Junction Improvement by Implementing Traffic Signals And Road Widening At Thirumala, Thiruvananthapuram, Kerala

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***Abstract*: Industrial development in India induces huge increase in the number of vehicles .The development of any country depends upon the ability of its transporting system. Intersections are integral part of any road network. Intersections represent potentially dangerous locations from point view of traffic safety. This paper examines the traffic problems that occurs at road intersection at Thirumala, Kerala. The vehicular traffic count were taken by manual method and the existing features of the road intersections are determined. Absence of traffic signals, insufficient width of road and wrongful parking of vehicles leads to the congestion at the intersection. Sufficient safety measures such as proposal of road widening and implementing traffic signals are to be proposed for the junction improvement.**

Keywords: Thirumala, Intersection, congestion, vehicular traffic, traffic signal, junction improvement

I. INTRODUCTION

India is a fast developing country .Transporting system is a major factor for the development of any country. The speed of mobilization and intensity of traffic has been increasing day by day. For minimizing the economic loss due to fuel wastage and loss in valuable man hours, the functioning of the transporting network should be very efficient and flexible. When we consider our state the land area is very low and cost is very high. Intersections are major part of any regional road network from the efficiency of operations, safety, speed, cost of operation and capacity are directly governed by the intersections. At-grade intersections are the major cause of delay and hence result in valuable time and economical loss. The efficiency of an intersection is determined on the basis of how well an intersection accommodates the demands of all road users.

SITE SELECTION-THIRUMALA

Thirumala junction is a major junction comes under Thiruvananthapuram corporation in Thiruvananthapuram-Neyyar Dam road. Following datas were collected from the reconnaissance survey. Roads leading to Kattakada, Mangattukadavu and Pangode are originating from this junction. Establishments like Pangode Military Campus, Pareeksha Bhavan, Hospitals, Educational Institutions, Police station, Village office, Mosque, religious buildings, market, etc. are located near this junction. Hence the bottlenecked areas of different roads at the junction need to be improved. The junction causes substantial vehicular traffic throughout the day especially during peak hour. Also considerable pedestrian traffic is observed throughout the day. The bus-stops are located close to the junction and on street parking, auto stands and taxi stands close to the junction adding traffic congestion and hampering the smooth flow of traffic. Utility services such as electric poles and telephone poles are located within Right of Way(ROW) and close to carriage way. Land use on the either side comprises of commercial establishments, Educational Institutions, Banks, Hospitals, Market, residences, etc.This paper aims to estimate the need for improvement of Thirumala junction and to determine the traffic improvement schemes by optimal utilization of existing as well as upgradation facilities and also whether one of the junctions demands a fully fledged signal system.

DATA COLLECTED

Traffic volume study

Traffic volume is the number of vehicles crossing a section of a road per unit time at any selected period. Traffic volume studies were conducted on major routes such as Pangode-Thirumala,Kattakada-Thirumala and Mangattukadavu-Thirumala.

Passenger Car Unit(PCU)

Different classes of vehicles are found to use the common road way facilities. To estimate the traffic flow the different vehicle classes are converted to one common standard vehicle unit. It is a common practice to consider the passenger car as a standard vehicle unit to convert the other vehicle classes and the unit is called PCU.

Table 1: As per IRC:70-1977 Recommended PCU Factors for Various Types of Vehicles in Urban Road

Sl.No	Type of Vehicle	PCU Equivalent for Urban Roads
1	Heavy or medium goods vehicle	1.75
2	Light goods vehicle	1.00
3	Bus	2.25
4	Motor cycle, Moped or Scooter	0.33
5	Pedal cycle	0.2

Hourly Variation of Traffic

To establish the traffic flow characteristics such as hourly variation, composition and peak hour flow at junction's studies were conducted at Thirumala junction. Hourly traffic volume by vehicle type and direction was added separately determine the peak hour traffic at each intersection. The hourly variation of traffic is taken by manual methods and the data are collected for every directions.

Table 2 Kattakada to Mangattukadavu(Morning)

TIME	TOTAL PCU	TIME	TOTAL PCU
6 - 6.15 am	7.89	8.30-8.45am	32.8
6.15-6.30am	7.56	8.45-9am	29.89
6.30-6.45am	5.97	9-9.15am	28.9
6.45-7 am	10.08	9.15-9.30am	17.92
7 - 7.15am	16.95	9.30-9.45am	19.25
7.15-7.30am	23.14	9.45-10am	19.27
7.30-7.45am	22.14	10-10.15am	20.7
7.45-8am	30.12	10.15-10.30am	18.57
8-8.15am	32.47	10.30-10.45am	12.62
8.15-8.30am	32.71	10.45-11.00am	10.71

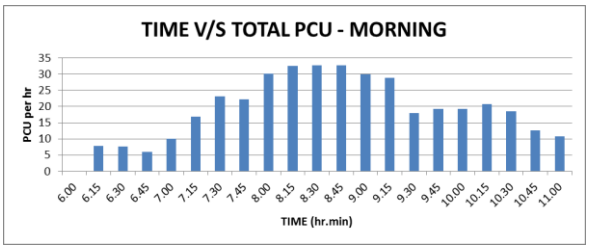

Fig.1 Hourly Variation (Morning)

Table 3 Kattakada to Mangattukadavu(Evening)

TIME	TOTAL PCU
4-4.15 pm	79.34
4.15-4.30pm	78.41
4.30-4.45pm	89.81
4.45-5pm	96.93
5-5.15pm	96.37
5.15-5.30pm	109.24
5.30-5.45pm	110.93
5.45-6pm	110.47
6-6.15pm	97.69
6.15-6.30pm	85.75
6.30-6.45pm	85.04
6.45-7pm	74.85

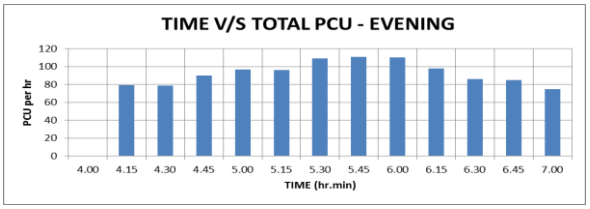

Fig 2.Hourly Variation (Evening)

Table 4 Mangattukadavu to Pangode(Morning)

TIME	TOTAL PCU	TIME	TOTAL PCU
6 - 6.15 am	20.15	8.30-8.45am	167.07
6.15-6.30am	32.84	8.45-9am	206.54
6.30-6.45am	25.24	9 - 9.15 am	242.92
6.45-7am	36.51	9.15-9.30am	268.16
7-7.15am	78.49	9.30-9.45am	246.96
7.15-7.30am	101.31	9.45-10am	256.53
7.30-7.45am	96.87	10-10.15am	238.23
7.45-8am	139.21	10.15-10.30am	206.67
8 - 8.15 am	150.69	10.30-10.45am	166.71
8.15-8.30am	162	10.45-11am	167.85

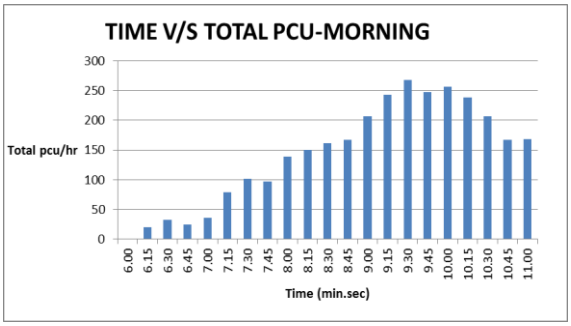

Fig.3 Hourly Variation (Morning)

Table 5 Mangattukadavu to pangode(Evening)

TIME	TOTAL PCU
4- 4.15pm	158.69
4.15-4.30pm	168.81
4.30-4.45pm	161.57
4.45-5 pm	157.32
5-5.15 pm	181.67
5.15-5.30pm	187.79
5.30-5.45pm	196.91
5.45-6 pm	200.51
6-6.15 pm	204.13
6.15-6.30pm	194.29
6.30-6.45pm	130.14
6.45-7 pm	98.91

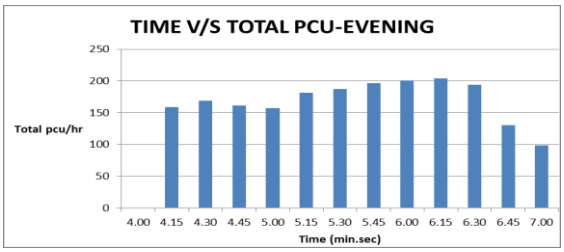

Fig.4 Hourly Variation (Evening)

Similarly routes such as: Kattakada to Pangode, Mangattukadavu to Kattakada, Pangode to Kattakada and Pangode to Mangattukadavu were also plotted.

Flow Diagram

Peak hour flow of each route was computed and flow diagram was drawn separately for morning and evening time.

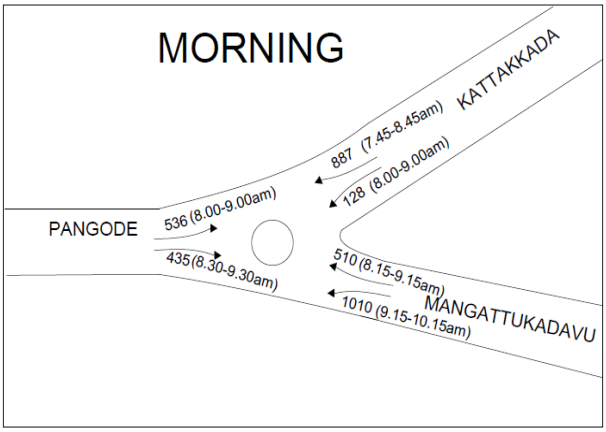

Fig 5 Peak hour flow at Thirumala Junction during morning time

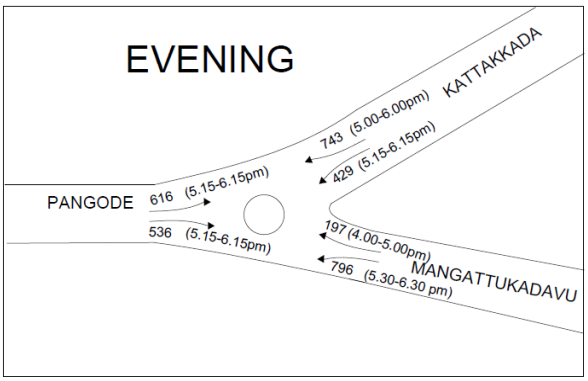

Fig 6 Peak hour flow at Thirumala Junction during evening time

SIGNAL DESIGN

The design is done as per Webster's method.

The Webster's formula for Optimum cycle time, Co = (1.5L+5)/(1-Y)

Y= y1+y2+y3+.....+yn

Yi= qi / si

L = ∑ (I-a) + ∑l

where, L= total lost time per cycle in seconds

Y= volume / saturation flow for critical approach in each phase

qi= flow

si= saturation flow

Three phase signal is to be designed as per Webster's method.

The three phases are following-

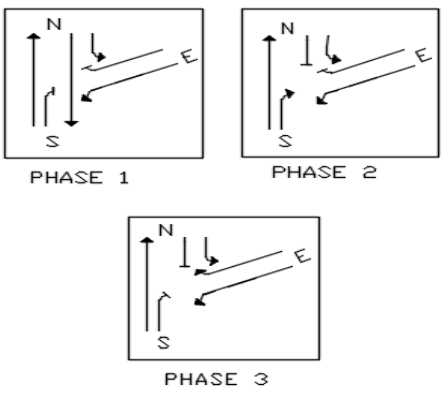

Fig 7 Phasing Diagram

1.Design of signals at morning time

Table 6 Computation of Y(Morning)

From	Kattakada		Pangode		Mangattukadavu	
To	Pangode	Mangattukadavu	Kattakada	Mangattukadavu	Kattakada	Pangode
Flow PCU/Hour	887	128	536	435	510	1010
Corrected Flow	887	160	536	762	510	1010
Width (w) in m	8	8	8	8	8	8
Saturation Flow	4200	4200	4200	4200	4200	4200
Phase 1	√	√	√	X	X	√
y1	0.25		0.13	–	–	0.24
Phase 2	X	√	√	√	X	√
y2	–	0.04	0.31		–	0.24
Phase 3	X	√	√	X	√	√
y3	–	0.04	0.13	–	0.36	

Y= 0.25+0.31+0.36=0.92

L=3[(4-2)+2]=12 sec

Optimum cycle time, Co=[(1.5x12)+5]
(1- 0.92)
=288 sec

But max Co = 120 sec

Effective green time ;-

a)Phase 1=y1(Co-L)=0.25(120-12)
Y 0.92
=30 sec

b)Phase 2=y2(Co-L)=0.31(120-12)
Y 0.92
=36 sec

c)Phase 3=y3(Co-L)=0.36(120-12)
Y 0.92
=42 sec

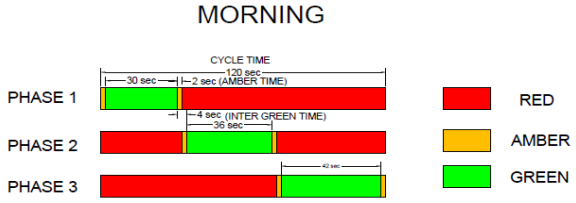

Fig 8 Timing Diagram (Morning)

2.Design of signals at evening time

Table 7 Computation of Y (Evening)

From	Kattakada		Pangode		Mangattukadavu	
To	Pangode	Mangattukadavu	Kattakada	Mangattukadavu	Kattakada	Pangode
Flow PCU/Hour	743	429	616	536	197	796
Corrected Flow	743	537	616	938	197	796
Width (w) in m	8	8	8	8	8	8
Saturation Flow	4200	4200	4200	4200	4200	4200
Phase 1	√	√	√	X	X	√
y1	0.3		0.15	–	–	0.19
Phase 2	X	√	√	√	X	√
y2	–	0.13	0.37		–	0.19
Phase 3	X	√	√	X	√	√
y3	–	0.13	0.15	–	0.23	

Y= 0.30+0.37+0.23=0.90

L=3[(4-2)+2]=12 sec

Optimum cycle time, Co=[(1.5x12)+5]
(1- 0.90)
=230 sec

But max Co = 120 sec

Effective green time ;-

a) Phase 1=y1(Co-L)=0.30(120-12)
Y 0.90
=36 sec

b) Phase 2=y2(Co-L)=0.37(120-12)
Y 0.90
=44 sec

c) Phase 3=y3(Co-L)=0.23(120-12)
Y 0.90
=28 sec

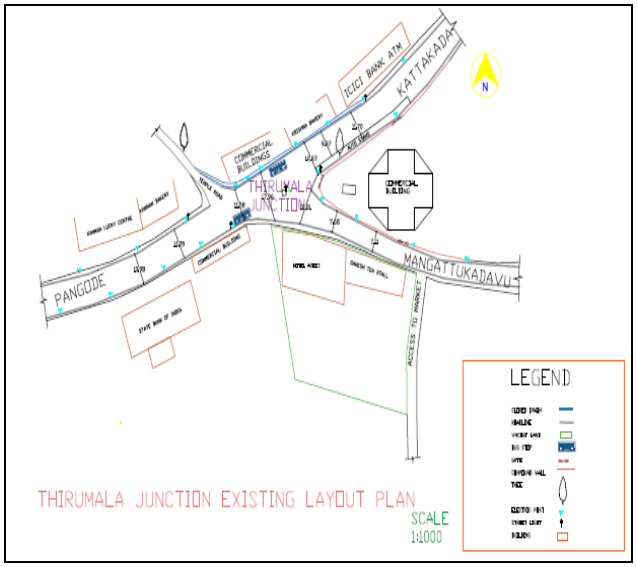

Fig 10 Existing Features of Thirumala Junction

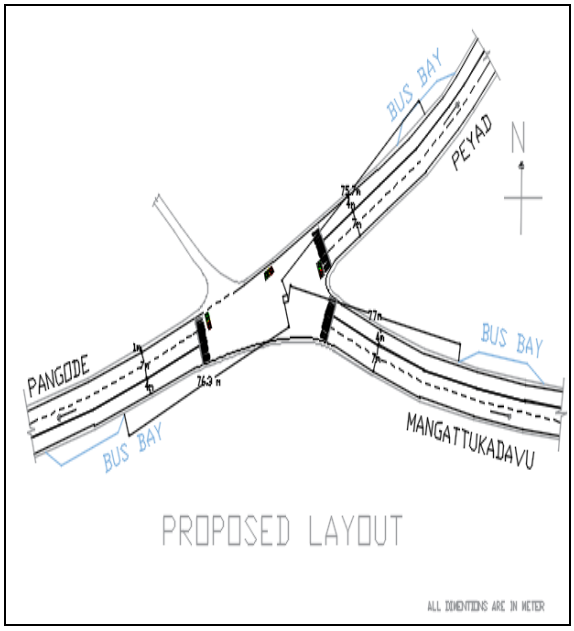

Fig 11 Proposed Layout of Thirumala Junction

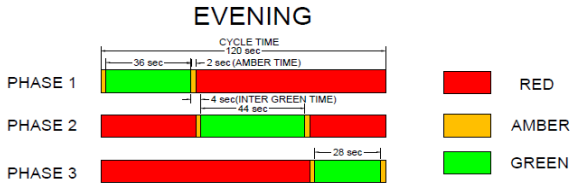

Fig 9 Timing Diagram(Evening)

Total Station Survey

Existing features of the junction was taken by total station survey. AutoCAD drawing was also made.

CONCLUSIONS

This paper examines about the congestion and delay problems that occurs at Thirumala. From the study conducted the following conclusions are deduced:

- Design of three phase traffic signal is done so that traffic conflicts can be eliminated.
- Proposal of road widening significantly reduces traffic congestion and delay.
- Shifting of bus bays from the junction minimizes the interruptions that may occur.
- Conflict points can be reduced to a greater extent.

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