



## **Parking Demand Studies at V.V Mahal Road in Tirupati**

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### **ABSTRACT**

Nowadays, due to increased population in the urban areas, there is continuous need to facilitate public transport and adequate parking facilities. Management of parking facilities in public areas in the big town like Tirupati is very essential. According to current situation, the management of parking facilities does not meet the desired requirements as per survey. In the present research work, we have considered the VV mahal road of Tirupati facing serious problems of lack of parking facility. This leads to many serious problems like delays parking congestion, unclear orientation of parking lots, more carbon emission from vehicles in road, increase in temperature and pollution, etc. In this project report, firstly a parking supply and demand survey was prepared in order to identify the of parking problem. Secondly, current situation and problems of parking are analyzed systematically and thoroughly. Then, the reasons of these problems are find out. Finally, suitable suggestions are put forwarded.

**Key Words :-** Parking demand and capacity, PCU, Parking management, Pattern

### **1. Introduction**

#### **1.1 General**

Nowadays two-wheeler or car parking steals the most valuable asset every individual has i.e. time. A lot of time is wasted in finding for an available parking space. Lack of parking spaces is an additional source of traffic congestion and pollution. More traffic means more pollution. Vehicle's CO<sub>2</sub> emission is higher while you are circling around looking for available parking spot than you could just drive to your spot and park the vehicle.

Parking is an important urban transportation element. It has various long and short- term impacts on individuals, communities and transportation system. Parking also affects the vitality of communities, commercial and business center, transit system and airports as well as the efficiency of traffic circulation in downtown areas. Parking is one of the major problems that are created by the increase in the vehicle traffic. Transportation is the key infrastructure of a country.

As road transportation gives personal mobility to the person, the vehicle ownership rate has increased at a fast rate. This increase in the number of vehicles has given birth to the problem of parking. The availability of less space in urban areas has increased the demand for parking space, especially in shopping centers, public places and office complexes. It also has an impact on transportation development. With the growing population of motor vehicles, the problem of parking has assumed serious proportions in the towns and cities. Shortage of parking spaces forces drivers to park their vehicles on the kerb side which further creates lot of problems like congestion, jams, accidents and also reduces effective road width. A systematic study of parking characteristics and demand and regulatory measures for controlling the parking is of great help to a traffic engineer as well as a town planners. The increasing concentration of human activity on limited land both in terms of residential activity and commercial activity causes the parking problem. Every car owner would wish to park the car as close as possible to his destination so as to minimize his walking distance. This results in greater demand for parking space in the central business district (CBD) and other areas where the activities are concentrated.

There is a significant and tremendous increase in the demand of parking spaces due to increase of road traffic during the last one decade in small cities as well. This has led to congestion of on-street spaces in the office and shopping area neighborhoods during peak hours. The parking demand also leads to socio-economic and environmental losses.

#### **1.2 PARKING FACILITY**

In cities the problem of parking vehicles is becoming more and more acute day by day. When vehicles are parked on the roadside, even for a short while there is restriction to other vehicles passing by, resulting in congestion and accidents. In shopping centers, public places and localities with offices there is a shortage of parking facilities. Proper design of parking facilities is essential in cities and large towns. Proper design of parking space is very important for the good transporting system. If there will be a lack of parking space and facility, then it will be a chaotic condition for everyone. But designing of any parking space is not an easy job. Parking facilities may be broadly divided into two types:

### A. On Street Parking

On street parking means the vehicles are parked on the sides of the street itself. This will usually be controlled by government agencies itself. Common types of on-street parking areas listed below. This classification is based on the angle in which the vehicles are parked with respect to the road alignment. As per IRC the standard dimensions of a car are taken as  $5 \times 2.5$  meters and that for a truck is  $3.75 \times 7.5$  meters

**1) Parallel Parking:** The vehicles are parked along the length of the road. Here there is no backward movement involved while parking or un-parking the vehicle. Hence, it is the safest parking from the accident perspective. However, it consumes the maximum curb length and therefore only a minimum number of vehicles can be parked for a given kerb length.

Parking produces least obstruction to the on-going traffic on the road since the least road width is used. Parallel parking of cars is shown in Figure 2.1. The length available to park an N number of vehicles,  $L = N/5$ .

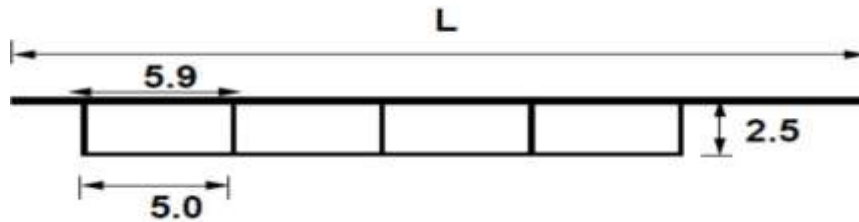


Fig 1 Illustration of Parallel Parking

**2) 30° Parking:** In thirty-degree parking, the vehicles are parked at  $30^\circ$  with respect to the road alignment. In this case, more vehicles can be parked compared to parallel parking. Also, there is better maneuverability. Delay caused to the traffic is also minimized in this type of parking. An example is shown in Figure

**3) 45° parking:** As the angle of parking increases, more number of vehicles can be parked. Hence, compared to parallel parking and thirty degree parking, more number of vehicles can be accommodated in this type of parking. From the Figure 2.3, length of parking space available for parking N number of vehicles in given kerb is  $L = 3.54 N + 1.77$



Fig 2 Illustration of 45° Parking

**4) 60° Parking:** The vehicles are parked at  $60^\circ$  to the direction of the road. More number of vehicles can be accommodated in this parking type. From the Figure 2.4, length available for parking N vehicles  $= 2.89N + 2.16$

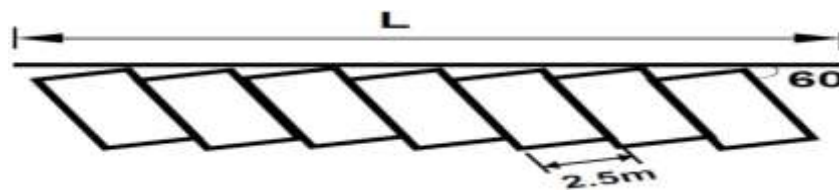


Fig 3 Illustration of 60° Parking

**5) Right Angle Parking:** In the right angle parking or  $90^\circ$  parking, the vehicles are parked perpendicular to the direction of the road. Although it consumes maximum width, kerb length required is very little. In this type of parking, the vehicles need complex maneuvering and this may cause severe accidents. This arrangement causes obstruction of the road traffic, particularly if the road width is less. However, it can accommodate a maximum number of vehicles for a given kerb length. An example is shown in Figure 2.5. Length available for parking N number of vehicles is  $L = 2.5N$ .

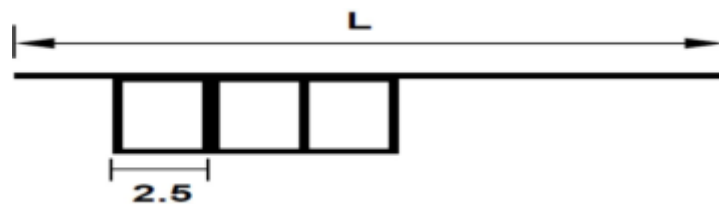


Fig 4 Illustration of 90° Parking

### B. Off street Parking:

In many urban centers, some areas are exclusively allotted for parking which will be at some distance away from the main stream of traffic. Such a parking is referred to as off-street parking. They may be operated by either public agencies or private firms. A typical layout of an off-street parking is shown in Figure 2.6. Off street parking can solve a part of the parking problem of major cities. For a satisfactory answer, various types of off-street facilities become unavoidable. The type of off-street facilities commonly considered are:

1. Surface car parking
2. Multistory car parking
3. Roof parking
4. Mechanical car parking
5. Underground car parking

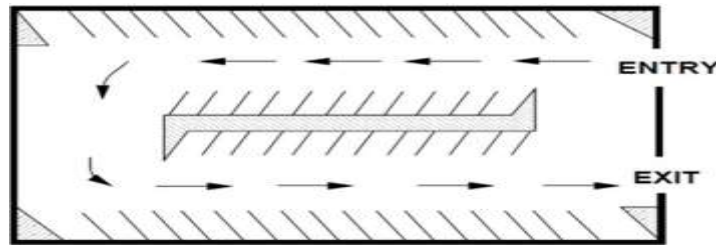


Fig. 5 Illustration of off-street Parking

### 1.3 OBJECTIVES

- To Study the Parking Studies at Busy Area in Tirupati.
- Data Collection of Parked Vehicles
- Provide Adequate Parking Space Demand For Parking.
- To Study About the Demand of Park

### 1.4 PARKING STUDIES

Before taking any measures for the betterment of conditions, data regarding availability of parking space, the extent of its usage and parking demand is essential. It is also required to estimate the parking fares also. Parking surveys are intended to provide all these this information. Since the duration of parking varies with different vehicles, several statistics are used to access the parking need .

#### A. Parking Statistics

1. **Parking Accumulation:** It is defined as the number of vehicles parked at a given instant of time. Normally this is expressed by accumulation curve. Accumulation curve is a graph obtained by plotting the numbers of bays occupied with respect to time.
2. **Parking Volume:** Parking volume is the total number of vehicles parked at a given duration of time. This does not account for repetition of vehicles. The actual volume of vehicles entered in the area is recorded.
3. **Parking Load:** Parking load gives the area under the accumulation curve. It can also be obtained by simply multiplying the numbers of vehicles occupying the parking area at each time interval with the time interval. It is expressed as vehicle hour.
4. **Average Parking Duration:** It is the ratio of total vehicle hours to number of vehicles parked  $\text{Parking duration} = \text{Parking load} / \text{Parking volume}$

#### B. Parking Surveys

Parking surveys are conducted to collect the above said parking statistics. The most common parking surveys conducted are in-out survey, fixed period sampling and license plate method of survey

##### 1. In-out Survey

In this survey, the occupancy count in the selected parking lot is taken at the beginning. Then the number of vehicles that enter the parking lot for a particular time interval is counted. The number of vehicles that leave the parking lot is also taken. The final occupancy in the parking lot is also taken. Here the labor required is very less. Only one person may be enough. But we will not get any data regarding the time duration for which a particular vehicle used that parking lot. Parking duration and turnover is not obtained. Hence we cannot estimate the parking fare from this survey.

## 2. License plate method of Survey

This results in the most accurate and realistic data. In this case of the survey, every parking stall is monitored at a continuous interval of 15 minutes or so and the license plate number is noted down. This will give the data regarding the duration for which a particular vehicle was using the parking bay. This will help in calculating the fare because fare is estimated based on the duration for which the vehicle was parked. If the time interval is shorter, then there are less chances of missing short-term parkers. But this method is very labor intensive.

### PARKING REQUIREMENT

There is some minimum parking requirement for different types of building (IRC-1973).

- 1) For residential plot less than 300 sq.m. only community parking space is required.
- 2) For residential plot area from 500 to 1000Sq.m, minimum one fourth of the open area should be reserved for parking.
- 3) Offices may require at least one space for every 70sq.m Parking area.
- 4) One parking space is enough for 10 seats in a restaurant
- 5) Whereas theatres and cinema halls need to keep only one parking space for 20 seats. Thus the parking requirement is different for different land use zones.

### 1.5 EFFECTS OF PARKING

#### A. Congestion

Parking takes considerable street space leading to the lowering of the road capacity. Hence, speed will be reduced, journey time and delay will also subsequently increase. The operational cost of the vehicle increases, leading to greater economic loss to the community.

#### B. Accidents

Careless maneuvering of parking and un-parking leads to accidents which are referred to as parking accidents. Common type of parking accidents occur while driving out a car from the parking area, careless opening of the doors of parked cars, and while bringing in the vehicle to the parking lot for parking.

#### C. Environmental Pollution

They also cause pollution to the environment because stopping and starting of vehicles while parking and un-parking results in noise and fumes. They also affect the aesthetic beauty of the buildings because cars parked in every available space create a feeling that building rises from a plinth of cars.

#### D. Obstruction to Fire Fighting Operations

Parked vehicles may obstruct the movement of firefighting vehicles. Sometimes they block access to hydrants and access to buildings.



Fig. 6 Improper parking at VV Mahal road

### 1.6 PROHIBITED PARKING

#### a) Near Intersection

The capacity of an intersection is greatly reduced if vehicles are allowed to park on the approaches. Visibility is also adversely affected and safety is reduced. It is the general practice to prohibit parking for a distance of about 50m on the approaches to a major intersection.

**b) Narrow Streets**

Narrow streets with heavy traffic require that all possible measures should be taken to remove obstacles to traffic flow. Prohibition of parking can have salutary effects on traffic flow and congestion. In busy street of central area, it is generally desirable to prohibit parking on two-way streets less than 5.75 m wide and one way streets less than 4.0m wide.

**c) Pedestrian Crossing**

As already mentioned, parking man oeuvres causes accidents and pedestrians are the worst sufferers. Parked cars obstruct the visibility at pedestrian crossing. For these reasons, it is desirable to prohibit parking within about 8 m from the pedestrian crossing.

**d) Structures**

Structures such as bridges, tunnels and underpasses generally have a roadway width less than highway and for this reason it is desirable to prohibit parking on them.

**e) Entrance Driveways**

The vehicle should be prohibited from parking in front of entrance driveways leading to the house and building. The period for which parking to be prohibited should be determined by a careful analysis of traffic condition

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**2. Literature review**
**AN ANALYSIS OF THE SPATIAL DISTRIBUTION OF PARKING SUPPLY POLICY AND DEMAND:**

*Young, Beaton, Satgunarajah* (department of civil engineering, Monash university, Victoria, Australia,2010) studied the spatial distribution of parking of Melbourne City. Parking facility is one of the important transport facility in urban area specially the central districts having high retail activity & employment opportunities. Parking policies & pricing impacts the entire city transportation & land use. Transport planner & Land use planner look for parking places differently. Spatial integration of parking, land use & transport facility is ignored. Parking influences the spatial distribution of transport use & viability of development. Parking should be considered as at metropolitan level than to consider for a particular region.

**BEHAVIORAL CHARACTERISTICS OF CAR PARKING DEMAND( A CASE STUDY OF KOLKATA):**

Generalized parking rates are assumed for estimating the parking demand & other parameters are ignored. *Chakrabarty & Mazumdar* (Institute of town planner, India journal 7-4, of December 2010) in this paper took into consideration various behavioral characteristics of parking demand for various trips, location & with various urban areas. Various factors influencing the parking demand & also their influence on each other was tried to find out.

**ANALYSIS ON PARKING DEMAND OF THE COMMERCIAL BUILDINGS CONSIDERING THE PUBLIC TRANSPORT ACCESSIBILITY:**

*Qin, Xiao, Gan, Pan* (nature and science. 2010; 8(3): 63-68), [ISSN: 1545-0740] analyzed the parking demand of shopping center & markets from the data obtained by conducting parking demand survey at various locations of Beijing. Relationship between parking demand & transport accessibility was analyzed. Parking demand decreases with good & efficient transport facility. Parking demand rate with different public transport accessibility was determined & a parking demand model with different accessibility was provided.

The phenomenon of “difficult parking and disorderly parking”, which has serious impacts on citizens’ quality of life and the running of urban roads Unavailability of sufficient parking spaces at rest areas results in illegal and unsafe parking at entrance/exit ramps, and other unauthorized areas.

It is found that long-term parking is the key reason causing parking congestion, which is due to unclear function orientations of the parking lots. Car-parking has always been an unresolved issue in most municipal cities. Despite efforts by officials of the relevant government departments to put forth new policies and launch various solution proposals from time to time; followed by aggressive actions in the implementation of improvement action plans, their work seldom yield tangible/visible outcome, and the problem remains.

The traffic on roads and parking space has been an area of concern in majority of Indian cities. To avoid these problems, recently many new technologies have been developed that help in solving the parking problems to a great extent.

Thus, day by day due to rapid increase in population in the cities throughout world, industrialization, infrastructure development etc. leads to increased commercial motor vehicle traffic. The available land area is limited. Therefore, management of parking systems to improve parking characteristics is of great need.

Car parking is an issue of significance both at local and at strategic level planning (William, Russell & Michael, 1991). In order to make a firm parking policy, it is desirable to study the parking behaviour and characteristics properly. Number of studies has been done on parking in the past, such as estimation of parking accumulation profiles from the survey data by the cluster analysis technique (Tong, Wong & Leung, 2004) which states that parking supply is an effective means to restrain the car ownership and usage, however acute shortage of parking might drive away commercial and other activities. Shoup (2006) shown that even a small time for searching a curb space for parking will create considerable amount of traffic. Also, the search time increases approximately 20 percent in the commuting time (Van Ommeren, Wentink, Dekkers, 2011). High number of on-street parking spaces along the major road in the urban area affects local traffic operations, especially when traffic is high (Zhenshan, Zhirong, Yi, 2014). They proposed a solution of

“Division, Construction, Adjust & Share” for parking management to the Wujiang district’s urban parking problem. Paul C. Box (2004) studied the hazard and congestion due to on-street parking, specially the angular parking, which is useful for the local officials and planners to improve the safety and operation of the traffic. Since, the old areas are pre-planned, there is limited parking spaces available which creates spill over. Shuang Li, Ru- Hua Zhang, and Yue-Chun Ge (2017) have carried out the comprehensive survey and analysis of parking facilities in old community in Jinan, China and used the parking supply model based on livable environment to determine the suitable scale of parking supply. A study based on stated preference survey was undertaken by David and Jenny in 2001 to investigate the role of parking pricing and supply as well as the location of parking lot on the demand of the parking in the particular area of the Sydney central business district.

In many urban areas, the illegal parking is also the common problem which is hazardous to traffic safety. Also, haphazard parking due to lack of parking demarcation leads to inefficient utilization of the parking lot area. In Greece, the analysis had been carried out (Christina and Constantinos, 2012) regarding the illegal parking behaviour in six different cities for which the data had been collected in the year of 2010. In that, three cities are taken in Athens and other three are smaller Greek cities. It is seen that illegal parking is more in big urban cities due to saturation of parking spaces and also the tendency to park as near as possible to the destination. One of the major solution to reduce the demand for parking is to reduce or stable the private car ownership and mode shift from private car to public transportation. Parking fee is one of most influencing factor for the mode shift. The study of willingness of people to shift from private car to public transport has been done by Kian Ahmadi Azari et al. (2013) in CBD area of Mshhad (Malaysia). They found the elasticity for search time (0.182) greater than that for egress time (0.083) that means demand is more sensitive to the search time.

Recently, Qun Chen et al. (2015) have studied the characteristics of parking in Central Shanghai of Shanghai city, china. The authors have classified the whole survey area based on the land use and analysed parking facilities for the same. Authors also suggested the parking policy for different areas and to use the modern techniques in parking to balance the parking facilities types and to provide choice to parking users

### 3. METHODOLOGY

Identification of parking site



Questionary Survey



Data collection from the site



Results and discussions



Possible recommendations

The parking demand is directly related to the land use of a particular area. It is common that commercial area having large number of offices will require large space for the parking because the people coming in the offices by private vehicle park their vehicle throughout the day and also the extra space for visitors. The area having market place having fluctuating demand throughout the day depending upon the requirement of the visitors. The demand for parking at weekend will be higher compare to week days. The different types of areas having different land use have been selected as study area in Tirupati region such as commercial and business-oriented area, market area.. These are the area having problems of spill over, haphazard parking, violation of enforcement rules and illegal parking, parking on carriageway which mainly arises due to improper parking management, insufficient parking space at some locations, absence of required signs for parking, tendency of the drivers to park the vehicle as near as possible to the final destination, indecorous utilization of the available parking space. So that these locations have been selected to as a study area to analyse and evaluate the parking characteristics and also to suggest the parking guidelines for the same. The procedure followed regarding the data collection is described in the further section of this project. field survey required for parking like In-Out survey, have been carried out to collect the data. data was collected at weekdays to study the typical characteristics. A detailed analysis have been done to evaluate different parking characteristics. Finally, the parking guidelines have been suggested based on the observation and analysis.



#### 4. STUDY AREA

In This project we selected one of busiest road in Tirupati ie. VV mahal road because at these place regular traffic jams will occurs due to improper parking system due to commercial shops, hotels, banks and showrooms etc which helps to study.



Fig. 7 Satellite image of VV Mahal Road

#### 5. DATA COLLECTION

##### 5.1 QUESTIONNAIRE SURVEY

Survey was carried out by making a questionnaire regarding parking problem faced by the public so their responses are recorded and it is represented in pie charts.

A) This question was framed to know about the problems of parking faced by the voters.

Table -1: Survey on problem of parking faced

Sr. No	Categories	Contribution
1	Yes	88.8%
2	No	4.9%
3	Maybe	6.3%

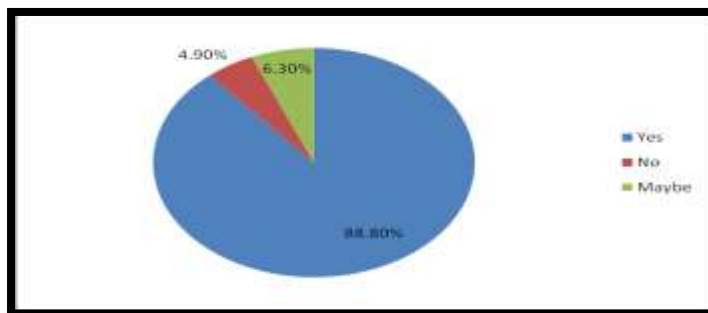


Chart -1: Survey on problem of parking faced

B) This question was framed to know the mode of transportation of the voters.

Table -2: Survey on problem of parking faced

Sr. No	Categories	Contribution
1	Cycle	0.6%
2	2 Wheeler	83.2%
3	4 Wheeler	11.1%

4	Walking	4.6
5	Others	0.5

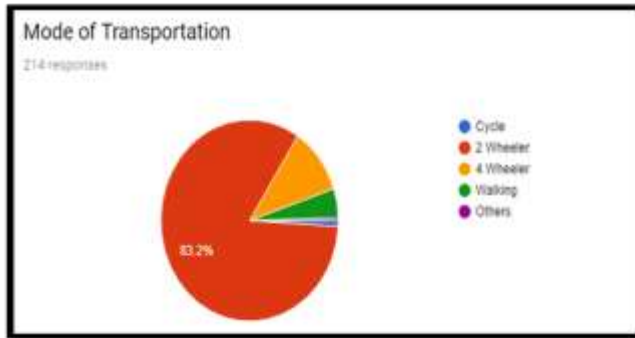


Chart -2: Survey on mode of transportation

C). This question was framed to know whether the users come alone or by sharing the ride

Table-3: Survey on mode of ride

Sr. No	Categories	Contribution
1	Ride sharing	48.4%
2	Alone	56.8%

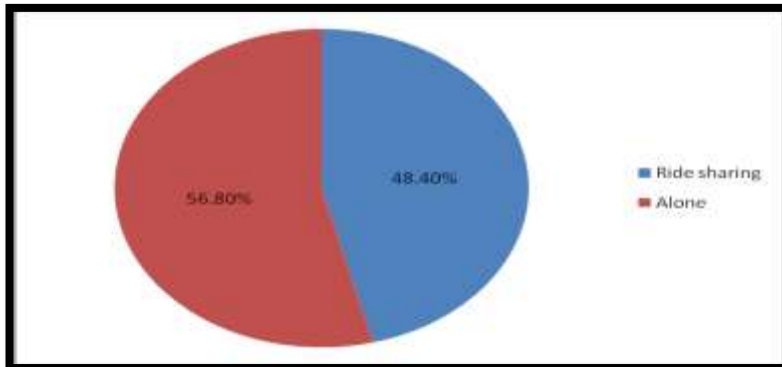


Chart-3: Survey on mode of ride

D) This question was framed to know that how many users face problems while taking out their vehicles due to improper parking.

Table 4: Survey on problem faced due to improper parking

Sr. No	Categories	Contribution
1	Yes	75.5%
2	No	7%
3	Sometimes	17.5%





Chart 4 : Survey on problem faced due to improper parking

E) This question was framed to know the categories of voters wants elevated parking facility or underground parking facility

Table-5: Survey on elevated or underground parking

Sr. No	Categories	Contribution
1	Elevated	52.6%
2	Underground	47.4%

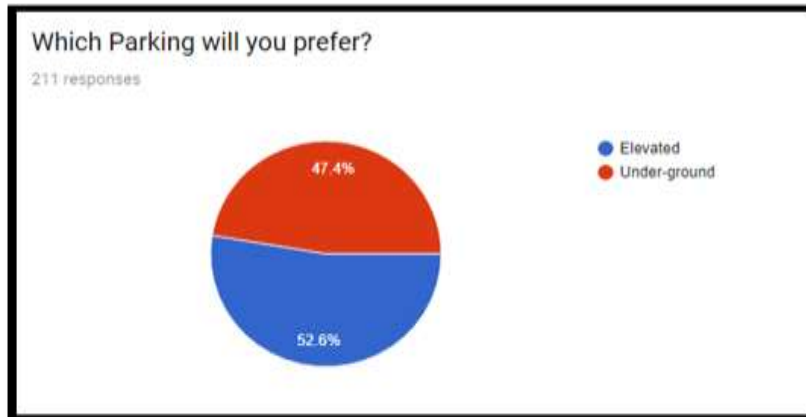


Chart-5: Survey on elevated or underground parking

F) This question was framed to whether the users want free parking or paid parking

Table-6: Survey on Free or paid parking

Sr. No	Categories	Contribution
1	Free parking	98.6%
2	Paid parking	1.4%

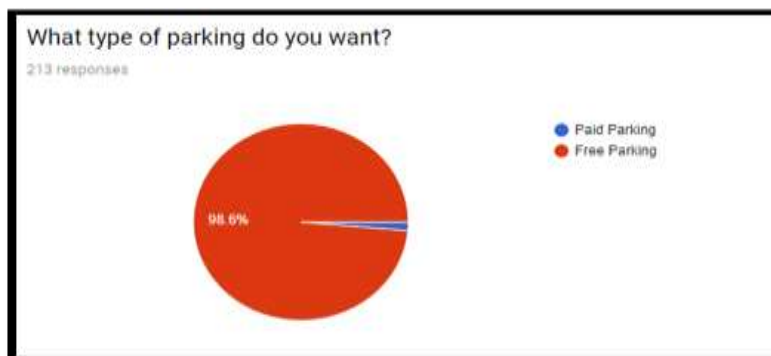


Chart -6: Survey on Free or paid parking

G) This question was framed to know whether the users are interested in using public transport.

Table-7: Survey on use of public transportation facility

Sr. No	Categories	Contribution
1	Yes	31.8 %
2	No	42.1 %
3	May be	26.2 %

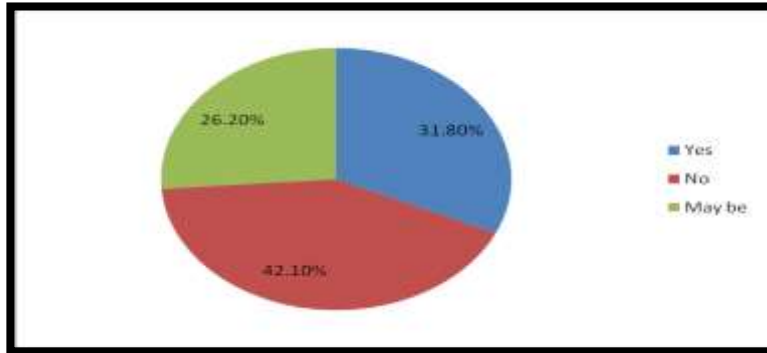


Chart -7: Survey on use of public transportation facility

H) This question was framed to know whether the police had taken action on their vehicles while parking roadside

Table-8: Survey on police had taken action on their vehicles while parking

Sr. No	Categories	Contribution
1	Yes	41 %
2	No	59 %

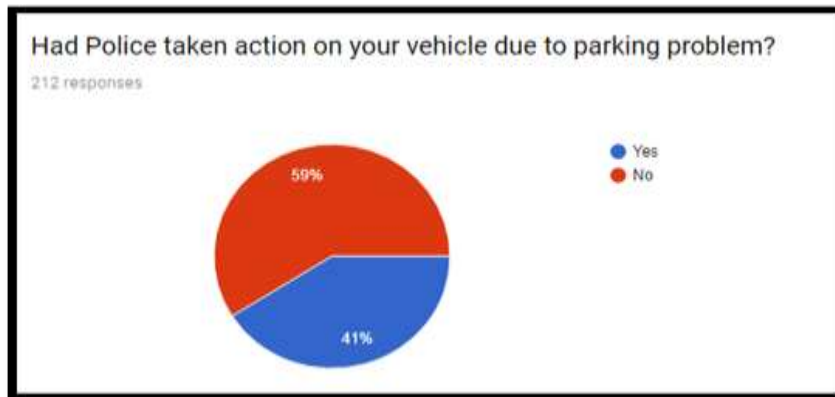


Chart-8: Survey on police had taken action on their vehicles while parking roadside

I) This question was framed to know the user's vehicle got damaged due to improper parking.

Table-9: Survey on user's vehicle got damaged due to improper parking.

Sr. No	Categories	Contribution
1	Yes	70.8 %
2	No	19.8 %
3	Maybe	9.4 %

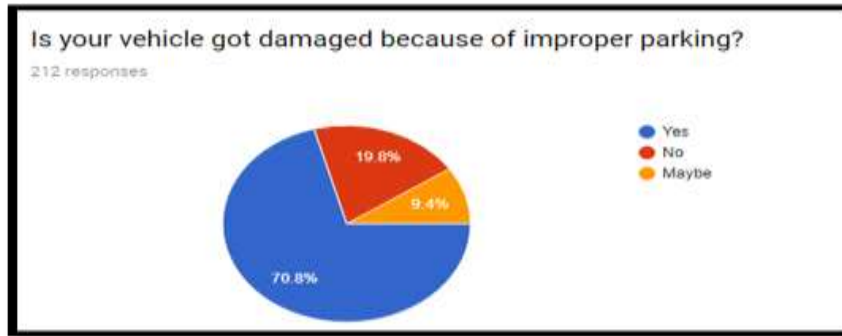


Chart -9: Survey on user's vehicle got damaged due to improper parking.

J) This question was framed to know the categories of voter for making the survey more efficient.

Table-10: Survey on user get space for parking

Sr. No	Categories	Contribution
1	Yes	5.2 %
2	No	60.2 %
3	Sometimes	34.6 %

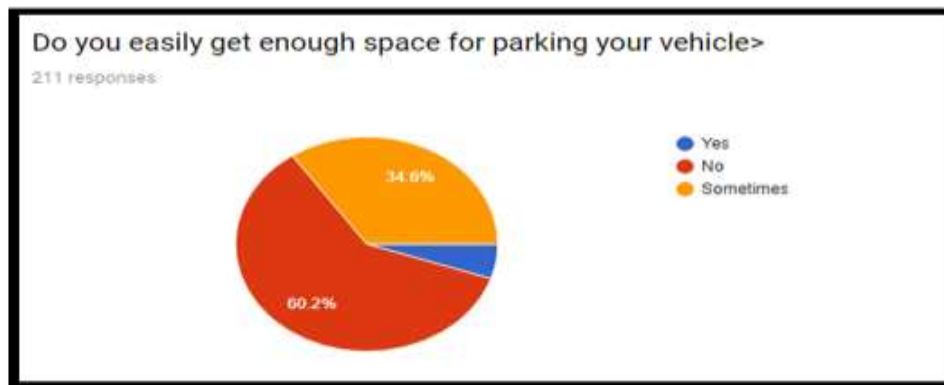


Chart-10: Survey on user get space for parking

5.2 PARKING VOLUME DATA COLLECTION

PLACE: V-V Mahal Road		TIME: 10:00 - 12:00 AM							
S.NO	DATE	DAY	BYCYCLE	2 WHEELER	AUTORICKSHAW	4-WHEELER	TOTAL	MAX CAPACITY	
1	03-05-21	MON	13	723	606	130	1570	850	
2	04-05-21	TUE	10	819	717	113	1659	850	
3	05-05-21	WED	17	712	613	98	1440	850	
4	06-05-21	THU	8	689	576	93	1365	850	
5	07-05-21	FRI	24	830	670	135	1659	850	
6	08-05-21	SAT	33	927	726	151	1837	850	
7	09-05-21	SUN	48	1230	725	172	2175	850	

Fig.8: Data Collection Sheet



Fig.9 Data Collection at VV Mahal Road

6. RESULTS AND DISCUSSIONS

S.NO	DATE	DAYS	TIME	TOTAL PARKED VEHICLE COUNT	MAX CAPACITY	SURPLUS VEHICLES
1	12-01-2023	MON	12:00-12:30PM	1570	850	720
2	13-01-2023	TUE	12:00-12:30PM	1659	850	809
3	14-01-2023	WED	12:00-12:30PM	1440	850	590
4	15-01-2023	THU	12:00-12:30PM	1365	850	515
5	16-01-2023	FRI	12:00-12:30PM	1659	850	809
6	17-01-2023	SAT	12:00-12:30PM	1837	850	987
7	18-01-2023	SUN	12:00-12:30PM	2175	850	1325

Fig. 10 Data sheet

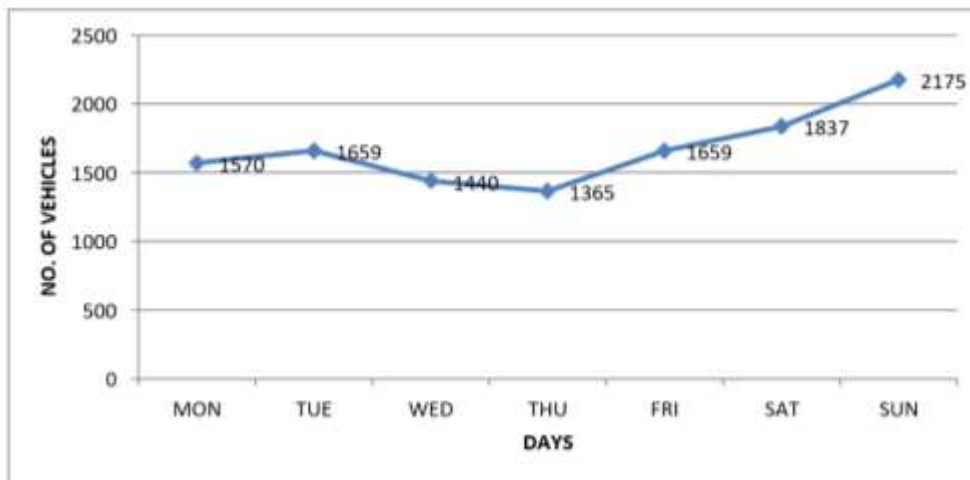


Fig. 11 Data sheet graph

By comparing above results it clearly shows that Sunday and Saturday having peak growth of parking demand as which surplus value is also more 1325 at Sunday

7. CONCLUSION

Parking takes considerable street space leading to the lowering of the road capacity. This results in reduction of speed and increase in journey time and delay. The operational cost of the vehicles increases leading to great economic loss to the community. It is required to remove hazard road parking for an efficient transportation system. The present study conducted at VV mahal road Tirupati indicates that the mid-sized road are also affected by parking problems these days. The main conclusions drawn from the study are.

- The parking facilities, both on-street as well as off-street, are not properly provided at the selected site of the study.
- All the parking areas are fully packed to their on-the road parking capacity and are in-fact overloaded.

- The average utilization factor of the existing on-the-road parking space at selected site is indicating that demand of parking space is more than double the existing parking space available for on-the-road parking.
- When purpose of trip is recreation like watching a movie in the mall, people are ready to pay the parking charges whereas when purpose of trip is shopping / banking / office work of short duration, they try to avoid the paid parking.
- Road currently has parking supply of 850 spaces to support enrollment population of This means that most parking lots are effectively full during peak parking time period. The development created through the research study depicts parking deficiencies within the area, hence parking supplies or demand strategies are necessary.
- The above analysis shows that there is lack of parking space for 1325 vehicles in the campus. So, there is great need for management of parking system
- Finally we recommend that better to provide off street parking system like every building should provide cellar parking, open space parking because road widening is not possible by which it can Satisfy the demand of parking at these road

## REFERENCE

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