



## DETERMINATION OF L.O.S & DESIGN OF OFF STREET PARKING AT NELLORE FOR EFFECTIVE PARKING AND TRAFFIC OPERATION

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### ABSTRACT

The economy status of a country depends upon how deftly the country is served by its roads, air ports, railways, ports, shipping and pipelines. The economic growth rate of a country is very closely associates to the rate at which the transport sector grows. As road transportation provides the personal mobility to persons, the ownership of the vehicles has been rapidly increasing around the world. Because of expansion in car ownership, the parking problem is begun to be more and more acute by every day. A lot of problems such as traffic congestion, accidents, unwanted delays, reduce of effective road width and due to vehicles that are parked on the kerb side. The parking has a great influence transport development.

The main object of the study was to examine the present condition of parking, collect the behaviour response from the commuters and finally Level of Service (LOS). In this analysis data will be collected from various parking places in the city of Nellore. Particularly we have chosen the busiest roads with large traffic volume and major central business areas. Parking creates huge problems in urban areas and it requires an efficient and goal-oriented parking policy. A detailed study about the parking problem is very important in consideration of implementing a policy. To study about the on street parking an easy methodology was espouse, some of the primary survey were carried out such as traffic volume count, duration of the parking, demand survey and accumulation. In the early stages we worked out the variation of PCU with a certain time. In other part we find out the "Temporal distribution" of traffic on main road and its variation of Passenger Car Units (PCU) with time. These variables have been analogized to work out a long-lasting solution and finally, the best parking method is suggested to each street.

**Key words-** Parking demand, Traffic volume, Passenger Car Units, Parking Supply.

### I. LITERATURE REVIEW

**Lee et al (2005)** was studied travel choice and walking behaviour of the pedestrians regarding escalators and stairways in the train station of spoor Haag Den Holland. With reference to pedestrians walking behaviour, they concentrated on deriving traffic parameters such as principal diagrams of pedestrian flows and free speeds. With regard to the

pedestrians travel choice behaviour, two types of choice behaviours were analyzed the first one consisting of the selection among available escalators and stairways to facilitating level changes; the second one consisting of the choice between standing and walking on the escalators.

**Sachin Dass and Dhirendra Singhal (2011)** were examined the influence of pedestrian traffic,

elevator availability, (number of persons using the stairs and elevator per minute) occupancy of building (Number of individuals in the building) and delay time on stair descend and ascent at various workplaces. Elevator and Stair and choices were modulated by automatic counters on every weekday and during weekend at two phases. In this experiment, number of days with three elevators was compared with days when four elevators were available. The results of this experiment confirmed that use of stairs increased for four. Increase in occupancy of building was concerned with increased use of stairs, at the same time increase in pedestrian traffic and time of the day were associated with reduced use of stairs. A back-up study reveals the flattering effects of building occupancy and time of day on waiting times of elevator, advising that increased use of stairs by circumstantial factors reflects the increased waiting times of elevator. In contradistinction smaller waiting times were likely occurred when transient pedestrian traffic is so high during the day. Importantly, the degree of magnitude of the effects of these circumstantial factors was about ten times of that previously studied effect of stairs climbing intervention. Parking spaces are tactical commodities of present day transport facility. A small dataset permits accurately measures the utilization of spaces with regards of population, activity types, segments and duration.

**Trepainer and Morency** - (Interuniversity Research centre on transportation, logistics and enterprise networks (CIRRELT) 2008) suggested methods and empirical measures as regards the utilization of parking spaces in strategic urban areas. A detailed survey was organized representing 5% of the population of Montreal. Car driver moving towards the area investigated about the all type of parking space. Parking spaces were categorized accordingly to their sovereignty (public/private), place (on the

street/indoor/outdoor) and parking rates (fee charging /free/subsidized). Analyzing the data that collected from parking survey characteristics explaining the use of the spaces was implemented. On the one hand, people using the various sorts of spaces are expressed in terms of demographic attributes, residence location and type of activity. On the other hand, profiles of the parking accumulation were implemented and reviewed by key indicators.

## II. DATA COLLECTION METHODOLOGY

The site chosen is six major road Stretches in Nellore city having high traffic volume and parking problems. Methodology, road standards, study area and specifications are being given in the following chapter.

## III. SPECIFICATIONS OF ROAD GEOMETRY

The specifications of the road geometry those were found width of the road stretch, gradient of the pavement if any, width of the shoulder, Number of lanes and width of the median or divider all are been tabulated and presented below.

### ROAD MAP OF VARIOUS LOCATIONS UNDER STUDY Name of the road stretch: BOSE STATUE TO CMR GT ROAD



**Fig.1. Satellite image of Bose statue to CMR GEOMETRICS OF THE ROAD STRETCH**

**Table No 1. Geometrics of the road stretch of Bose Statue to CMR**

**Name of the Road Stretch: CMR TO BABU ICE CREAMS GT ROAD**

S. No	Width (in Meters)	Dual Carriage way Width (in mts)	Stretch (in Kms)	Gradient (in Degrees)	Shoulder Width (Mts)	No. of Lanes	Divider Width (Mts)
1	22.2	14.3	0.428	-	6.4	4	1.5
						2 – Way	



Fig.2.Satellite image of CMR to BABU ICE CREAMS

#### GEOMETRICS OF THE ROAD STRETCH

Table No 2. Geometrics of the road stretch of CMR to Babu ice creams

S. No	Width (in Meters)	Dual Carriage way Width (in mts)	Stretch (in Kms)	Gradient (in Degrees)	Shoulder Width (Mts)	No. of Lanes	Divider Width (Mts)
1	18.55	13.8	0.196	-	4.45	4	0.3
						2 – Way	

Name of the Road: BABU ICE CREAMS TO GANDHI STATUE GT ROAD

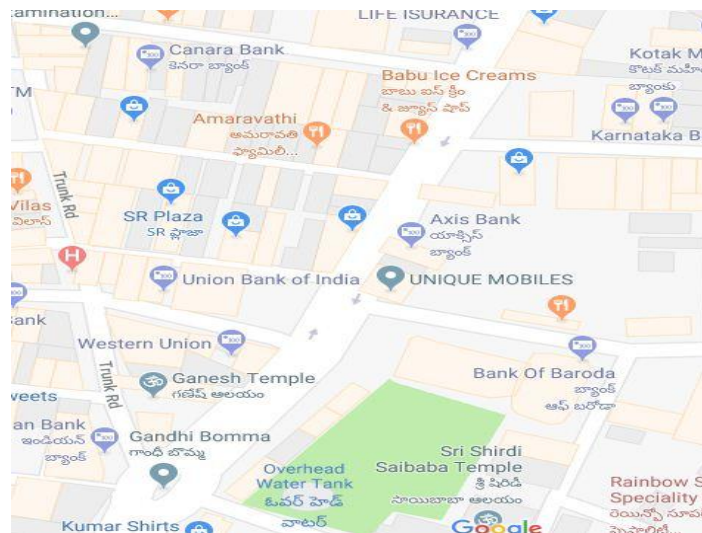


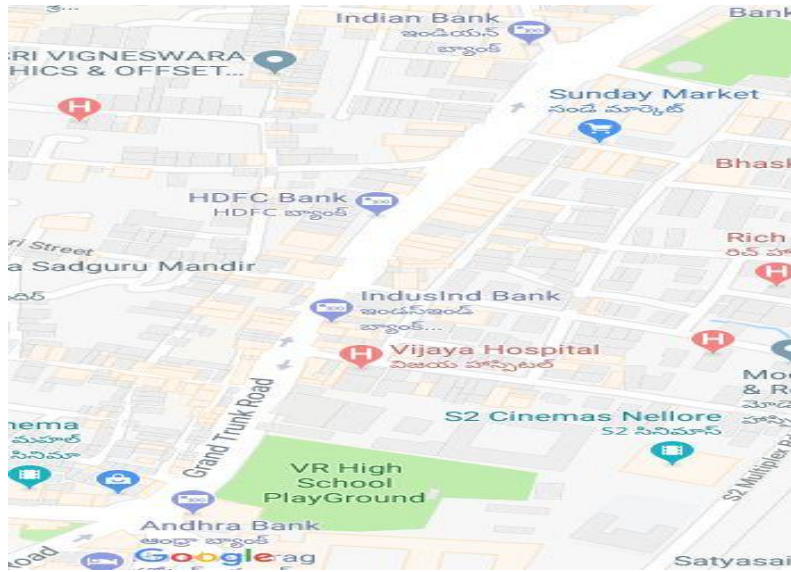
Fig.3.Satellite image of Babu Ice Creams To Gandhi Statue

#### GEOMETRICS OF THE ROAD STRETCH

Table No 3. Geometrics of the road stretch of Babu Ice Creams To Gandhi Statue

S. No	Width (in Meters)	Dual Carriage way Width (in mts)	Stretch (in Kms)	Gradient (in Degrees)	Shoulder Width (Mts)	No. of Lanes	Divider Width (Mts)
1	24.9	14.2	0.163	-	10.4	4	0.3
						2 – Way	

**Name of the Road Stretch: GANDHI STATUE TO VRC GT ROAD**



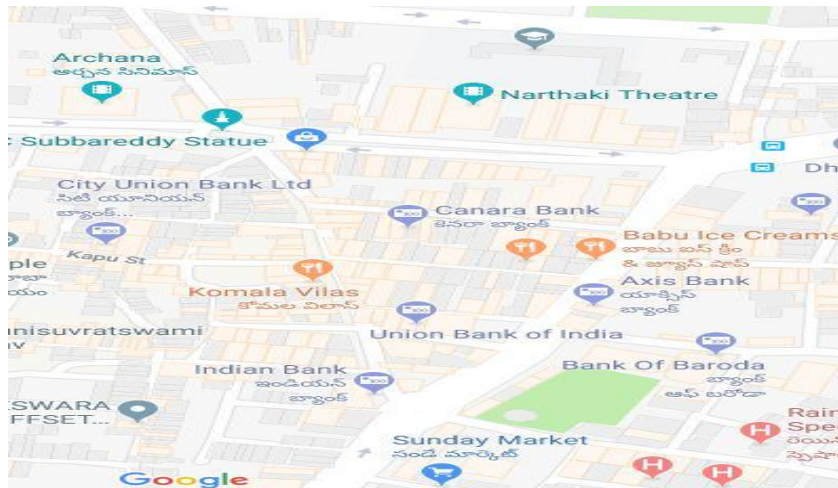
**Fig.4.Satellite image of Gandhi Statue To VRC**

**GEOMETRICS OF THE ROAD STRETCH**

**Table No 4. Geometrics of the road stretch Gandhi Statue to VRC**

S. No	Width (in Meters)	Dual Carriage way Width (in mts)	Stretch (in Kms)	Gradient (in Degrees)	Shoulder Width (Mts)	No. of Lanes	Divider Width (Mts)
1	19.55	14	0.524	-	4.55	4	1
						2 – Way	

**Name of the Road Stretch: GANDHI STATUE TO ARCHANA (TRUNK ROAD)**



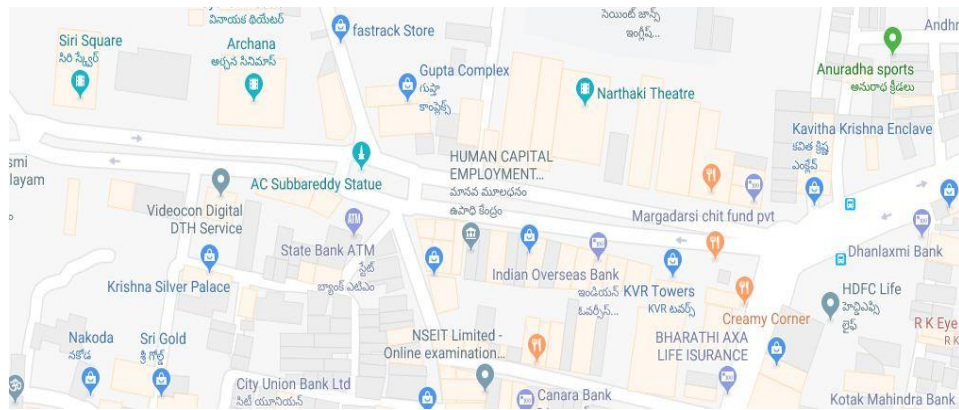
**Fig.5.Satellite image of GANDHI STATUE TO ARCHANA**

**GEOMETRICS OF THE ROAD STRETCH**

**Table No 5. Geometrics of the road stretch of Gandhi Statue To Archana**

S. No	Width (in Meters)	Carriage way Width (in mts )	Stretch (in Kms)	Gradient (in Degrees)	Shoulder Width (Mts)	No. of Lanes	Divider Width (Mts)
1	13.55	10.85	0.329	-	2.7	3	-
						1 – Way	

**Name of the Road Stretch: NARTHAKI RR STREET**



**Fig.6.Satellite image of Kanakamahall RR STREET**

**GEOMETRICS OF THE ROAD STRETCH**

**Table No 6. Geometrics of the road Kanakamahall RR Street**

S. No	Width (in Meters)	Dual Carriage way Width (in mts )	Stretch (in Kms)	Gradient (in Degrees)	Shoulder Width (Mts)	No. of Lanes	Divider Width (Mts)
1	27.15	15.6	0.647	-	10.05	4	1.5
						2-Way	

**IV.TRAFFIC VOLUME STUDIES**

Traffic Volume count was carried out in the important road Stretches of Nellore. They are Bose Statue to CMR, CMR to Gandhi Statue, Gandhi Statue to VRC, Gandhi statue to Archana (Trunk road), Kanakamahall RR Street. In these major road

Stretches four of them are two-way divided carriage way with four lanes and the remaining one is One-way road with 3 lanes. Data was collected from 8.00 A.M in the morning to 6.00 P.M in the evening on one hour interval for one day using field data sheets and carried out by the trained persons.

**BOSE STATUE TO CMR GT ROAD**

**Table No 7. Traffic volume of Bose statue to CMR GT road**

Type of vehicle	Slot 1		Slot 2		Slot 3		Slot 4		Slot 5		Slot 6		Slot 7		Slot 8		Slot 9		Slot 10	
		PCU		PCU		PCU		PCU		PCU		PCU		PCU		PCU		PCU		PCU
2 wheel	894	447	1176	588	836	418	573	286.5	1104	552	1164	582	929	464.5	989	494.5	1408	704	1619	809.5
3 wheel	589	589	860	860	595	595	694	694	650	650	550	550	620	620	923	923	934	934	982	982
4 wheel	459	459	388	388	296	296	166	166	176	176	176	283	102	102	120	120	194	194	410	410
NMV	17	6.8	26	10.4	38	15.2	19	7.6	36	14.4	38	15.2	30	12	32	12.8	22	8.8	25	10
PCU	1501.8		1846.4		1324.2		1154.1		1392.4		1430.2		1198.5		1550.3		1840.8		2211.5	

**CMR TO GANDHI STATUE**

**Table No 8. Traffic volume of CMR to Gandhi Statue GT road**

PCU	NMV	4 wheeler	3 wheelers	2 wheel	Type of vehicle	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7	Slot 8	Slot 9	Slot 10
1023.8	12	161	398	920											
	4.8	161	398	460	PCU										
1118.7	18	298	320	987											
	7.2	298	320	493.5	PCU										
1117.2	23	242	423	886											
	9.2	242	423	443	PCU										
1019.9	21	167	508	673											
	8.4	167	508	336.5	PCU										
1437.3	27	278	542	1014											
	10.8	278	542	507	PCU										
1796.7	32	337	608	959											
	12.8	337	608	479.5	PCU										
1431.9	31	297	528	1189											
	12.4	297	528	594.5	PCU										
1578.0	35	383	508	1346											
	14	383	508	673	PCU										
1749.8	27	421	614	1408											
	10.8	421	614	704	PCU										
1910.2	43	465	635	1586											
	17.2	465	635	793	PCU										

**GANDHI STATUE TO ARCHANA (TRUNK) ROAD**

**Table No 9 Traffic volume of Gandhi Statue to Archana theatre GT road**

PCU	NMV	4 whe	3 whee	2 whee	Type of vehicle	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7	Slot 8	Slot 9	Slot 10
472	40	54	142	520	PCU										
	16	54	142	260											
648.8	47	33	276	642	PCU										
	18.	33	276	321											
665	45	51	297	598	PCU										
	18	51	297	299											
765.3	57	107	521	229	PCU										
	22.	107	521	114.5											
899.5	48	173	543	445	PCU										
	19.	173	543	222.5											
1157.9	39	105	555	571	PCU										
	15.	105	520	235.5											
621.2	43	75	236	586	PCU										
	17.	75	236	293											
844.8	32	165	319	696	PCU										
	12.	165	319	348											
1009.1	84	196	427	705	PCU										
	33.	196	427	352.5											
1154.9	96	207	486	847	PCU										
	38.	207	486	423.5											

## GANDHI STATUE TO VRC GT ROAD

Table No 10. Traffic volume of Gandhi Statue VRC GT road

Type of vehicle	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7	Slot 8	Slot 9	Slot 10
2 wheelers	963	1672	1786	798	951	1069	1155	1233	1448	1668
3 wheelers	485	684	602	620	671	556	496	411	522	610
4 wheelers	264	521	339	276	301	290	313	341	443	549
NMV	21	32	24	23	31	35	29	20	31	27
PCU	1238.9	2053.8	1843.6	1304.2	1478.5	1394.5	1398.1	1376.5	1701.4	1837

## KANAKAMAHAL RR STREET

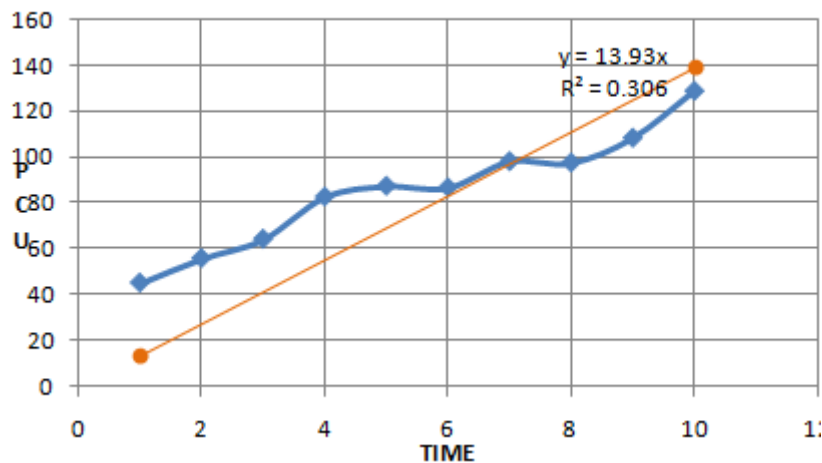
Table No 9. Traffic volume of Kanakamahahal RR Street

Type of vehicle	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7	Slot 8	Slot 9	Slot 10
2 wheelers	445	414	483	367	812	946	792	848	869	912
3 wheelers	195	284	302	533	754	596	247	525	472	639
4 wheelers	127	184	265	228	306	302	356	272	171	274
NMV	38	32	61	67	70	87	31	136	56	104
PCU	559.7	687.8	832.9	971.3	1494	1405.8	1011.4	1275.4	1099.9	1411.4

## V.PARKING STUDIES

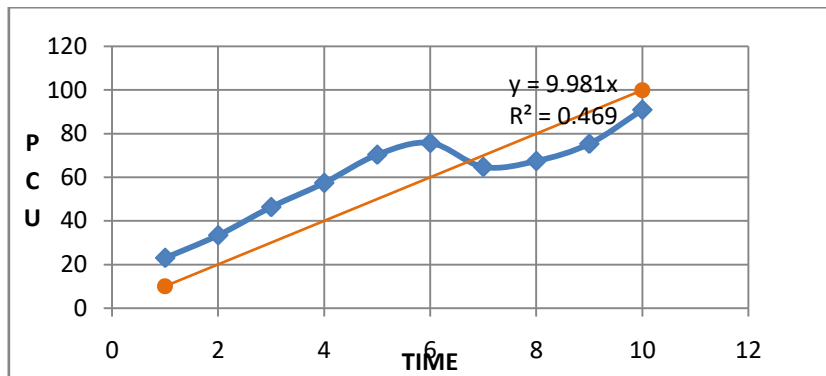
Parking criteria was observed for two days on one hour interval based during Weekend and in Weekday for the same slots and also Peak parking demand from these days were taken. Parking studies were carried with ten slots all through the day. Later various characteristics of the parking were calculated and tabulated for the further use.

### BOSE STATUE TO CMR



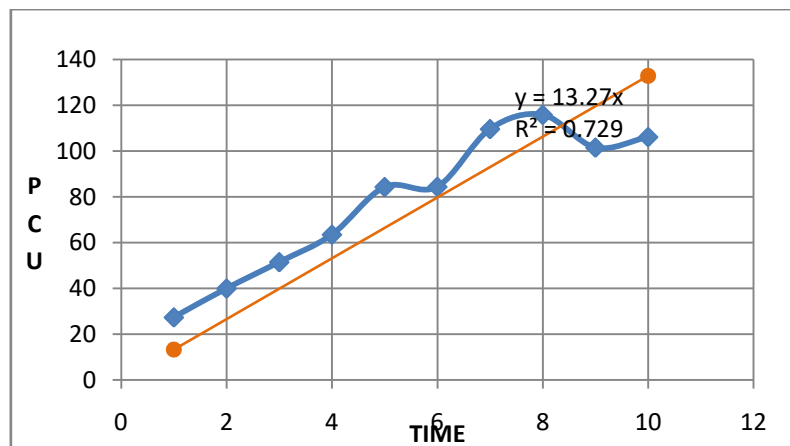
Graph 1. Variation of Parking Volume with Time

### CMR TO BABU ICE CREAMS



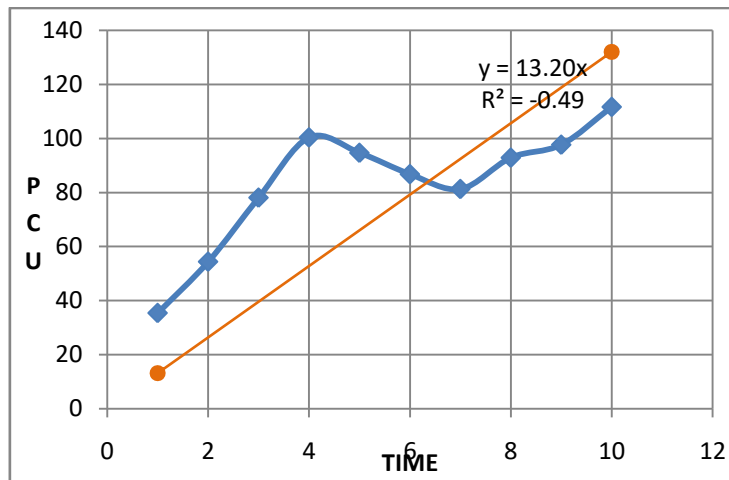
Graph 2. Variation of Parking Volume with Time

### BABU ICECREAMS TO GANHI STATUE



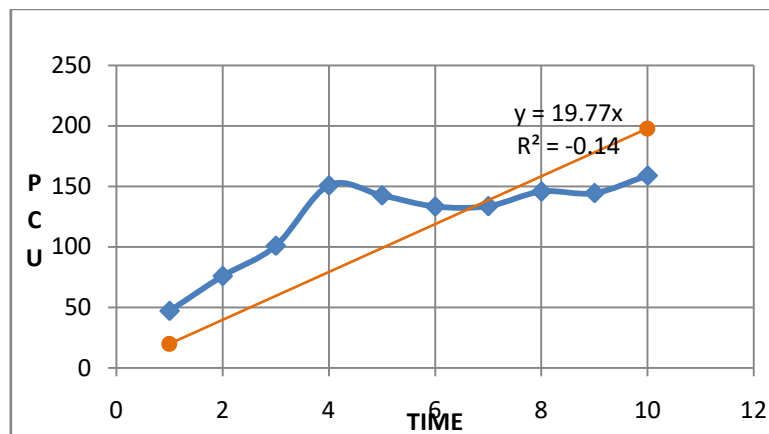
Graph 3. Variation of Parking Volume with Time

#### GANDHI STATUE TO VRC



Graph 4. Variation of Parking Volume with Time

#### KANAKAMAHAL RR STREET



Graph 5. Variation of Parking Volume with Time

#### VI. CLASSIFICATION OF ROADS

From IRC 86, design speeds are given in table are recommended for adoption,

Table No 10. Classification of roads based on Design speed

S. No	Classification	Design Speed (Kmph)
1.	Arterial	80
2.	Sub-arterial	60
3.	Collector Street	50
4.	Local Street	30

Table No 11. Classification of roads under study based on Design speed

S. No	Name of Road Stretch	Design Speed (KMPH)	Type of Road
1	BOSE STATUE TO CMR GT ROAD	50	Collector Street
2	CMR TO BABU ICE CREAMS GT ROAD	30	Local Street
3	BABUICE CREAMS TO GANDHI STATUE GT ROAD	30	Local Street
4	GANDHI STATUE TO VRC GT ROAD	40	Local Street
5	GANDHI STATUE TO ARCHANAROAD	30	Local Street
6	KANAKAMAHAL	40	Local Street

## VII. LEVEL OF SERVICE

The levels of service and the related operating conditions for such type of facilities are given below.

**Table No 12. LOS of roads based on Design speed**

Level of Service	Operating Characteristics
A	Operating speed of 100 K.P.H. or more. Service volume is about 33% of Capacity, i.e., 650 passenger cars per hour per lane.
B	Beginning of stable flow area, operating speed about 90 K.P.H. Service volume will not exceed 50% of capacity, i.e., 1000 passenger cars per hour per lane.
C	Stable flow, with service volume not exceeding 65% of capacity, i.e., 1300 passenger cars per hour per lane. Operating speed at least 75 K.P.H.
D	Approaching unstable flow, with service volume up to 80% of capacity i.e., 1600 passenger cars per hour per lane. Operating speed at least 60 K.P.H.
E	Flow at capacity, i.e., 2000 passenger cars per hour per lane. Operating speed at least 50 K.P.H.
F	Forced flow, congested conditions, with operating speed less than 50 K.P.H.

## LEVEL OF SERVICE OF VARIOUS LOCATIONS

**Table No 13. LOS of roads under study based on Design speed**

S. No	Name of Road Stretch	Level of Service
1.	BOSE STATUE TO CMR GT ROAD	E
2.	CMR TO BABU ICE CREAMS GT ROAD	F
3.	BABU ICE CREAMS TO GANDHI STATUE GT ROAD	F
4.	GANDHI STATUE TO VRC GT ROAD	F
5.	GANDHI STATUE TO ARCHANAROAD	F
6	KANAKAMAHAL	D OR F

## CAPACITY ANALYSIS OF CORRIDORS

From IRC 86, Capacities Tentative Capacities of Urban Roads between Intersections

### Capacities Tentative Capacities of Urban Roads between Intersections

**Table No 14. Recommendations for improvement of various roads**

S.No	No. of traffic lanes and widths	Traffic flow	Capacity in PCUs per hour for various traffic conditions		
			Roads with no frontage access, no standing vehicles, very little cross traffic	Roads with frontage access but no standing vehicle and high capacity intersections	Roads with free frontage access, parked vehicles and heavy cross traffic
1.	2-lane (7-7.5m)	One way	2400	1500	1200
		Two way	1500	1200	750
2.	3-lane (10.5m)	One way	3600	2500	2000
3.	4-lane (14m)	Two way	4800	3000	2400
		Two way	4000	2500	2000
4.	6-lane(21m)	One way	3600	2500	2200
		Two way	6000	4200	3600

## VIII.RECOMMENDATIONS FOR IMPROVEMENT OF THE PARKING

### BOSE STATURE TO CMR

Table No 15. Geometric Details Of Bose Statue To CMR GT Road

S. No	Width (in Meters)	Lane Width (in mts)	Stretch (in Kms)	Gradient (in Degrees)	Shoulder Width (Mts)	No. of Lanes	Divider Width (Mts)
1	22.2	14.3	0.428	-	6.4	4	1.5
						2 – Way	

It is observed that the total width of the road is 22.2m and it could be categorized under **Collector Street** as per IRC-69-1977.

Also we observed that the width of the carriage way is **14.3m** and as per IRC-86-1983 the road can be classified as 4 lane two way with the total capacity can be taken as **2000 PCU/hr** in both the directions, parked vehicles and heavy cross traffic with free frontage access.

At present the traffic volume is **2211**. Hence, there is an **excess traffic** on the road **beyond its capacity**.

As it is observed that the traffic flow rate of the road is reached just above the maximum capacity it is not a profound problem, if the road should be widened for the future purpose.

In response to the parking supply and demand position we observe that the no of available parking

spaces are **124** and the present parking demand: **110**, Thus, there is no problem with parking demand. It has just started surpassed the parking supply. Since, there is a need to create additional parking spaces and to identify alternate parking areas or to implement various methodologies to meet future demand.

The best options for this road can be:

- 1) **Widening of the road should be done for future purpose.**
- 2) **Creating the paid off street parking system.**
- 3) **Allowing only two wheelers to park on one side of the road as the shoulder width is less compared to other side.**

### CMR TO BABU ICE CREAMS

Table No 16. Geometric Details Of CMR Babu Ice Creams

S. No	Width (in Meters)	Lane Width (in mts)	Stretch (in Kms)	Gradient (in Degrees)	Shoulder Width (Mts)	No. of Lanes	Divider Width (Mts)
1	18.55	13.8	0.196	-	4.45	2	0.3
						2 – Way	

We observe that the total width of the road is **18.55** m and as per IRC-69-1977 the road can be classified as a **local street** only.

Also we observed that the width of the carriage way is **13.8m** and as per IRC-86-1983 the road can be classified as 4 lane two way with the total capacity can be taken as **2000 PCU/hr** in both the directions, parked vehicles and heavy cross traffic with free frontage access. At present the traffic volume is **1910**. Thus, the traffic volume is below **its capacity**.

In response to the parking supply and demand position we observe that the no of available parking spaces are **52** and the present parking demand: **90**. Thus there is a need to create additional parking

spaces and to identify alternate parking areas or to implement various methodologies to meet future demand. With the help of electronic sensors which are in connection to the parking lots the no. of available parking spaces should be displayed on this road before vehicles can enter onto this road.

Due to non availability of off street parking locations for this road at this time and so space for off street parking should be persuade from the private land owners and the cost of land acquisition, construction and maintenance the off street parking system can be regain from the vehicle users through parking fee.

The best options for this road can be:

- 1) **Creating the paid off street parking system**
- 2) **Creating Multi-Storey building**

## BABU ICECREAMS TO GANDHI STATUE

**Table No 17. Geometric Details Of Babu Ice Creams To Gandhi Statue**

S. No	Width (in Meters)	Dual Carriage way Width (in mts)	Stretch (in Kms)	Gradient (in Degrees)	Shoulder Width (Mts)	No. of Lanes	Divider Width (Mts)
1	24.9	14.2	0.163	-	10.4	4	0.3
						2 – Way	

We observe that the total width of the carriage way is **24.9m** and as per IRC-69-1977 the road can be classified as a **collector street** only. Also we observed that the width of the carriage way is **14.2m** and as per IRC-86-1983 the road can be classified as 4 lane two way with the total capacity can be taken as **2000 PCU/hr** in both the directions, parked vehicles and heavy cross traffic with free frontage access. At present the traffic volume is **1910**. Thus, the traffic volume is below **its capacity**.

In response to the parking supply and demand position we observe that the no of available parking spaces are **49** and the present parking demand: **116**. Thus there is a need to create additional parking

- 1) **Creating the paid off street parking system**
- 2) **Widening of the road should be done.**

## GANDHI STATUE TO VRC

**Table No 18. Geometric Details of Gandhi Statue To VRC**

S. No	Width (in Meters)	Dual Carriage way Width (in mts)	Stretch (in Kms)	Gradient (in Degrees)	Shoulder Width (Mts)	No. of Lanes	Divider Width (Mts)
1	19.55	14	0.524	-	4.55	4	1
						2 – Way	

We observe that the total width of the road is **19.55 m** and as per IRC-69-1977 the road can be classified as a **local street** only.

Also we observed that the width of the carriage way is **14m** and as per IRC-86-1983 the road can be classified as 4 lane two way with the total capacity can be taken as **2000 PCU/hr** in both the directions, parked vehicles and heavy cross traffic with free frontage access. At present the traffic volume is **2053**. Thus, the traffic volume was reached above **its capacity**.

spaces and to identify alternate parking areas or to implement various methodologies to meet future demand. With the help of electronic sensors which are in connection to the parking lots the no. of available parking spaces should be displayed on this road before vehicles can enter onto this road.

Due to non availability of off street parking locations for this road at this time and so space for off street parking should be persuade from the private land owners and the cost of land acquisition, construction and maintenance the off street parking system can be regain from the vehicle users through parking fee.

The best options for this road can be:

In response to the parking supply and demand position we observe that the no of available parking spaces are **144** and the present parking demand: **175**. Thus there is a need to create additional parking spaces and to identify alternate parking areas or to implement various methodologies to meet future demand. The ideas of providing on street parking lots with sensors, provision of paid off street parking, introduction of parking meters can be installed.

As there is no space available for providing off street parking it is preferable to design multistoried building parking.

The best options for this road can be:

- 1) **Multi-story building parking should be provided.**
- 2) **Widening of the road should be done.**

## GANDHI STATUE TO ARCHANA

**Table No 19. Geometric Details Of Gandhi Statue To Archana**

S. No	Width (in Meters)	Carriage way Width (in mts )	Stretch (in Kms)	Gradient (in Degrees)	Shoulder Width (Mts)	No. of Lanes	Divider Width (Mts)
1	13.55	10.85	0.329	-	2.7	3	-
						1 – Way	

We observe that the total width of the road is **13.55m** and as per IRC-69-1977 the road can be classified as a **local street** only. Also we observed that the width of the road including shoulders is **10.85m** and as per IRC-86-1983 the road can be classified as one way three lane with the total capacity can be taken as **2000 PCU/hr**, parked vehicles and heavy cross traffic with free frontage access. At present the traffic volume is **1154.9**. Thus, the traffic volume is below **its capacity**.

In response to the parking supply and demand position we observe that the no of available parking spaces are **89** and the present parking demand: **111**. Thus there is a need to create additional parking spaces and to identify alternate parking areas or to The best options for this road can be:

- 1) **Creating the paid off street parking system**
- 2) **Parking should be prohibited for 4 wheeler vehicles**

## NARTHAKI RR STREET

**Table No 20. Geometric Details of Kanakamahar RR Street**

S. No	Width (in Meters)	Dual Carriage way Width (in mts )	Stretch (in Kms)	Gradient (in Degrees)	Shoulder Width (Mts)	No. of Lanes	Divider Width (Mts)
1	27.15	15.6	0.647	-	10.05	4	1.5
						2 – Way	

We observe that the total width of the road is **27.15 m** and as per IRC-69-1977 the road can be classified as a **collector street** only. Also we observe that the width of the carriage way is **15.6m** and as per IRC-86-1983 the road can be classified as 4 lane two way with the total capacity can be taken as **2000 PCU/hr**

in both the directions, parked vehicles and heavy cross traffic with free frontage access. At present the traffic volume is **1411**. Thus, the traffic volume is below **its capacity**.

In response to the parking supply and demand position we observe that the no of available parking

spaces are 183 and the present parking demand is 159. Thus there is a need to create additional parking spaces and to identify alternate parking areas or to implement various methodologies to meet future demand. The ideas of providing on street parking lots with sensors, provision of paid off street parking, introduction of parking meters, can be installed. With the help of electronic sensors which are in connection to the parking lots the no. of available parking spaces should be displayed on this road before vehicles can enter onto this road.

Due to non availability of off street parking locations for this road at this time and so space for off street parking should be persuade from the private land owners and the cost of land acquisition, construction and maintenance the off street parking system can be regain from the vehicle users through parking fee.

The best options for this road can be:

**"At present there is no problem with both traffic flow and parking demand."**

#### IX. DESIGN OF SURFACE CAR PARKING

As we observed that there was a problem with parking of 3 wheelers and four wheelers at various locations namely CMR to Babu Ice Creams and One Way Street from Gandhi Statue to near Archana theatre, so it is advised to provide a paid parking nearby these locations. From our survey we have found a private land nearby Radha theatre which is easily accessible for CMR, One Way Street of Gandhi Statue to Archana theatre and Babu ice creams and that can be utilized for Surface car parking with the cooperation of State Government. Surface car parking, properly located at vacant space or surrounding an office complexes or super markets or nearby main working places when there is no sufficient on street parking facilities available. A stall size of 2.5 X 5 m is probably adequate for Indian conditions. The layout designed for the present parking facility is shown in the figure below.

Available width of the plot is 39.2 m

Available length of the plot is 66.4 m

Size of the stall in Indian conditions is 2.5 m X 5 m

Width left for manoeuvrability is 6.25m.

Total area available for surface parking lot  
(39.2\*66.4) = 2602.88 m<sup>2</sup>

Area to be left for manoeuvrability is (3\*6.25\*66.4)  
= 1245 m<sup>2</sup>

Effective area available for surface parking lot  
= 2602.88 - 1245

= 1357.88 m<sup>2</sup>

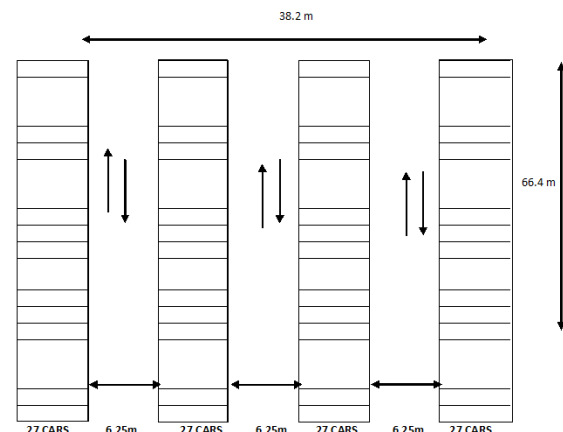
Total number of parking stalls available

= 1357.88/2.5\*5 = 108 No's

Few of the available parking stalls may also use for parking two wheelers based on the conversion. In one parking slot five numbers of two wheelers can be parked, so the available stalls may be used as

If 28 parking stalls are accommodated for two wheelers, the no. of two wheelers can be accommodated = 28\*5 = 140

The remaining 80 parking stalls may be accommodated for three and four wheelers.



#### X. CONCLUSIONS

In this project the travel patterns of on-street parking area in six major streets of Nellore, Andhra Pradesh, India. The various facts and finding of the study can be listed as under:

1. It is observed that almost five out of six sub areas the width of the roads has to be widened as they are about or surpassed the maximum traffic volume.
2. Among six parking sub-areas, four locations are fully wadded to their capacity and are indeed overlade in many cases with 3 or 4 wheelers group of vehicles.
3. The Level of service (L.O.S) of all the roads is classified as E or D based on their design speed.
4. The heavy parking accumulation is in the time period of 04:00 pm to 6:00 pm and the peak hour observed generally between 5:00 pm to 6:00 pm in all the cases.

5. In cooperation with the government if an off street parking developed nearby CMR shopping mall, it can accommodates 108 number of 3/4 wheelers and reduces the parking problem partially.

## XI. RECOMMENDATIONS

Based on the analysis and conclusions some of the recommendations which are mentioned below:

- Off street management should be implemented for effective traffic and parking operation.
- It is observed that there are not enough on street parking lots available at VRC and it is advisory to develop a Multi story parking nearby VRC due to non availability of land for surface car parking.
- A Detailed Parking Audit at Nellore has to be conducted of existing buildings and land uses by a team especially constituted for the same, to determine the actual parking demand for the type of building / land use.
- The NELLORE URBAN DEVELOPMENT AUTHORITY (NUDA) Rules need to be amended accordingly. Any new development should be mandated to submit an Impact Statement, clearly setting out the impact it will have on all urban infrastructure, especially the transport infrastructure.
- During the parking surveys it was observed that some of the vehicles are coming in opposite direction to the one way streets which were intended only for moving vehicle in one direction and are causing traffic congestion and making difficulty for parking the vehicle on the other side of the road. Restricting them by collecting fines if they come in wrong route will help to reduce the traffic congestion.
- It was also observed that nearby VRC intersection the traffic signal was not in use, due to it there occurring traffic congestion and unwanted delays to the vehiculars. The effective usage of the traffic signal will definitely provide better traffic operation.

- On-street parking should be minimized, especially on Local and Collector streets to avoid traffic congestion.
- Parking restrictions are to be enforced forcefully, and traffic police will need to be empowered to do.

## XII. REFERENCES

1. *Warden, Borgers, Timmermans*, Attitudes and behavioural responses to parking measures, *EJTIR*, 6, no. 4 (2006), pp. 301-312.
2. *Morency & Trepainer*, Characterizing parking spaces using survey data, Interuniversity Research Centre on Enterprise Networks, Logistics and Transportation CIRRELT, (2008):
3. *Ghaziasgari, Farzanmanesh and Abdullah*, Parking site selection management using Fuzzy logic and Multi Criteria Decision Making, Interuniversity research centre on enterprise networks, Logistics and transportation (CIRRELT) Abdullah, (2008):3-7
4. *Syedah Tabish 1, Er. Munish Kumar*, review paper on study of pedestrian flow on grade separated crossing, *International Journal of Latest Research in Science and Technology* ISSN Volume 6, Issue 4, (2017):48-51.
5. *Sachin Dass and Dharendra Singhall*, Study of Pedestrian Flow/ Behaviour on Indian Roads, *Journal of Mechanical and Civil Engineering*, e-ISSN: 2278-1684, p-ISSN: 2320-334X, (2016) Pages 38-42
6. *Carol Holland, Ros Hill*, Gender differences in factors predicting unsafe crossing decisions in adult pedestrians across the lifespan, Volume 42, Issue 4, (2010), Pages 1097-1106.
7. *IRC* guidelines for *space* standards for roads in urban areas (1977):69; page 5.
8. *K. Khanna and C.E.G Justo and A.Veeraraghavan*, A revised 10<sup>th</sup> edition of Highway engineering: page 229.
9. *L.R Kadiyali*, Traffic Engineering and Transport planning: Pages 250 -258.
10. *Mrs Priyanka*, Offstreet parking management plan for Dharwad city, *Journal of Engineering Research and Studies*, (2012).