Design of Traffic Signals from 7*24 Manual Volume Data

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Abstract: **At this point in time, the population of the whole world is consistently growing at an alarming rate. The rise in the number of accidents has led to an increase in the number of vehicles on the road, which has led to an increase in the amount of time spent waiting for traffic and a decrease in the level of safety. In light of this, it is imperative that we conduct an investigation into the existing traffic analysis and strictly adhere to the safety guidelines in order to mitigate the effects of these problems. The purpose of this research is to analyse and calculate the traffic volume and level of service for each lane of an LR-type staggered crossroads at Pamur Bus Station in Kanigiri, which is located in the Prakasam district for the purpose of this study. The data on the traffic have been gathered manually in order to guarantee accuracy and a smaller overall amount of errors. This process has been carried out over the course of about seven days for each configuration consisting of four lanes and eight directions. The results of this study project include the amount of time that each lane and each direction is green, the primary design of the signals, and the traffic metrics that continue to be considered. Additionally, the study of safety criteria such as space, number of automobiles, trip time, and delays to rapidly move vehicles on the road at junctions was followed by IRC: 93-1985. This was done in order to ensure that vehicles could move quickly on the road. The model that has the best possible cycle time, green time for each lane and each direction, lane capacity, pedestrian crossing time, and delay time may be considered the best model.**

Keywords: Traffic volume, LR-Type staggered intersection, Level of services, Manual method, passenger car units (PCU).

INTRODUCTION

Road safety matters in developing countries. Indian accidents have grown owing to automobile proliferation and poor road infrastructure. Poor road geometry, heterogeneous traffic, and inadequate traffic control cause high accident rates. Analysing accident causes, variables, and conditions is necessary to build a safe roadway network. Innovative design and control strategies may overcome system weaknesses. To find highway accident hotspots, evaluate accident data. To find remedies, accident-prone locations must be extensively explored. International corporations have increased car sales, but roads remain poor. For social, political, etc. In our country, 235 people die and 1243 are injured in vehicle accidents daily. Even though night traffic is 15% of 24 hours volume—8 times greater than day traffic in India—nearly 60% of accidents occur at night. According to national accident data, drivers cause most accidents because they fail to perceive the situation owing to poor reflexes, weariness, inexperience, or toxicants. Other factors cause traffic accidents. To accurately capture local traffic, traffic surveys attempt. Traffic surveys count vehicles and measure traffic volume. People wrote their opinions on paper pads beside roadsides. In recent years, video cameras and office traffic analysis have replaced this strategy. Traffic surveys help transportation engineers plan and build infrastructure, diagnose issues, assess new ideas, etc.

Study road traffic volume and car categorisation at specified periods. Daily or hourly volume might vary greatly. Traffic volume surveys measure, classify, and move cars at a place. Before the traffic survey, we must know key phrases: PCU (Passenger Car Unit) measures highway volume. IRC-set DSV is for single- or double-lane roadways. Initial traffic volume studies may aim for design: Pavements, bridges, and roadway amenities are designed structurally and geometrically. Minimum intersection turning route, channelisation, flaring,

and traffic control devices. Pavements, intersections, etc. are designed using pedestrian volume studies. Dynamic traffic management: Current flow/congestion data is needed to improve traffic signal design, junction efficiency, and network productivity by alerting road users. Other aims Highway usage projection and facility demand assessment. Traffic volume analysis covers design, planning, improvement, dynamic traffic management, highway utilisation prediction, accident rate calculation, and traffic stream. This survey will largely count cars travelling through a span, but we must first identify them. Examine UK Standard Vehicle Classification Schemes. Classes that track hicleves' movements are below. Vehicles under 16 seats: Cars, taxis, 'people carriers', minibuses, RVs, and camper vans. Three-wheeled cars, Land Rovers, Range Rovers, Jeeps, and windowed ambulances are seen. Cars with caravans or trailers are 'Car'. All car-type delivery and transit vans with the next larger carrying capacity are LGVs. Includes milk floats, small vehicles, and windowless ambulances. Delivery vans and middle-sized vehicles with single rear wheels dominate this group. Counts LGVs with caravans or trailers as 'LGV' This category excludes vehicles with side guards between axles or four rear wheels. Ambulances with double rear wheels, tractors (without trailers), road rollers for tarmac pressing, box vans, comparable big vans, and middle-sized trucks with double rear wheels are OGV 1 (Ordinary Goods Vehicle 1).

All articulated and rigid vehicles with four or more axles are OGV2. This class contains OGV1 freighters with caravans or trailers. Public service vehicles and works buses exceeding 16 seats and 3.5 tonnes or more are PSVs. The name "MC" covers all motorcycles, including sidecars. PC: All pedal cycles, including passenger ones. Common Confusing Factors:

PSV minibus or car A minibus under 16 seats is a car. Small buses with 16 or more seats called PSVs. Use the Car class when unsure about the category. LGV or OGV1 class van/middle-sized vehicle with single or double rear wheels LGVs are vans/middle-sized vehicles with one rear wheel, whereas OGV1s have two. It might be hard to see whether the back has numerous wheels. Twin wheels are common on large vehicles. If the vehicle is unreadable, classify it as OGV1. Ambulances are automobiles, LGVs, or OGV1. Ambulances are cars with windows. Windowless LGVs resemble tiny vans. With double rear wheels, OGV1s resemble box-vans/middle-sized trucks. Ishant Sharma et al. (2015) suggested an autonomous traffic signal at Madhya Marg, Chandigarh, using Webster's and I.R.C signal design methods to build pre-timed lights. Webster's technique optimises cycle duration, whereas the I.R.C method minimises green time by checking pedestrians' approach lane crossing times. The count was obtained via sluggish laptop video playback. In this research, he contrasted pre-timed signals with automated signals, which were more efficient since they saved time and increased capacity. Rubiyah Yusuf et al. (1996) used electromagnetic sensors to count cars and fuzzy logic technology to give traffic green time to clear the intersection. Traffic management was quite successful using this strategy.

Sachin Jat et al. (2015) built a Vidisha, Madhya Pradesh traffic light. Traffic volumes for passenger, commercial, and agricultural vehicles were manually gathered without devices or sensors. The I.R.C approach of traffic signal design uses maximum P.C.U on each junction direction. Saleem Akhter et al. (2015) examined whether to offer traffic signals or rotaries. Classified traffic volume data was gathered for 12 minutes. The categorised volume became a Passenger Car unit. Rotary's traffic capacity is 3017 PCU/hr, which is larger than 3000 PCU/hr (highest traffic volume a rotary can handle). Thus, a 140-second traffic signal system should be installed at the crossing. Shamsul Haque studied Bangladesh's Dhaka-Sylhet highway traffic patterns in 2013. They measured weekly and monthly traffic flow, increase, and heavy vehicle proportion. Their paper found that in Dhaka-Sylhet highway, the highest average percentage of Bus/Truck/Covered Truck 2 axle from 2007 to 2009 is 42.46%, the daily directional distribution is 47% to 53%, and the average annual traffic growth rate is 23.79%. In 2015, Ahad Ullah studied traffic increase variables on three major Bangladeshi roadways. They discovered 23.79% traffic rise on Dhaka-Sylhet motorway. The main objectives of the study are: To conduct traffic volume assessments at certain junctions of the Pamur-Kanigiri-Podili-Garlapeta routes. Maximum flow density per lane, maximum vehicle flow per lane, peak periods, time headway, and the number of vehicles transformed into passenger car units (PCU). The examination of

safety criteria including spatial dimensions, vehicle quantity, journey duration, and delays affecting the fluidity of vehicle movement at road crossings. This analysis adhered to IRC: 93-1985. To assess the capacity and quality of service of the roadway. To develop models for signal design, including optimum cycle time, green time, lane capacity, pedestrian crossing time, and delay time.

LR-TYPE STAGGERED INTERSECTION

Staggered intersections are unique to road networks. Staggered intersections are two T-legged intersections with a distance between them and can be divided into two types, the left–right (LR) type and the right–left (RL) type, based on the order in which the driver encounters the branches when driving down the main road. It's improper for the LR type because small road left-turns conflict, unlike the RL type. Road Traffic Signal Setting and Installation Specification (GB14886-2006).

TRAFFIC SIGNAL DESIGN

The conflicts arising from movements of traffic in different directions is solved by time sharing of the principle. The advantages of traffic signal include an orderly movement of traffic, an increased capacity of the intersection and requires only simple geometric design. However, the disadvantages of the signalized intersection are it affects larger stopped delays, and the design requires complex considerations. Although the overall delay may be lesser than a rotary for a high volume, a user is more concerned about the stopped delay.

LOCATION

Study Location

Traffic study done at a small intersection of Traffic at Pamur-Kanigiri-Podili-Garlapeta roads Date: 02/01/2025 to 09/01/2025.Counting Period: 7 days (Every hour) Weather Condition: It was initially a sunny day but afterwards it became cloudy, Survey Location: Pamur-Kanigiri-Podili-Garlapeta, Observation: Classified Vehicle Count, Method: Manual Method, Duration: Every hour thought out day same as 1 total week, Equipment's: Data Sheet, Stop Watch.

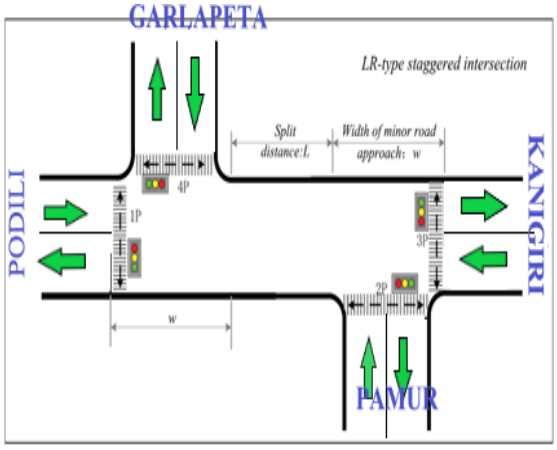

Figure 2.1 Geometrical view of the junction [1]

STUDY DATA

We have adapted Manual Method. In this method, data is collected using a Data Sheet. Data recorded on data sheets; data can be recorded with tick mark on a pre-prepared field form. A stopwatch is necessary to measures desired count interval. The data taken as recorded format designed by own process according to LR-Type staggered intersection at Pamur Bus station, Kanigiri From fig 2.1, 4-Roads, 8 Directions (In and out), data observed 7 days at each and every hour with continually the division as follows

I. PODILI-KAN (IN)
II. KAN-PODILI (OUT)
III. KAN-GARLAPETA(OUT)
IV. GARLAPETA-KAN(IN)
V. CIRCLE-KAN(OUT)
VI. KAN-CIRCLE (IN)
VII. PAMUR-KAN(OUT)
VIII. KAN-PAMUR (IN)

RESULTS AND DISCUSSION

Perform traffic volume tests at Pamur-Kanigiri-Podili-Garlapeta road junctions. The maximum flow density, vehicle flow, peak hours, time headway, and number of vehicles have been translated into passenger car units. The examination of safety needs such space, number of cars, journey duration, and delay to easy-moving vehicles at junctions. This analysis followed IRC: 93-1985. To assess road capacity and service.

MAXIMUM FLOW DESITY

The data from traffic volume on selected junction of Pamur-Kanigiri-Podili-Garlapeta roads, among all

the lanes and directions explained fig 4.1, and table 4.1. From these table and figure maximum traffic flow / density/ volume and explained PCU per lane with all directions.

- The maximum flow of vehicles observed during Weekday is 9052 Vehicles/day.
- The Peak Time of Traffic Flow during Weekday is 7/01/2025-08/01/2025 in the direction of KAN-PODILI ROAD.
- The maximum flow of vehicles observed during Weekend is 377 Vehicles/ Hr.
- The Peak Time of Traffic Flow during Weekend is 8.00 AM - 9.00 AM

Table 4.1 Maximum Volume Density (Pcu) Per Lane and Direction with time

Date	MAXIMUM VOLUME DENSITY (PCU) per lane and direction							
	I	II	III	IV	V	VI	VII	VIII
02/01/2025-03/01/2025	5568	5663	3068	2895	6877	6836.5	5945	4815
03/01/2025-04/01/2025	6425	6786	4073	4170	7643	7559	7299	5909
04/01/2025-05/01/2025	6470	6564	5033	5576	6844	6983	6724	5533
05/01/2025-06/01/2025	5288	5268	4512	4703	5954	5726	7385	5741
06/01/2025-07/01/2025	7939	7931	4309	4590	6313	7236	6977	5740
07/01/2025-08/01/2025	5331	9052	5253	5385	6441	6705	6592	7136
08/01/2025-09/01/2025	7389	7899	4492	5514	6114	6281	7272	5872

- The maximum flow of vehicles (Truck, Bus, Ag tractor with trailer) observed during Weekday is 1121 Vehicles/day.
- The maximum flow of vehicles (Passenger car, Tempo, Auto-ricksaw, Jeep,Van,Ag tractor) observed during Weekday is 3375 Vehicles/day.
- The maximum flow of vehicles (Motor-bike, Scooter and Cycle) observed during Weekday is 4304 Vehicles/day.
- The maximum flow of vehicles (Ricshaw) observed during Weekday is 140 Vehicles/day.

Table 4.2 Level of services

Directions	Total (PCU / Hr.)	DSV (per lane)	LOS	Grade
I	264.3	900	0.29	A
II	292.6	900	0.33	A
III	183.0	900	0.20	A
IV	195.4	900	0.22	A
V	274.9	900	0.31	A
VI	281.7	900	0.31	A
VII	286.9	900	0.32	A
VIII	242.5	900	0.27	A

Directions	Traffic Volumes (PCU / Hr.) Yi	Saturation Volume Si (4m width)	Actual flow Y =(Yi/Si)	Co - optimum cycle time (sec)
I	264.3	1950	0.14	
II	292.6	1950		
III	183.0	1950		
IV	195.4	1950	0.1	

V	274.9	1950		86.62 (Assume 90)
VI	281.7	1950	0.144	
VII	286.9	1950		
VIII	242.5	1950	0.146	

- maximum Level of services observed during Weekday is 0.33, with grade A, in the direction of II.
- The Level of services of remains directions observed during Weekday, with grade A.

Co=(1.5L+5)/(1-Y)

L=Lost time (2N+R) =24 sec(2*4+16)

Y=Traffic volume/Saturation Volume

Effective green time

Effective green time is the actual time available for the vehicles to cross the intersection. It is the sum of actual green time (G_i) plus the yellow minus the applicable lost times. Thus effective green time can be written as,

$$g_i = G_i + Y_i - L_i \quad (4)$$

Table 4.3 Optimum Cycle time

Directions	Traffic Volumes (PCU / Hr.) Yi	Green time	Optimum Green time
I	264.3	17	22
IV	195.4	13	20
VI	281.7	18	24
VIII	242.5	18	24

Lane capacity

The ratio of effective green time to the cycle length $\left(\frac{g_i}{C}\right)$ is defined as green ratio. We know that saturation flow rate is the number of vehicles that can be moved in one lane in one hour assuming the signal to be green always. Then the capacity of a lane can be computed as, where c_i is the capacity of lane in vehicle per hour, s_i is the saturation flow rate in vehicle per hour per lane, C is the cycle time in seconds.

- lane capacity -369veh/hr
- pedestrian crossing-6sec

CONCLUSIONS

The numbers of bikes travelling are more when compared to autos and cars. The number of autos and cars are more when compared to buses so, if numbers of buses are increased, then the dependency on Public transports increase. This will make decrease in number of personal vehicles. Hence the congestion gets reduced and free Flow of Traffic will be possible. It adds to comfortless of a road user. We are settled on a suggestion that if the No. of buses could be increased then the traffic system would become efficient. So huge modification is recommended in the public transportation.

1. Co - optimum cycle time is 87 sec and assumed to 90sec
2. Green time for Direction-I is 17sec, IV is 20sec, VI is 24sec, VIII is 24.
3. lane capacity -369veh/hr
4. pedestrian crossing-6sec

SCOPE OF FUTURE WORK

The present study is focused mainly on traffic volume only. Speed-flow studies are useful to evaluate the more parameters. There is a scope on speed flow studies on urban road links for future work.

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