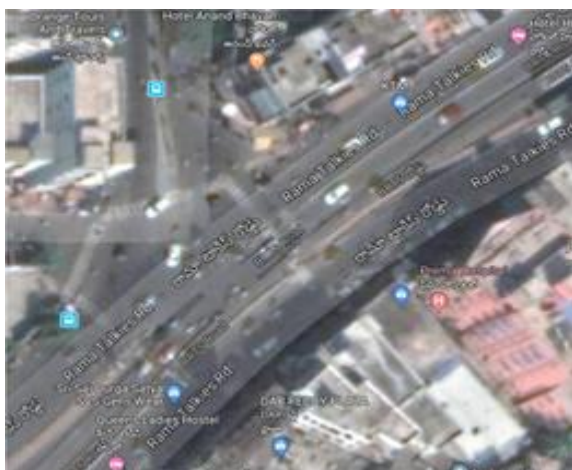
**Fig 3 Satellite view of Dabagardens junction**

##### 3. Rama Talkies Junction:

This is a T- junction, which is connecting three major roads i.e., Satyam junction, Maddilapalem junction, Dwaraka bus station and it is a hub for many educational institutions which are located very nearer to this junction.



**Fig 4 Rama Talkies junction**



**Fig 5** Satellite view of Rama Talkies junction

### 3.2 Data collection:

Traffic volume study has been carried out at three junctions in peak hours of morning and evening. The traffic volume data is used and PCU values were determined using the IRC: 64-1990.

**Table 1: Passenger car unit (PCU) values for different type of vehicles**

S.No	Vehicle type	PCU-Equivalent factor
1	Motor cycle and scooter	0.50
2	Passenger car, van, auto rickshaw	1.00
3	Truck or bus	3.00
4	Truck-trailer / Tractor-trailer	4.50
5	Cycle	0.50
6	Cycle rickshaw	2.00
7	Handcart	3.00
8	Horse-drawn vehicle	4.00
9	Small bullock-cart	6.00
10	Big bullock-cart	8.00

The traffic volume study and spot speed study was conducted at all the three junctions.

The cumulative frequency of vehicles were determined and presented in the Table 2 to 10.

The directional PCU was also determined for a junction. The details are shown in the Table 11.

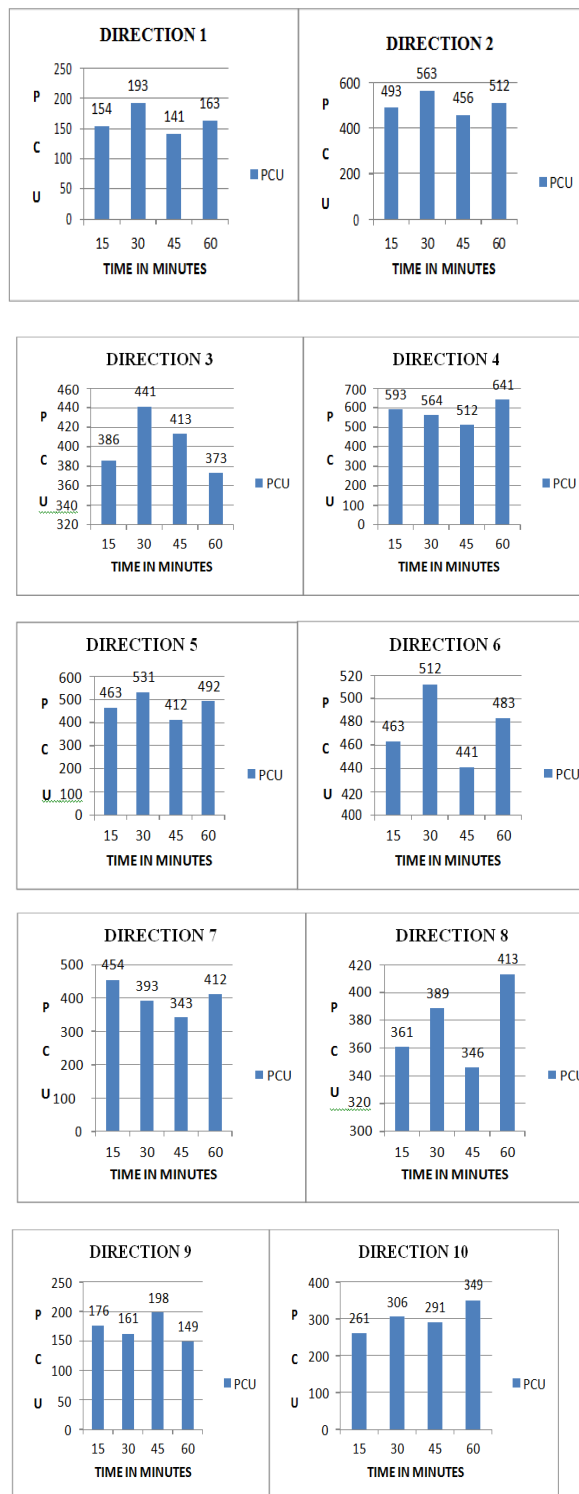
The peak hour factor (PHF) is the hourly volume during the maximum-volume hour of the day divided by the peak 15-minute flow rate within the peak hour.

The peak hour factor (PHF) is found by dividing the peak hour volume by four times the peak 15 minute volume.

A peak hour factor (PHF) is used to convert hourly traffic volume into the flow rate that represents the busiest 15 minutes of the rush hour.

The directional PCU's are calculated and these are used to determine the peak hour factors. These are calculated on all the directions of traffic.

The bar charts have been drawn using time duration on X-Axis and PCU on Y-axis. They are as shown in below.



**Fig 6: PCU values for each 15Minutes in all the directions**

**Table 13: Peak hour factors**

TIME	DIRECTION/ Peak Hour factor									
	1	2	3	4	5	6	7	8	9	10
09:00 AM- 10:00AM	0.82	0.88	0.84	0.86	0.85	0.83	0.85	0.88	0.82	0.79
10:00AM- 11:00AM	0.83	0.82	0.76	0.84	0.85	0.90	0.73	0.85	0.89	0.85
3:00 PM - 4:00 PM	0.80	0.86	0.83	0.90	0.85	0.84	0.81	0.76	0.81	0.85
4:00 PM - 5:00 PM	0.89	0.91	0.92	0.92	0.85	0.95	0.88	0.89	0.88	0.91
5:00 PM - 6:00 PM	0.84	0.89	0.91	0.90	0.89	0.92	0.88	0.91	0.86	0.86



**Figure 7: Directions at Jagadamba Junction**

- Direction -1 : Judge Court Road
- Direction -2 : Jagadamba Theater Road
- Direction -3 : Theater Opposite Road
- Direction -4 : Green Park Hotel Road



**Figure 8: Directions at Ramatalkies Junction**

- Direction – 1: Rama Talkies Road
- Direction – 2: Satyam Junction Road



**Figure 9: Directions at Dabagardens Junction**

- Direction - 1: Rk Family Store Road
- Direction - 2: Railway Station Road
- Direction - 3: Diamond Park Road
- Direction - 4: Lic Building Road
- Direction - 5: Jail Road

The spot speed values of the three junctions were presented in the Table 13.

### 3.3 Procedure for determining Level of Service:

#### 1. Determination of flow rate

$$vp = \frac{V}{PHF * N * fHV * fp}$$

Where:

$V_p$  = Demand flow rate under equivalent ideal conditions, pc/h/ln

PHF = Peak – hour factor

N= Number of lanes (in one direction) on the facility

fHV = adjustment factor for presence of heavy vehicles

FP = adjustment factor for presence of occasional or non-familiar users of a facility.

#### 2. Free flow speed:

The free-flow speed of a freeway can be estimated as:

$$FFS = BFFS - FLW - FLC - FN - FID$$

Where:

FFS = free-flow speed of the free way, mi/h

BFFS = base free-flow speed of the freeway, (70mi/h for urban and suburban freeways, 75mi/h for rural freeways)

FLW= Adjustment for lane width, mi/h

FLC = Adjustment for lateral clearance, mi/h

$F_N$  = Adjustment for number of lanes, mi/h

$F_{ID}$  = Adjustment for interchange density, mi/h

**TABLE 17: Adjustment to Free-Flow Speed for Lane Width**

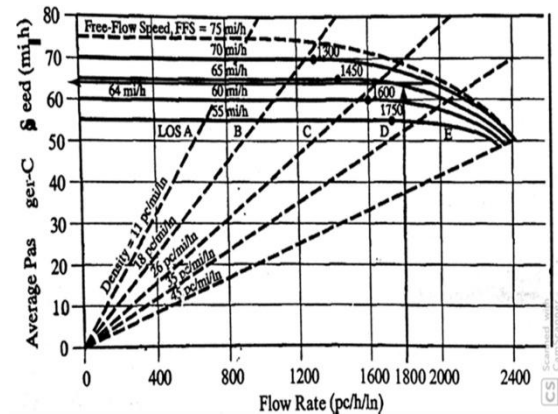
Lane width(ft)	Reduction in free flow speed, $F_{LW}$ (mi/h)
$\geq 12$	0.0
11	1.9
10	6.6

**Table 18: Adjustment to free flow for number of lanes**

Number of lanes (in one direction)	Reduction in free- flow speed, $f_N$ (mi/h)
$\geq 5$	0.0
4	1.5
3	3.0
2	4.5

**Table 19: Adjustment to free-flow speed for lateral clearance on a free way**

Right shoulder lateral clearance(ft)	Reduction in free-flow speed, $F_{LC}$ (mi/h)			
	Lanes in one direction			
	2	3	4	$\geq 5$
$\geq 6$	0.0	0.0	0.0	0.0
5	0.6	0.4	0.2	0.1
4	1.2	0.8	0.4	0.2
3	1.8	1.2	0.6	0.3
2	2.4	1.6	0.8	0.4
1	2.0	2.0	1.0	0.5
0	3.6	2.4	1.2	0.6



**Fig 10: Graph for determining the Level of service based on speed and flow rate**

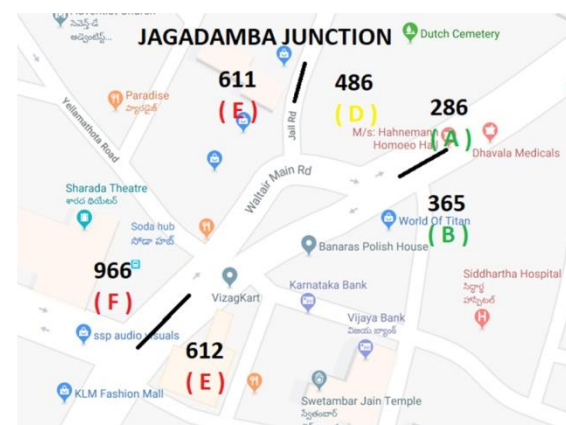
## 4. RESULTS AND DISCUSSIONS

The traffic volume survey has been carried out for each leg at three junctions i.e., Jagadamba junction, Dabagardens and Ramatalkies. The data was collected manually at one hour interval during peak and off-peak hours.

It is observed that there is an increase in the traffic volume at Jagadamba junction from to due to the increase in the users for shopping and hospital visits etc.

There is an increase in volume at Ramatalkies in particular period i.e., because of presence of bus shelter near junction which is majorly utilised by the educational institution people.

After determining the flow rate and spot speed, the level of service is determined for all the roads at all junctions.



**Fig 11 Level of service for Jagadamba Junction**

- (A) - Jagadamba to Green Park Road
- (B) - Green Park to Jagadamba Road
- (D) - Judge Court to Jagadamba Junction
- (E) - Jagadamba to Judge Court

(E) - Theatre Opposite Road

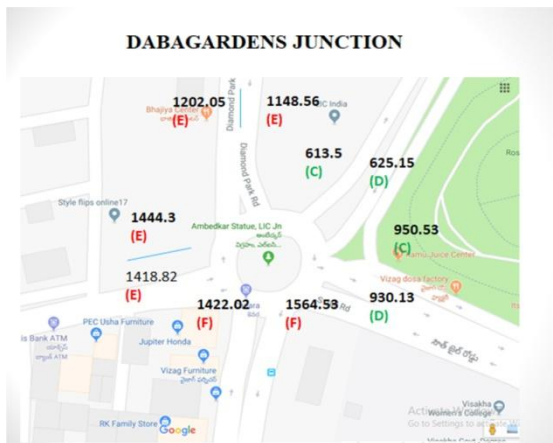
(F) - Theatre Road

At Jagadamba junction, the road from Jagadamba theatre to Green park achieved level of service A .The hourly peak value obtained is 611.

The roads from Jagadamba to Judge court and theatre opposite road got level of service E.

The level of service F was obtained for the roads in front of the theatre.

The hourly peak value for road from Judge Court to Jagadamba Junction got level of service as D.



**Fig 12 Level of service for Dabagardens Junction**

(C) - LIC Building Road

(C) - Central Park Back Side Road

(D) -Complex to RK Family Store Road

(D)– Jail Road

(F) - Rk Family Store Road

(F) \_ Rk Family Opposite Road

(E)– Complex to Station Road

(E)– Station to Complex Road

(E)– Rk Family Road to Diamond Park Road

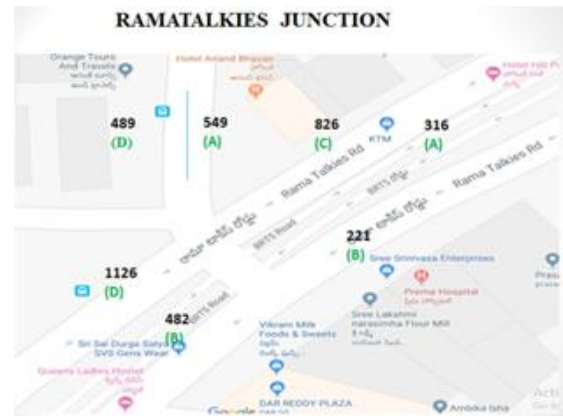
(E)– Diamond Park Road to Rk Family Road

The PCU values of the roads RK family store approach road and its opposite road are 1422, 1564 respectively.

The level of service observed for these roads are F. Traffic congestion is mainly due to shopping malls and Bus stop.

The major throwback at this road is its width.

The parking became more difficult part in this location.



**Fig 13 Level of service for Ramatalkies junction**

(A) – Satyam junction to Rama Talkies road

(C) – Complex to Maddilapalem road

(B)– Maddilapalem to complex road

(B)– Rama Talkies to complex road

(C)– Rama Talkies junction to Maddilapalem road

(D)– Complex to Rama Talkies junction

(D)– Rama Talkies to Satyam junction

The level of service for all roads is satisfactory.

The maximum hourly PCU at this junction is 1126 during 18<sup>th</sup> March of the Ramatalkies theatre road.

## 5. Conclusions

### Jagadamba Junction:

1. The reason for getting Level of Service as F for theatre road is because of the peak traffic due to theatre, shopping malls etc.
2. The lane width may be increased, so that the volume can be reduced.
3. It is suggested to restrict the three wheelers (autos) may reduce the traffic congestion when the theatre traffic is open.

### Dabagardens Junction:

1. The parking is the major problem at this junction especially in the route from Dabagardens to RK family store road.
2. To overcome parking problem, it is suggested to provide parking facility behind city central park and construct foot over bridge from central park backside to R.K. family store road.

### Ramatalkies Junction:

1. The bus shelter is near to the junction. It is the main reason for traffic congestion during peak hours.
2. Relocating this bus stop from existing location to a place after 100m of junction

may reduce the congestion due to the bus users, during peak hours

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