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EVALUATION ON TRAFFIC CHARACTERISTICS AND ITS MANAGEMENT ON NH83 (DINDIGUL)

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Abstract: Traffic surveys play a keyrole in ensuring the traffic characteristics and providing controlled and safe movement of vehicles. This study was aimed at analysing the traffic characteristics and to suggest the traffic control measures on PazhaniBy-pass, Dindigul. The location has three major highway intersections, namely, NH 183 (Chennai to Theni), NH 83 (Pazhani Road), and NH 44 (Dindigul By-Pass Flyover). Traffic census was carried out on the selected location, which includes traffic volume study, spot speed survey, traffic capacity study, origin and destination study and Parking study. From the traffic census reports, the reason for heavy traffic flow during peak hours was evaluatedand it has been suggested to control the traffic flow and regulate safe movement by providing signals and rotary-intersections.

Keywords: Traffic surveys, traffic volume, signals, Rotary intersection.

1. Introduction

For any improvement of traffic facilities, study on traffic characteristics is the most vital prerequisite. The traffic characteristics are quite complex with various types of road users in the roads. Apart from road users, the traffic census study on the actual traffic includes speed study, traffic volume study, spot speed, traffic capacity study and accident and parking study(Abrar Ul Haqbhat, Dr. Rakesh Gupta, 2018).All these traffic census studies help in deciding the geometric design and thereby ensures for efficient and safe traffic flow. The NH83 is a primary National Highway in India, which runs in an East-West direction, entirely within the state of Tamilnadu with three highway crossings namely,NH 183 (Chennai to Theni), NH 83 (Pazhani Road), and NH 44 (Dindigul By-Pass Flyover). The major scope of the study involves checking the existing operating service condition of the roadway section, to regulate the traffic flow during peak hours, to design rotary intersection, provision of signals with timings and channelization(Arash Moradkhani Roshandeh, Mahmood Mahmoodi Nesheli, and Othman Che Puan 2009). Fig. 1 shows the map view of the selected location on NH83 which depicts the roads connecting over there.

2. Methodology

The evaluation of traffic characteristics and its management on NH83 was carried out for the purpose of controlling the traffic flow and the reason for traffic issues are,

a) Heavy traffic flow during peak hours,
b) Improper parking of vehicles,
c) Improper road sidewalk,
d) Non-provision of traffic signals,
e) Improper pedestrians crossing,
f) Non-provision of traffic signs.

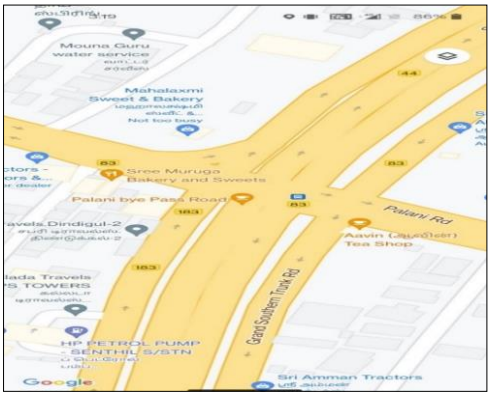

Fig. 1. Map View of NH83

Traffic characteristics on NH83 were evaluated by carrying out the traffic surveys to measure the traffic volumes, to reduce the number of accidents, to reduce the delays in road journey and to increase the traffic carrying capacity of roads and and suggest effective measures to ensure smooth and easy flow of the traffic intersection (Andrey Gorev et. al., 2018). The methodology adopted is shown in Fig.2 which includes:

a) Traffic Volume Study,
b) Spot Speed Study,
c) Traffic Capacity study,
d) Accident Study,
e) Origin and Destination Study and
f) Parking Study

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3. Traffic Census - Data Collection and Analysis

Traffic surveys conducted in the selected location involves Traffic Volume study, Origin and destination study, parking study, Traffic capacity study, etc (Abrar UI Haqbhat, Dr. Rakesh Gupta, 2018).The traffic flow on NH83 (near Pazhani By-Pass) during peak hour is shown in Fig.3.

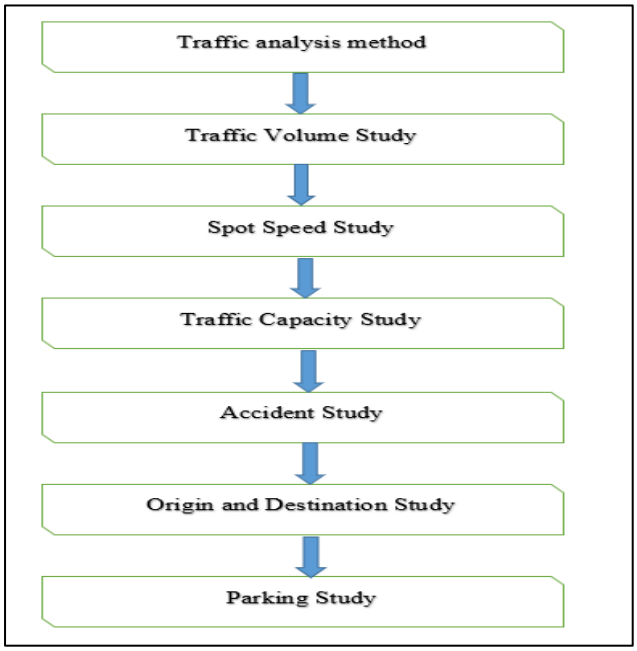


Fig. 2 Traffic Analysis

3.1. Traffic Volume Study

Traffic volume study can be done by counting the traffic volume by Manual count method and Automatic count method(Prudhviraj, M. and Akshith, V, 2019).In the present study, manual count method was used in which the enumerator was used to record the number of vehicles passing in all four directions.

Fig.3. Peak Hour Traffic Flow on Pazhani By-Pass

The data has been collected after carefully studying the location area.The hourly patterns in NH83 were observed which generally show a number of distinguishable peaks. Peak hour flow was taken thein morning (7.30am to 9.30am), followed by a lean flow until another peak in the mid-noon (2.00pm to 3.00pm), then followed by a very high peak in the evening (4.00pm to 6.00pm). This survey was conducted for about 3 days to analyse the traffic volume and the collected vehicle count was multiplied with Passenger Car units (IRC: 9 , 1972.Raj pratapsingh, HimanshuTekwani 2018).The Passenger Car Units (PCU)based on the type of vehicle is listed in Table 1 (Khanorkar, A.R. and Ghodmare, S.D., 2014).

Table 1. PCU values for vehicles

Vehicle Type	PCU Values
Car, Van	1.0
Motorcycle	0.5
Bicycle	0.2
Light commercial vehicle	2.2
Bus, Truck	3.5
Three wheeler	0.8

The table 2: shows the study of traffic volume count of the vehicles moving in all four directions on a peak hour of a day.

Table 2. Traffic Volume count on a Day

Direction	Car	Auto	Bus	Truck	Bike	Cycle
E - W	1326	174	246	92		47
N - S	595	65	78	99	719	27
W - E	1200	79	86	89	2488	35
S - N	829	77	112	112	1349	15
PCU Values	**988**	**103**	**456**	**340**	**4177**	**6**

Fig. 4. depicts the traffic volume in terms of Passenger Car Units on a day taken during the peak hours. From the Fig. 4, it is observed that the four wheelers movement is high during the peak hours and bicycle are the least moving vehicles.

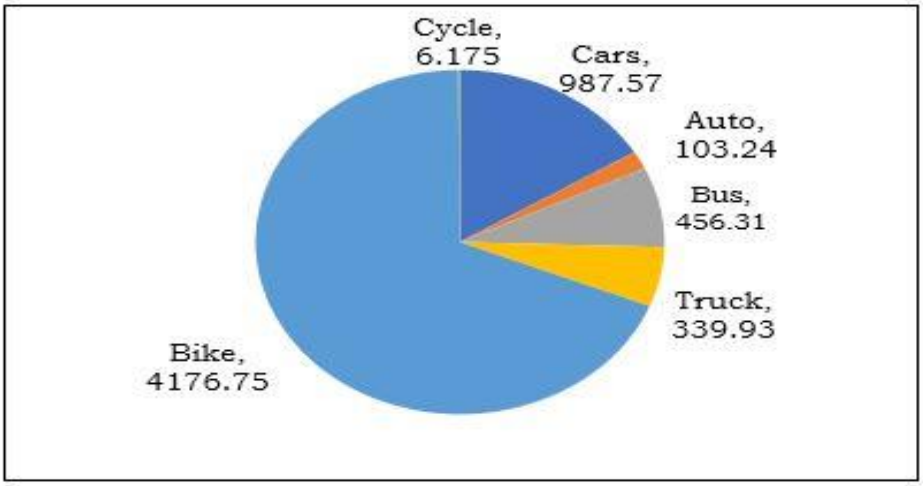
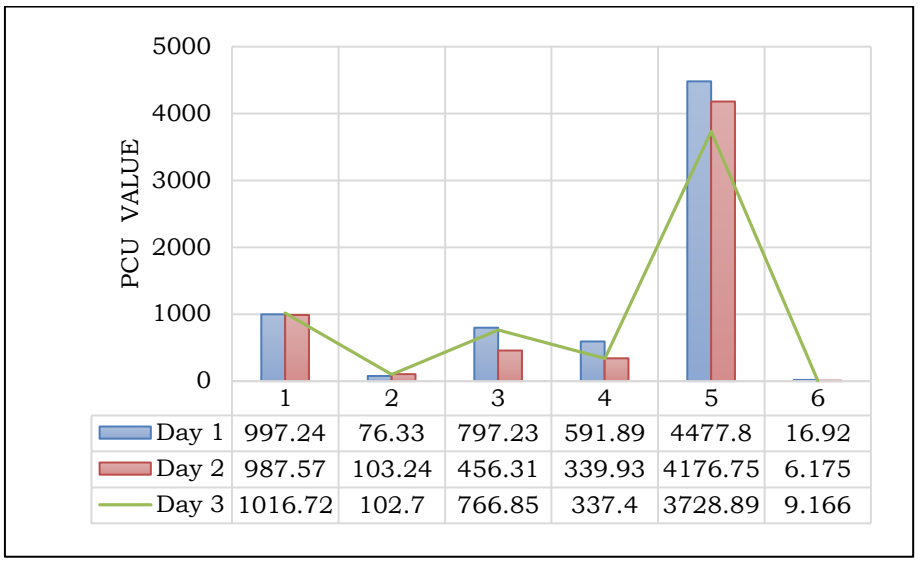


Fig.4. Traffic Volume in PCU in a day

The traffic volume survey was conducted for 3 days during the peak hours and the average daily traffic for each type of vehicle based on PCU is shown on Fig.5.



	1	2	3	4	5	6
Day 1	997.24	76.33	797.23	591.89	4477.8	16.92
Day 2	987.57	103.24	456.31	339.93	4176.75	6.175
Day 3	1016.72	102.7	766.85	337.4	3728.89	9.166

Fig.5. Average traffic Volume for 3 days

3.2. Spot Speed Survey

Spot speed studies are used to analyse the speed distribution of a traffic stream at a specific location. Speed related decisions are made based on the data gathered in spot speed studies (Sara Respatia, Ashish Bhaskarb, Edward Chungc 2018). Stop Watch method is adopted to carry out the spot speed study for about 176 feet for an average of 200 vehicles. Based on the time noted and distance, speed of vehicles is calculated using the formula given in equation (1).

$$V = D/1.47T \quad \text{.....(1)}$$

Where,

V - Speed

D - Length (feet)

T - Elapsed time (seconds)

1.47 is a constant that converts unit of feet per second into mile per second.

Based on the vehicle speed calculated above, Space Mean Speed which is the average speed of the vehicle in a certain length at any time.

Space mean speed is calculated using the formula (2),

$$X_s = \frac{3.6NL_j}{\sum_{j=1} t_j} \quad \text{.....(2)}$$

Where,

L_j= length of road (m)

N = number of vehicle

t_j = observed travel time (sec)

$$X_s = \frac{3.6\ x\ 200\ x\ 54}{[(2.8x1)+(3.0x1)+(3.2x6)+.....+(5.2x10)+(5.4x22)]}$$

Xs = 38880/713 = 54.53 kmph

The Space (or) average mean speed was found to be 54.53 kmph for 200 vehicles. Hence it is preferable to keep traffic sign boards representing the passengers to move on speed between 40kmph and 50kmph.

3.3. Traffic Capacity Study

Traffic capacity defines the maximum of vehicles in a lane or a road that can pass a given point in unit time, usually an hour (Sushmita, K.S. , Shashi kumar, V.N., 2021).

The traffic capacity can be determined using (3),

$$C = 1000V / (S+L) \quad \text{……..(3)}$$

Where,

V = Design speed (in km/h), V = 54.53 km/hr

S = Stopping distance (in m) = $0.278Vt + 0.01V^2$

L = Average length of vehicle

For an assumed vehicle length of 5m,

C = 1000V / (S+L)

= 1000 x 54.53 / (59.20+5)

Therefore, C = 884 vehicles per hour.

3.4. Accident Study

Accident analysis may be performed by range of experts, including forensic scientists, forensic engineers or health and safety advisors. The accident data in NH83 is collected and the major accident zone is found to be near Ramayanpatty on NH83.

3.5. Origin and Destination Study

Origin and Destination Study helps in determining the adequacy of existing routes and helps in planning new network of roads. For carrying out this study, roadside interview method was adopted at a predetermined location in which the interview was done with a standard questionnaire (Abhishek Chaudhary, Amit Kumar, Sajid, 2020). The questionnaire includes the place and time of origin and destination, type of vehicle, number of passengers in the vehicle, regular road user (current location) and purpose of the trip. A sample data sheet is shown in Table 3 and a roadside interview with driving personalities are shown in Fig.6.

Fig.6. Road Side interview on Pazhani By-Pass

Table 3. Sample Datasheet of Roadside interview

SI.NO	1	2	3	4	5	6	7	8	9	10
Native	TN 57 Dindigul	KL 36 Kerala	TN 94 Vagarai	TN 39 Tirupur	TN 54 Selam	TN 38 Kovai	TN 67 Virudhunagar	KL 36 Kerala	TN 64 Madurai	TN 57 Dindigul
Type of vehicle	Bus	Lorry	School bus	Car	Bus	Bike	Bus	Tourist bus	Bus	Bike
Trip start point	ODC	Kochin	Vagarai	Tirupur	Selam	Singanalur	Virudhunagar	Kochin	Madurai	Dindigul
Trip end point	Dindigul	Dindigul	Dindigul	Madurai	Madurai	Dindigul	Dindigul	Pazhani	Kovai	Ottanchathiram
Purpose of trip	Passenger	Pestisides	Repair work	Festival	Passenger	Home	Passenger	Tour	Passenger	Work
Type of place at trip end	Dindigul	Kochin	Vagarai	Tirupur	Selam	Kovai	Virudhunagar	Kochin	Madurai	Dindigul
No. of people in vehicle	55	03	01	06	49	02	51	55	41	02
regularly use this route(Yes/No)	Yes	No	No	No	Yes	Yes	Yes	No	Yes	Yes
Transportation you may have	-	-	-	-	-	Car	-	-	-	Car

Based on the questionnaire, the Origin and Destination flow map is drawn to find the route of maximum traffic flow and the origin and destination flow map is shown in Fig. 7 and it is clear that the maximum traffic flow is along Palani, Oddanchatram, Kovai and Madurai.

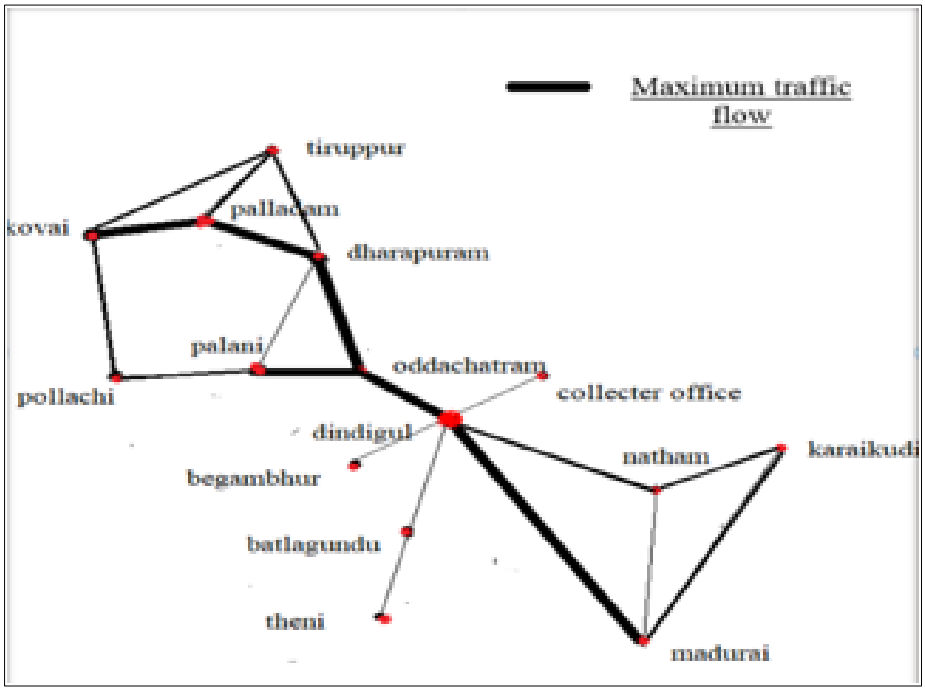


Fig. 7. Origin and Destination Flow map on NH83

3.6. Parking Study

Parking studies are conducted to arrive decisions about land use, transportation infrastructure, and parking management. This data was collected with intervals of 500 meters from Vani-villas to Ramayanpatty on Pazhani by-pass route. The table 4 shows the parking survey data and from the table 4, it is clear that most of the vehicles are parked out of the parking lot (Alex Karner , 2022).

4. Design of Rotary Intersection

Segment No. : 1 **Name of Enumerators: 4**

NO.	Name of the road	Approx. Length in 'm'	Approx. Width in 'm'	Starting point (road name)	Ending point (road name)	Number of legal on street parking lot			Number of illegal on street parking lot			Loading/ unloading trucks	Waiting Minibus
						Left	Right	Total	Left	Right	Total		
1.	NH83	500 m	21 m	Bypass	Vani villas	51	29	80	35	17	52	03	12
2.	NH83	500 m	21 m	Bypass	Sakthi talkies	53	29	82	19	15	34	12	20
3.	NH83	500 m	21 m	Dindigul	North paraipatti	92	46	138	15	16	31	00	15
4.	NH83	500 m	10 m	Bypass	Ganaeshwaram	31	19	50	12	9	21	05	11
5.	NH83	500 m	10 m	Bypass	Ramayan patti	26	17	43	7	12	19	02	08

Based on the traffic surveys conducted on NH83, it is necessary to provide signal and rotary intersection to tackle the traffic flow problems during peak hours. It has been decided to recommended circular rotary intersection because in most of the cases circular roundabouts are provided(Kadiyali, L.R., 2013). From the design, rotary intersection of diameter of about 4m was recommended. Fig.8. shows the 2D view on NH83 with rotary intersection.

Fig. 9 shows the provision of Rotary and Signal on Pazhani By-Pass below the fly-over.

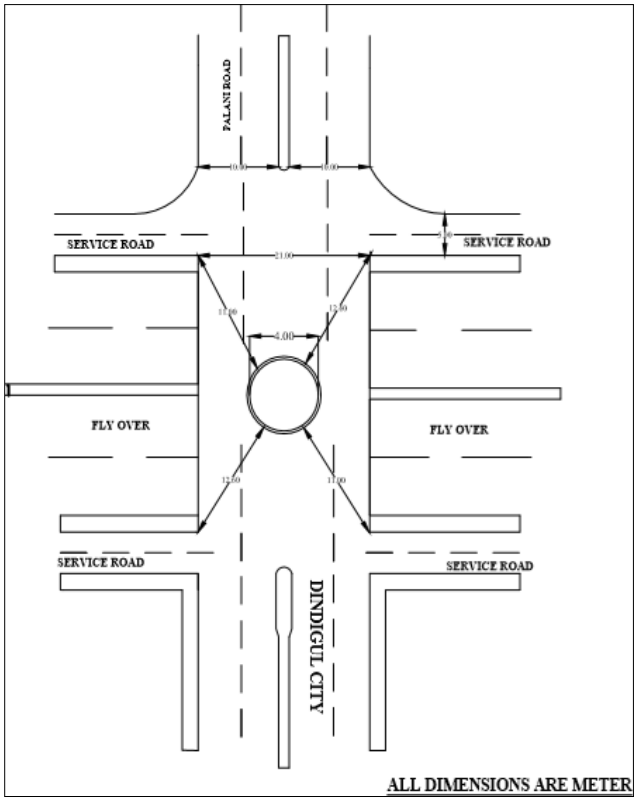


Fig. 8.2D View of Rotary intersection on Pazhani By-Pass

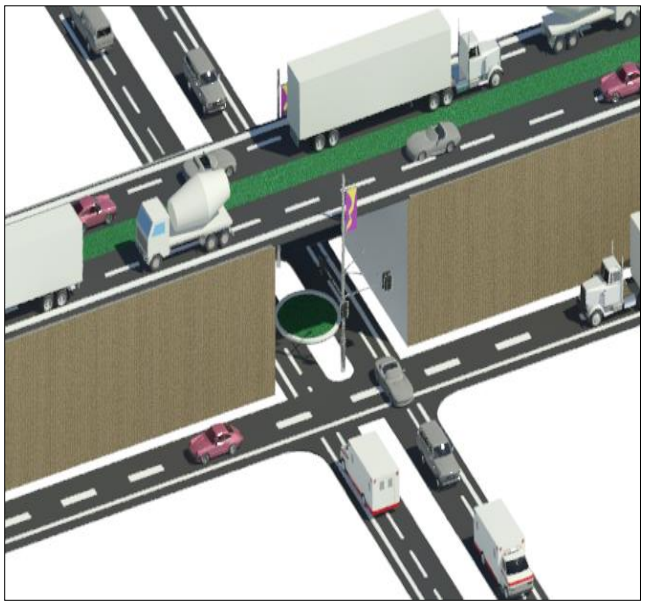


Fig. 9 Provision of Rotary and Signal on PazhaniBy-Pass

5. Design of Traffic Signal by Webster's Method

To avoid traffic related issues on NH83, traffic signals are designed using Webster's method (Nicholas Garber, J. , Lester Hoel, A., 2017).The design hour flow (f) and saturation flow (s) in all four directions are determined and given in Table 5.

Table 5. Traffic Signal Design Data

Details	North	South	East	West
Design hour flow (f) (PCU's/hr)	567.6 (f_1)	489.6 (f_2)	758.6 (f_3)	912.8 (f_4)
Saturation flow (s) (PCU's/hr)	2887.4 (s_1)	2467.7 (s_2)	4256.4 (s_3)	4305.5 (s_4)
Normal flow ratio 'x' (f/s)	0.19	0.20	0.17	0.21
Higher value of 'x' in N-S and E-W direction	**0.195 (X_1)**		**0.19 (X_2)**	

Critical flow ratio (X) = x_1+x_2

= 0 .195 +0.19

X =0.385

Total time lost for starting and stopping delays,

T= Σ (I – A) +Σ L

I=Minimum integration period = 5 sec.

A=Amber period= 2sec.

L = Red/Amber period (2sec)

T = (5-2) + (5-2) + 2 +2

T = 10 sec (for 2 phases)

Optimum cycle time(C_0)= (1.5T +5) / (1-X)

= (1.5(10)+ 5)/(1-0.385)

= 35.25sec.

Effective green time per cycle:

G_{NS} =(x_1/X) (C_0– T)

=(0.195/0.385)(36.25) = 18.36 sec.

G_{EW}=(x_2/X)(C_0–T)

=(0.19/0.385)(36.25) = 17.88sec.

It has been decided to provide signals on Pazhani By-Pass in east and west facing with amber period of 2 seconds and Fig.10 shows the signal with timings.

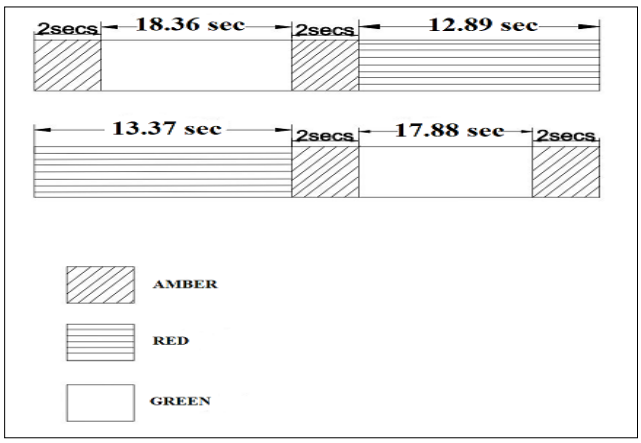


Fig. 10 Traffic Signal

6. Conclusion

From the evaluation of traffic characteristics on NH83, it becomes evident that the traffic flow on NH83 is heavy, unsteady with improper parking, more accident rates and unwanted pedestrian crossings. To avoid the traffic issues and accidents, few recommendations to regulate the traffic flow on NH83 is given (Zhankaziev, S)

a) Provision of Traffic warning sign boards,

b) Sign boards with speed limit,

c) Proper parking lots with suitable patterns,

d) Provision of traffic signals,

e) Provision of rotary intersection

All the above said measures will be helpful in regulating a steady and continuous flow of vehicles on NH83.

Declaration of Competing Interest

The author declares that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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