

Assessment of parking requirement at university campus located in CBD area.

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ABSTRACT

India is amongst the fastest developing countries of the world adjoined by increase in urbanization leading to the growth of vehicular population in urban areas. This scenario accelerates various problems as congestion, air pollution, and spilling of demand for parking in most urban area. Education campuses are not exempted from these problems. In view of this notion, effectiveness of parking has to be increased by suitable techniques such as implementation of appropriate parking policy in university campus. This study is focused on recent condition of vehicle parking demand in selected faculties and effect of proposed paid parking policy in university campus for both staff and student of M. S. University in city of Vadodara. The parking demand estimation study has revealed spilling over of existing supply capacity in selected colleges. All colleges are located in CBD area Vadodara city locating in Gujarat state of INDIA. The response model developed for proposed paid parking policy using Binary and Multinomial logistic regression analysis has indicated that household income is more significant than any of the trip variable for making the decision. The study provides useful input for framing parking policy in University campus.

Keyword:-Urbanization, Air Pollution, Parking Policy, Parking Demand etc....

1. INTRODUCTION

Introduction related Nowadays, Parking is universal problem and university campus are also facing scare of space, most of the University facing the parking problem, to reduce the problem, my aim is to reduce vehicles in campus as well as revenue generated through it. This will be utilized for providing better parking facility as well for improvement of campus.

Campus parking is an essential component of any college campus located into CBD OR nearby CBD area. With growth of population as well as vehicle demand increase. Now, the colleges also increase their seat to balance with the population demand in situation parking demand increase day every day. Peaceful study area turns into the chaotic & hazardous condition.

Every vehicle trip required parking at its destination; parking is integral part of college campus. Providing parking is the major problem for college authority. Parking conflict is very often in campus, spaces available for parking are not sufficient. Parking management required otherwise situation get worst without solution. 'When we delay the harvest, the fruits rot. When we delay resolving problems, they continue to grow.' – Paulo Cohelo

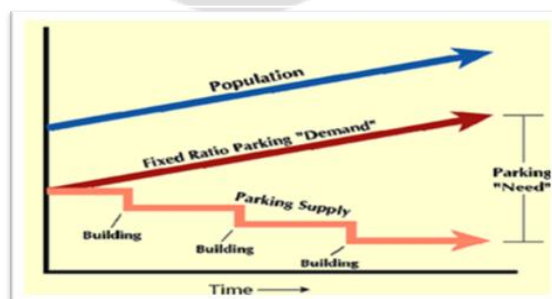


Figure:-0. Demand and supply not satisfied (Source: Pierce County Higher Education Sustainability Conference Feb 2008)

- When price goes up, demand goes down.
- Paid parking policy always discourage vehicle user and thus demand goes down
- Parking demand projections should include effect of price on demand - built otherwise Future too will be.

1.1 Parking Space

Fundamentally, parking is a problem of space. With the growing culture of automobile dependency in Indian cities, the demand for parking spaces has sky rocketed. This is especially because the infra-structural growth of our cities is unable to keep up with the growing demand for spaces to park. The resultant scarcity of parking space has begun to spill over to other aspects of urban life in the form of congestion, fuel loss, dispersed land use and low air quality. The parking problem can be viewed as one of supply or of parking management. The first is that of too few spaces being available for parking and the solution for this is to build more parking spaces. The second is that the available spaces are not used to their maximum capacity. The solution to the latter is parking management. Cities across the world have been successful in using parking management as a tool to influence consumer choices and reduce travel by private vehicles. Provided that an efficient public transit system is in place, appropriate parking charges and restricting parking in various areas have led to a significant shift from private to public modes of transport. Private transport entails both monetary or 'out-of-pocket' costs and hidden social costs. The monetary costs of fuel, tolls and tax are borne directly by the user.



Figure:-2.Surface parking with land cost double against Structured parking Pierce County Higher Education Sustainability Conference Feb 2008

Vehicle growth for Vadodara city

Currently in Vadodara city, the private vehicles such as two wheelers & private cars has a tremendous growth due to which transport problems are becoming hazardous & out of control causing much mind crust to planning engineers. The growth of autos is also imposing traffic related problems as seen in graphs below causing congestion problems and non-integration of transit services.

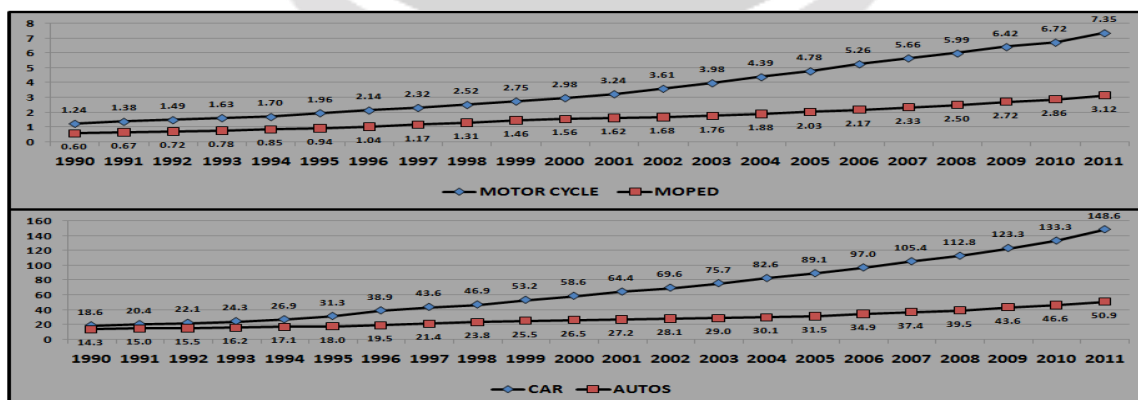


Figure:-3.Vehicle growth of Vadodara city (source: RTO Vadodara city)

1.2 Objectives of the study

1. To study the existing parking demand in the selected college of the M.S.U.
2. To work out various parking parameters e.g. parking accumulation, parking load
3. To formulate parking policy for the management of parking demand in the campus.
4. To develop behavioral model for the response to proposed paid parking policy.

1.3 Literature review general-1

Parking in college campus is the key concern for authority. Evaluation of any particular system is to measure the gap between the system required to perform and in actual how the system functioning. Campus parking system generally evaluate based on the technical issues, operational evaluation, organizational evaluation, and user acceptance evaluation. This study focuses on the response to paid parking policy and its probable effect on travel behavior.

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Parking strategies adopted in various universities

The University of Georgia:

Prioritize parking permit distribution. In 2002, The University of Georgia instituted a formula to assign parking permits based on the requester's role on campus and longevity. A customized computer program determines the rankings. "It used to be called a 'hunting license,'" quips Walter. "We would give parking permits to anyone and you just had to find a spot." Now faculty might share a lot with senior staff, or even students, leading to better lot utilization.

Binghamton University (N.Y.)

Make meters mobile. Binghamton University (N.Y.) introduced portable parking meters, which hang from a car's rearview mirror, during the 2006-2007 academic years. Time is purchased in advance at a cost of 60 cents per hour with a \$20 refundable deposit for the meter. The program is most popular with nontraditional students and local residents who use the running track. It expands meter parking on campus since users don't have to find an open metered space in order to park. Other users: the University of Wisconsin-Milwaukee, the University of Massachusetts, Washington State University, and the University of California, Santa Cruz.

2. METHODOLOGY

2.1 General

The purpose of the study is to develop the evaluation methodology for improvement in parking policy campus area to develop efficient parking in colleges. The methodology adopted in the present study is presented briefly in below.

Problem Definition:

Significant modal is needed to improve parking in college campus of all national college for future betterment, an inclusive society and clean environment for study. A significant trend amongst many student and staff not to use public transport or shared vehicle in the face of increasing congestion, pollution in college campus. Too much parking space acquired by vehicle which reduces space for future development of college and in also reduces sports facility and recreation facility at the cost.

2.2 Data Collection

Data collection is the most fundamental part of study. Parking survey is conducted in all three campuses with the 'License plate method'. Questionnaire survey method has been selected to conduct on site at all three campuses covering all departments as well all year of student and staff with different designation. Data was collected by me and volunteer at Study Area of all three campus of M.S. University of Vadodara City. More than 500 samples are collected out of which 400 samples are for further analysis. Vadodara, also known as Baroda, Sayaji nagari, Sanskari nagari. It is the third largest city in the state of Gujarat, India. The population of Vadodara city is 18.22 lakhs (As

per Census 2011) having an area of 149 km². Sex ratio is 923 female per1000 males; population density is 552 persons per kilometer.

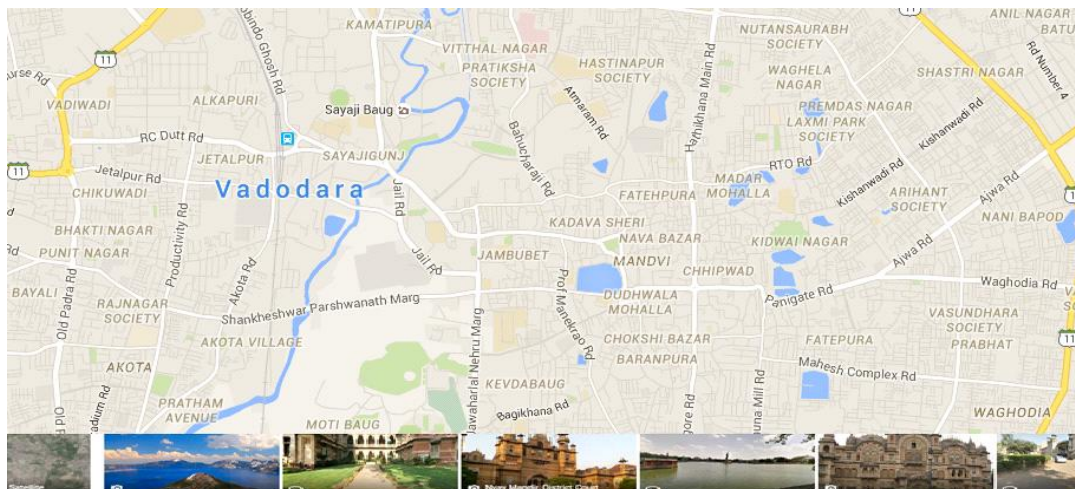


Figure:-4.Area of Vadodara city

The M.S.University of Vadodara established in 1949. More than 1200 qualified faculty and 1500 administrative staff and more than 35000 students. It is having an area of 275 acre of land. It made of 13 faculties having 90 departments.

Out of 13 faculties I have selected 3 faculties because sufficient number of samples can be collected.

- 1) Faculty of Technology.
- 2) Faculty of Polytechnic.
- 3) Faculty of Commerce.

About The Study Area:

- 1) Free parking is provided to student, staff and visitor.
- 2) In these area, are establish various kind of department of various courses.
- 3) In these building, many students, faculty and others are work within the building are comes with their own vehicle.
- 4) Majority of space occupied by 2w
- 5) The occupancy of parking is concentrated near respective department with often chaotic behavior on sides of internal road as well as on the carriage way of internal road.
- 6) Occupancy of 4w is only 10% of total parking demand.
- 7) All faculties have separate parking space for 2w & 4w however sidewalks are not provided in any of the faculty for safe movement of pedestrian.
- 8) In certain faculties access demand for parking usually create pressure on available pedestrian area of the faculties.
- 9) At most of faculty's available open space are occupied for parking resulting in reduction in space available for sports.
- 10) Colleges will not expand its structure.

1). The Faculty of commerce

Total area of faculty	8096.65 sq.m.
Area of parking	1773 sq.m (22% of total area)
Student	4000
Teaching staff	142



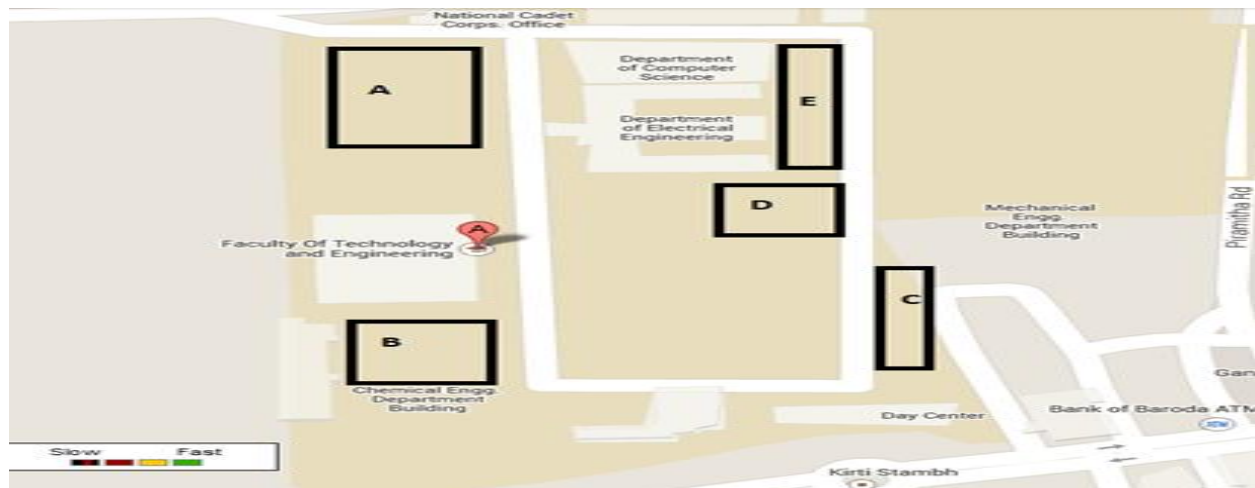
2). Polytechnic College

Total area of faculty	36462 sq.m.
Area of parking	1637 sq.m(5% of total area)
Student	1481
Teaching staff	97
Non-teaching staff	10



3). Faculty of Technology

Total area of faculty	63075sq.m
Area of parking	3585 sq.m (6% of total area)
Student	4000
Teaching staff	142
Non-teaching staff	26



	Faculty of technology	Faculty of commerce	Polytechnic college.
Area in sq.m.	3584.72	2392.90	1636.53

LAND COST AS PER VADODARA MUNICIPAL CORPORATION JANTRI 2011

Land cost valuation

Zone no.	Rate of development per sq.mt	Residential	Office	Shop	Rate of open land of industry per sq.mt	Rate of agricultural per sq.mt
		Rate land + construction (Rs.per.sq.mt)				
B/20/1 (faculty of technology)	25000	12000	30000	55000	20000	--
VV1/1 (faculty of commerce)	25000	25000	15000	20000	45000	15000
VV1/3 (polytechnic college)	18000	10000	15000	25000	14500	10000

Source: Stamp Duty Annual Statement of Rates OF VMC

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3. DATA ANALYSIS

General

Data analysis is the process of producing the relevant outcomes from the data collected. Data collected using the parking survey and the questionnaire survey is analyzed using different statistical software. Collected data is

converted to appropriate scale before feed into any software. Evaluation of user acceptance is the simple process in which the users' opinions about system are determined

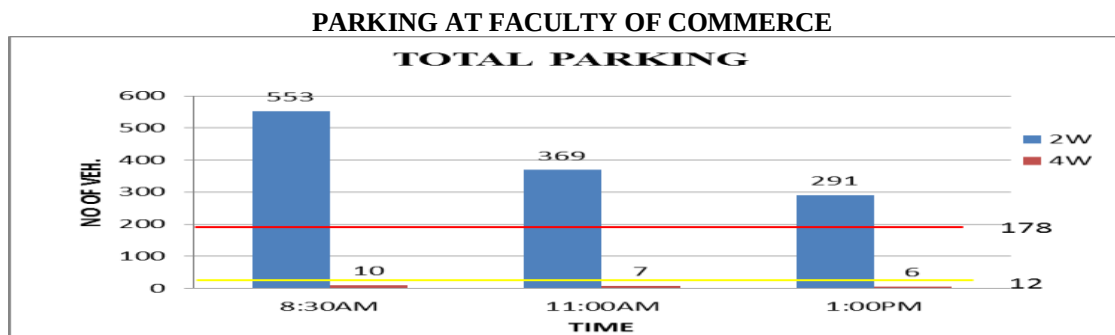


Chart.1 Day 1 parking at Faculty of commerce

Parking data collected from “license plate method” at faculty of commerce at day 1 out of three days, shows that available space for parking are 178 bays for 2w and 12 bays for 4w and highest parked vehicle in the morning are figure shows that the parking is almost 3 times of its capacity in the morning 8:30AM, almost 2 times at 11:00AM and 1.5times at 1:00 PM. Authority needs more man power (parking wardens) to control the situation. He has challenging task to meet the high demand big challenge to handle. User conflicts are very common

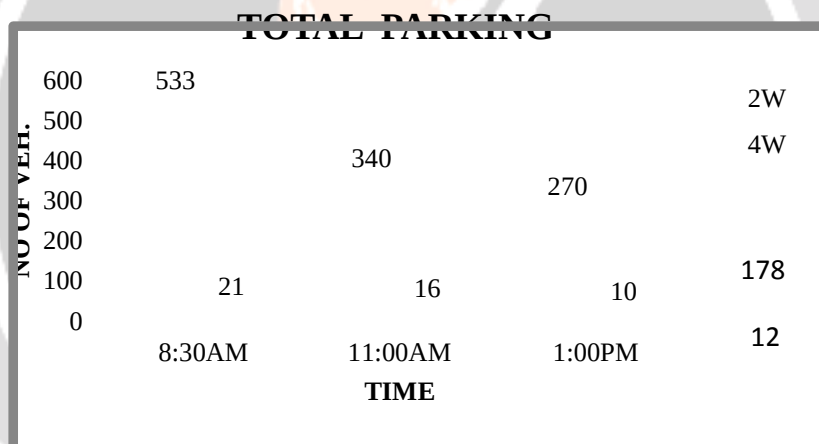


Chart.2 Day 2 parking at Faculty of Commerce

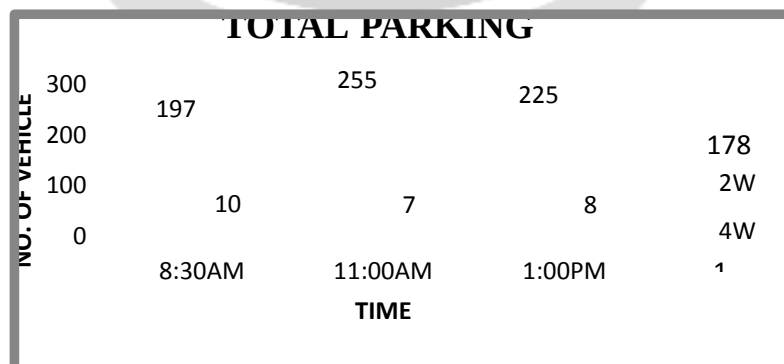


Chart.3 Day 3 Parking at Faculty of Commerce

Parking data collected from “license plate method” at faculty of commerce at day 3 out of three days, shows that available space for parking are 178 bays for 2w and 12 bays for 4w and highest parked vehicle in the morning are figure shows that normal parking almost higher than its capacity. Everybody can park their vehicle easily and there is no conflict.

The above figure shows the total number of parked vehicles at Faculty of Commerce on three days. From the figures, it is observed that total number of 2w and 4w are varied and maximum vehicles counted as 553 and 10 respectively on day-1. The corresponding maximum values are as 533 and 21 on day-2. While on the third day, the 2w and 4w observed as 97 and zero respectively. There is only one parking lot available having the area of 1435 sq.m. There are not marked bays at parking area.

PARKING AT POLYTECHNIC COLLEGE



Chart.4 Day 1 parking Polytechnic college

Above figure shows the parking at polytechnic college at day 1 out of three day survey conducted. Parking space available 202 bays for 2w and 21 bays for 4w. this is the capacity of main parking area in college campus. . Highest vehicle parked at 11:00AM. Parking is also done at internal road; vehicle parked at there shows as illegal parking. Total vehicle parked at both area shows in single figure total parking. Total parking shows that parking area on its full capacity.to match morning parking facility there are need of public transport from different area In the morning time.

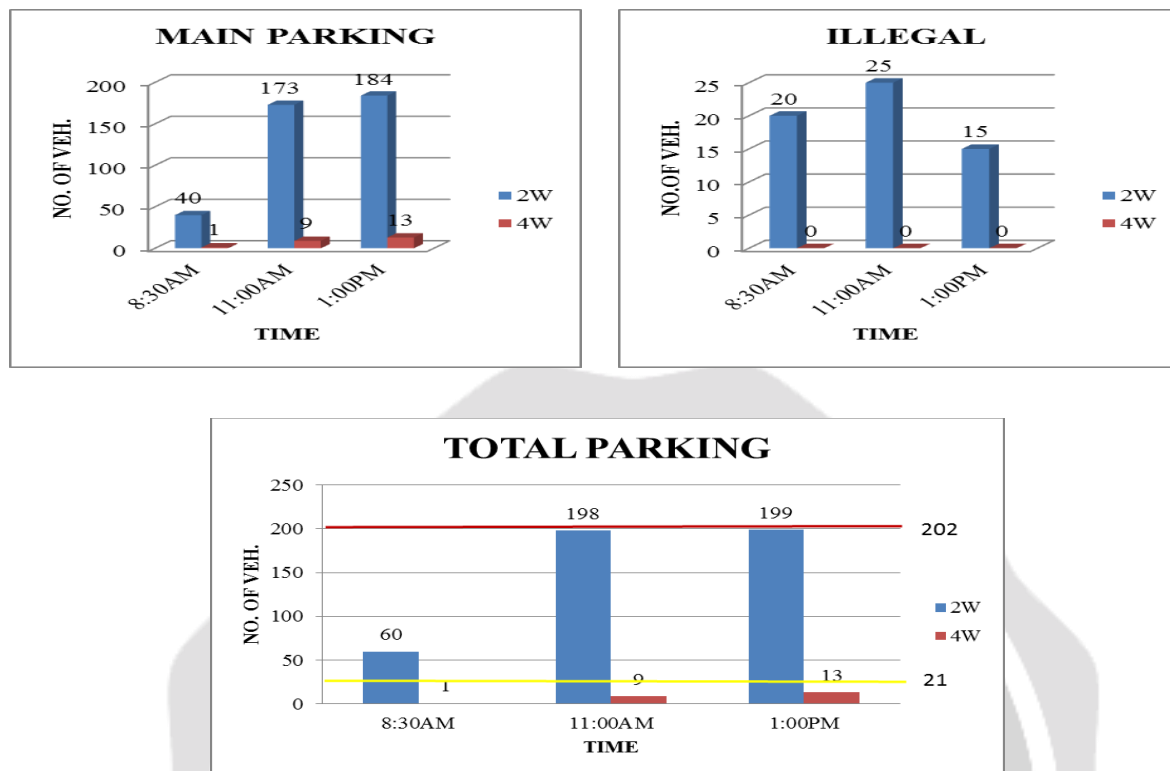
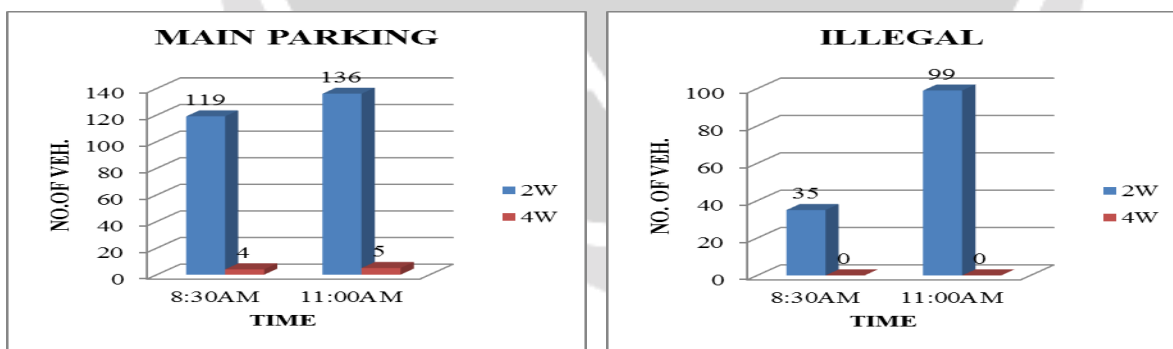


Chart.5 Day 2 parking at Polytechnic college

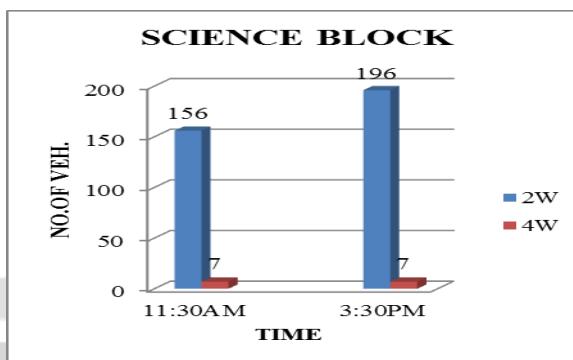
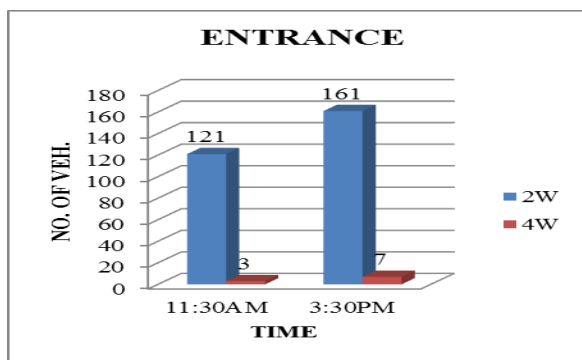
Above figure shows the parking at polytechnic college at day 2 out of three day survey conducted. Parking space available 202 bays for 2w and 21 bays for 4w. this is the capacity of main parking area in college campus. Highest vehicle parked at 1:00PM. Parking is also done at internal road; vehicle parked at there shows as illegal parking. Adding vehicle parked at both area shows in single figure total parking. Total parking shows that area on its full capacity.



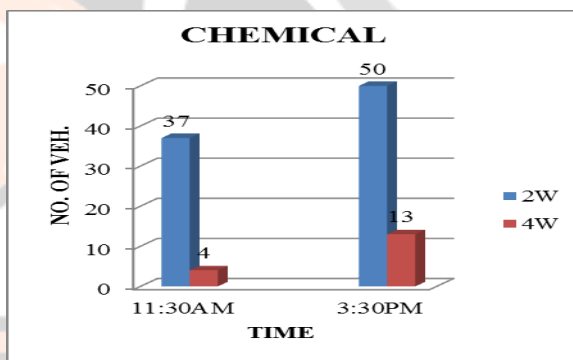
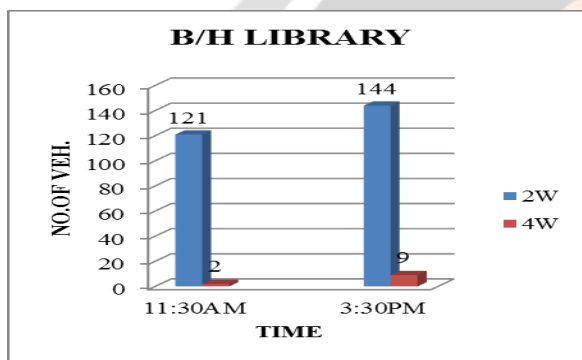
Above figure shows the parking at polytechnic college at day 3 out of three day survey conducted. There is event day; exam is going on at that day. Reading was taken just before of starting exam and before completion of exam. Parking space available 202 bays for 2w and 21 bays for 4w. This is the capacity of main parking area in college campus. Highest vehicle parked at 1:00PM. Parking is also done at internal road; vehicle parked at there shows as illegal parking. Adding vehicle parked at both area shows in single figure total parking. At polytechnic college only one parking lot available and other parking done at the entrance on both sides of road which term as illegal parking. Highest numbers of Vehicle Park are 235 number of 2W and 10 number of 4W at one time. There is less number of student coming with own vehicle in compare of faculty of technology and faculty of

commerce. But parking lot running at its full capacity. Most of the college staff coming with the vehicle. Total area occupied for parking is 1636.53 sq.m. There is marked bay for parking.

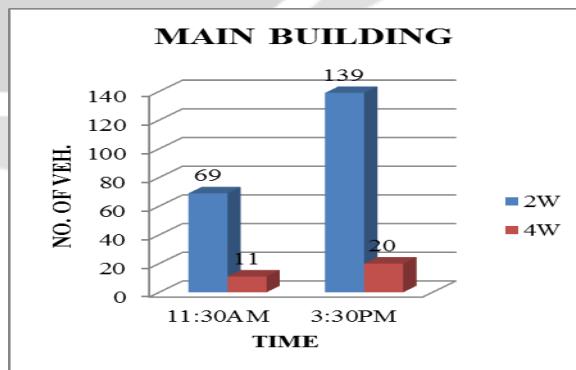
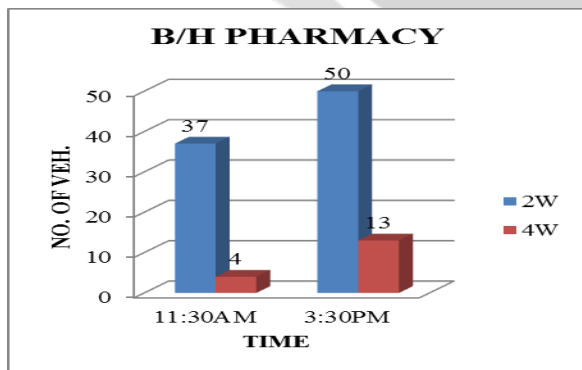
PARKING AT FACULTY OF TECHNOLOGY



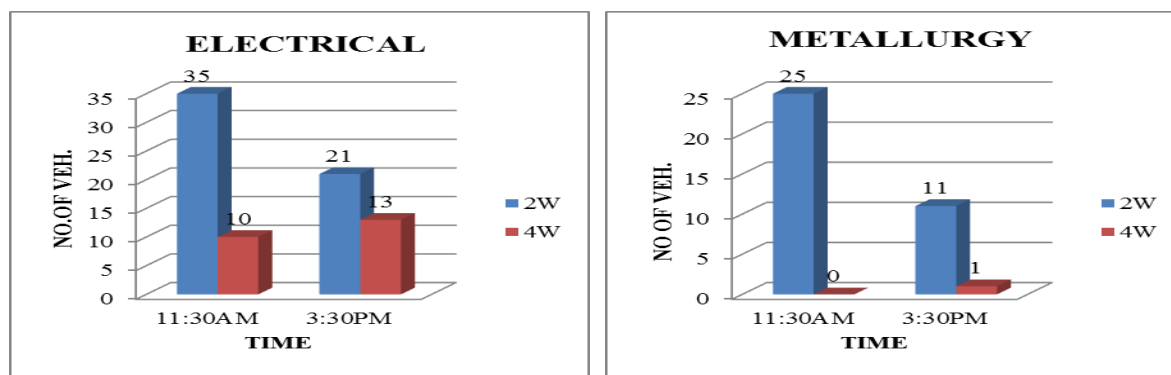
Parking of day1 at main entrance parking divided in to entrance and near science block. It has capacity of 393 bays of 2w and 18 bays for 4w. most of the parking done by student. Total 357 number of 2w and 14 number of 4w are registered at 3:30PM, which is almost of its capacity. Vehicle not parked in regular manner.



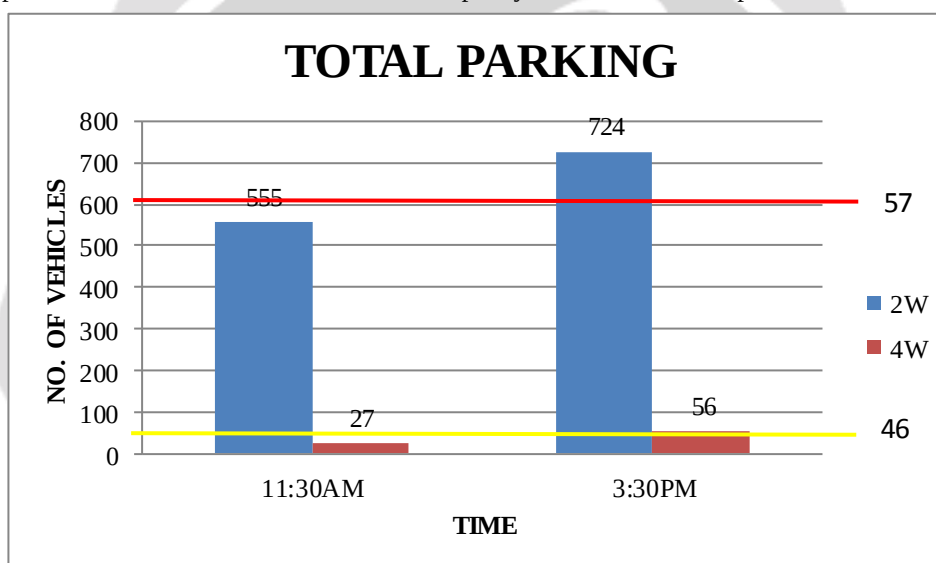
Parking of day1 at behind library on internal road termed as illegal parking and in front of chemical building have marked space 32 bay for 2w and 5 bay for 4w. highest number of parking done behind library are 144 number of 2w and 9 number of 4w. most of the parking was done by student. at chemical department highest number of parking on 3:30PM. Parking is almost 2 times of its capacity.



Parking of day1 at behind pharmacy there are parking for 10 number of 2w and 5 number of 4w. There is no marked parking space and at near main building, there are parking for 65 number of 2w. Highest number of vehicle registered at behind pharmacy and at near main building on 3:30PM. Vehicle above its capacity because of vehicle parked on the internal road.

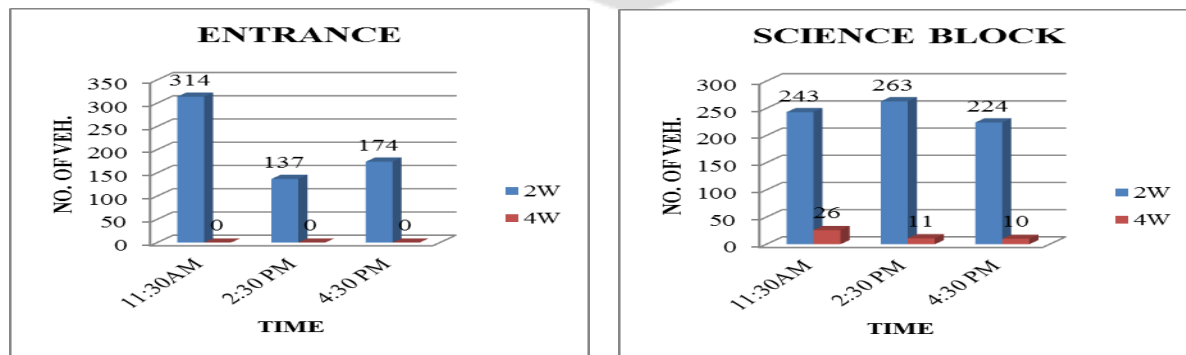


Parking of day1 at near electrical department there are parking for 72 number of 2w and 20 number of 4w. There is no marked parking space and at near electrical building. Near metallurgy department all parking is done on both sides of road without marking actually space is for pedestrian. Highest number of vehicle registered at 11:30AM at metallurgy department at 11:30AM. Vehicle above its capacity because of vehicle parked on the internal road.

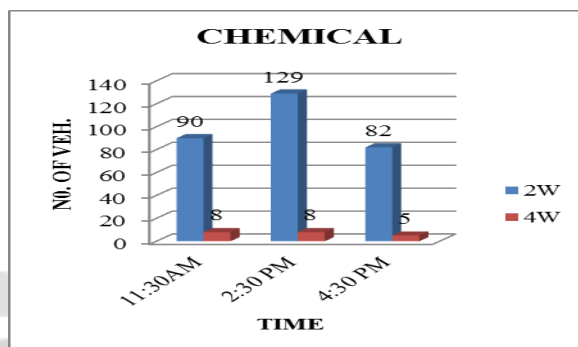
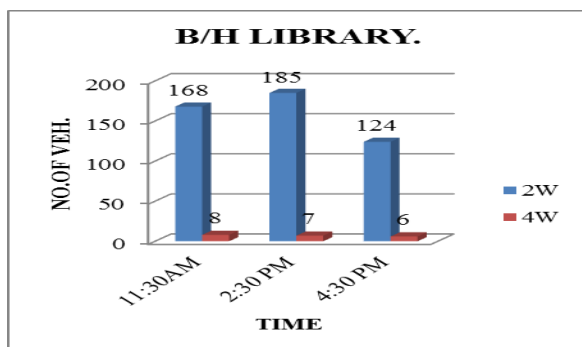


Total parking on day1 shows that there are 570 bays for 2w and 46 bays for 4w in whole campus of faculty of technology. Parking is at its full capacity. Highest parking 724 number of 2w and 56 number of 4w on 3:30PM. On day1, exam is going on that's why parked vehicle are less than normal college day. There is no enforcement for parking. Vehicles in morning are less than afternoon.

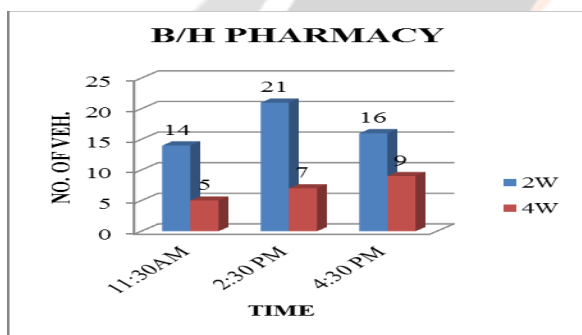
Day.2



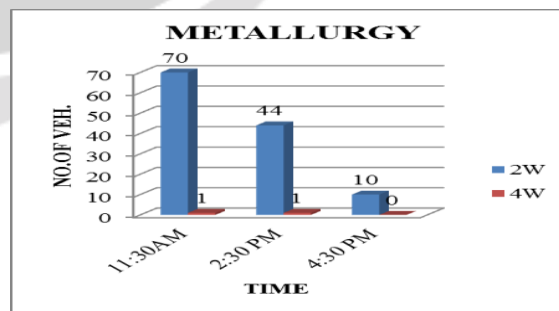
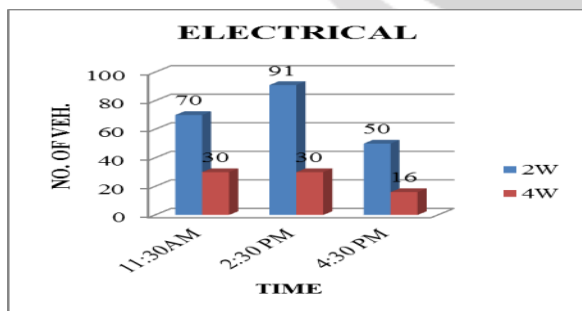
Parking of day2 at main entrance parking divided in to entrance and near science block. It has capacity of 393 bays of 2w and 18 bays for 4w. most of the parking done by student. Total 557 number of 2w and 26 number of 4w are registered at 11:30AM, which is almost 2 times of its capacity. Vehicles are not parked in regular manner. Vehicles are less in afternoon at 4:30PM.



Parking of day2 at behind library on internal road termed as illegal parking and in front of chemical building have marked space 32 bay for 2w and 5 bay for 4w. highest number of parking done behind library are 185 number of 2w and 8 number of 4w. Most of the parking was done by student. At chemical department highest number of parking is done at 2:30PM. Parking is almost 3 times of its capacity.



Parking of day2 at behind pharmacy there are parking for 10 number of 2w and 5 number of 4w. There is no marked parking space and at near main building, there are parking for 65 number of 2w. Highest number of vehicle registered 21 number of 2w and 7 number of 4w on 2:30PM at behind pharmacy and 72 number of 2w and 6 numbers 4w on 11:30AM at near main building. Vehicle above its capacity because of vehicle parked on the internal road.



Parking of day2 at near electrical department there are parking for 72 number of 2w and 20 number of 4w. There is not marked parking space and at near electrical building. Near metallurgy department all parking is done on both sides of road without marking actually space is for pedestrian. Highest number of vehicle registered 91 number of 2w and 30 number of 4w on 2:30PM at metallurgy department 70 numbers of 2w and 1 numbers of 4w on 11:30AM. Vehicle above its capacity because of vehicle parked on the internal road.

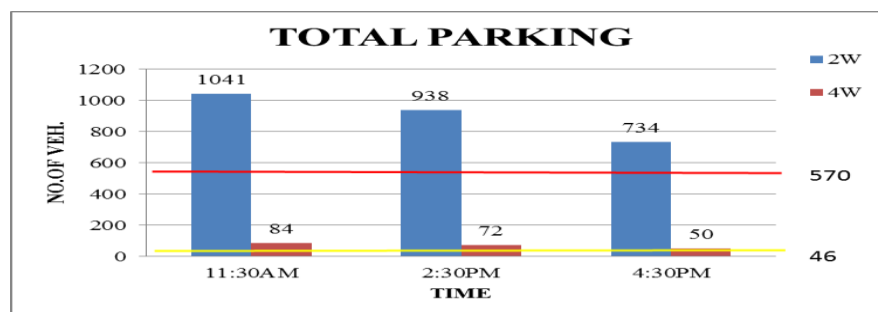
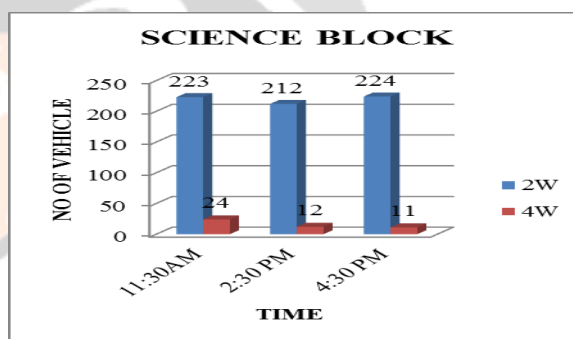
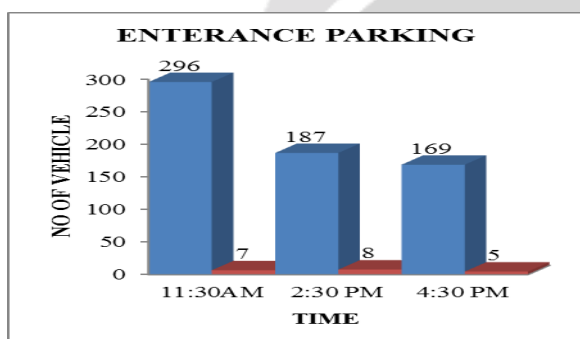
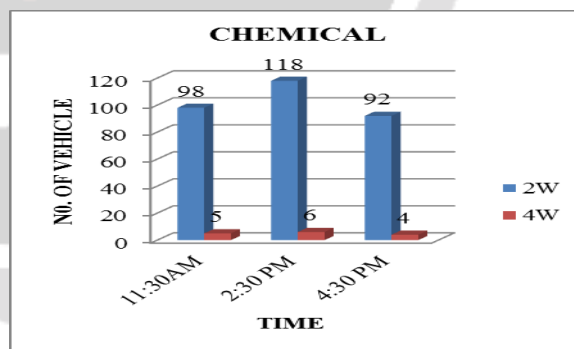
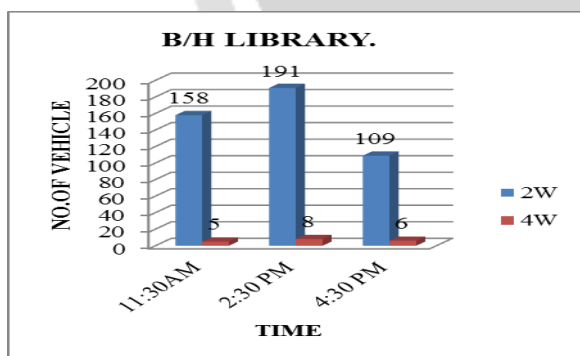


Chart.6 Day 2 Total parking at Faculty of technology

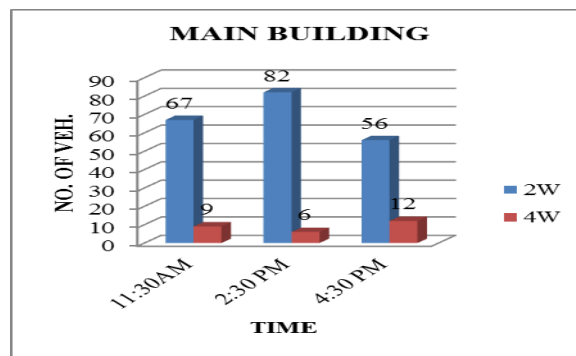
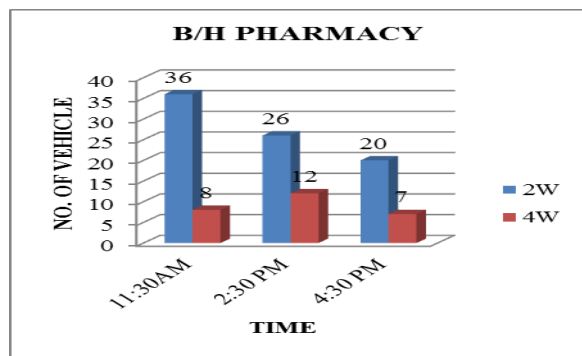
Total parking on day2 shows that there are 570 bays for 2w and 46 bays for 4w in whole campus of faculty of technology. Parking at its full capacity, Almost 2 times of its capacity. Highest parked vehicles 1041 numbers of 2w and 84 numbers of 4w on 11:30AM. On day2, Regular teaching is going on that's why parked vehicle are more than exam day. Figure shows that the in the morning parking is full as day go on its decreased. Situation will getting worst if there is no action.



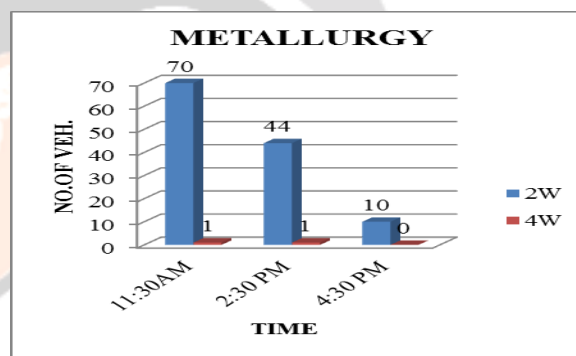
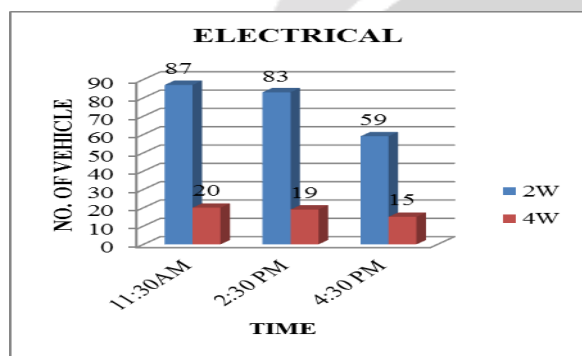
Parking of day3 at main entrance parking divided in to entrance and near science block. It has capacity of 393 bays of 2w and 18 bays for 4w. most of the parking done by student. Highest numbers of vehicles are registered at 11:30AM, which is almost of its capacity. Vehicle not parked in regular manner



Parking of day3 at behind library on internal road termed as illegal parking and in front of chemical building have marked space 32 bay for 2w and 5 bay for 4w. highest number of parking done behind library are 185 number of 2w and 8 number of 4w at 11:30AM, Most of the parking was done by student. At chemical department highest number of parking register are 129 number of 2w and 8 numbers of 4w on 3:30PM. Parking is almost 3 times of its capacity.



Parking of day3 at behind pharmacy there are parking for 10 number of 2w and 5 number of 4w. There is no marked parking space and at near main building, there are parking for 65 number of 2w. Highest number of vehicle registered 21 number of 2w and 5 numbers of 4w on 2:30PM at behind pharmacy and 72 number of 2w and 6 number 4w on 11:30AM at near main building. Vehicle above its capacity because of vehicle parked on the internal road.



Parking of day3 at near electrical department there are parking for 72 number of 2w and 20 number of 4w. There is no marked parking space and at near electrical building. Near metallurgy department all parking is done on both sides of road without marking actually space is for pedestrian. Highest number of vehicle registered 91 numbers of 2w and 30 numbers of 4w on 11:30AM at metallurgy department 70 numbers of 2w and 1 numbers of 4w on 11:30AM. Vehicle above its capacity because of vehicle parked on the internal road.

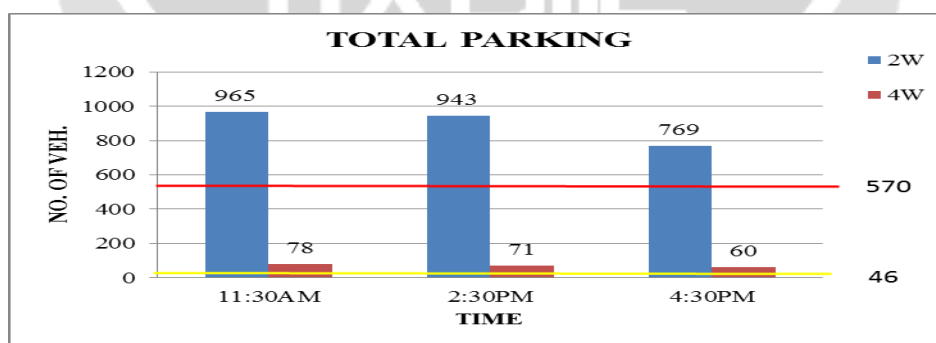


Chart.7 Day 3 Total parking at Faculty of technology

Total parking on day3 shows that there are 570 bays for 2w and 46 bays for 4w in whole campus of faculty of technology. Parking at its full capacity, Almost 2 times of its capacity. Highest parking at 11:30AM. On day2, Regular teaching is going on that's why parked vehicle are more than exam day. You can see vehicles at everywhere in whole campus.

Parking at faculty of technology where highest numbers of vehicle registered are 1079 2W and 84 4W registered. It has 8 parking places where generally parking has done. Almost double parking in campus against available parking of 570 bay for 2w and 46 bay for 4w. Also there are parking places where illegal parking has done. There is too much vehicle

on internal road that parked haphazardly. There is no marking in the parking area except entrance parking area. Total parking area is 3584.72 sq.m. Too much area is covered in parking which reduce recreation activity among student. Sports ground converted into parking area. Only 40% of student and staff coming by their own vehicle if in near future percentage will increased than there is no new place for parking and situation will be worst in near future. College authority cannot handle the situation; there must be some measurable action immediately.

Preliminary Analysis

Table-1. Parking cost calculation 2w

CALCULATION FOR TWO WHEELER			
Type	Faculty of commerce	Polytechnic college	Faculty of technology
Area of two wheeler	$2.5 \times 0.85 = 2.125 \text{ sq.m}$	$2.5 \times 0.85 = 2.125 \text{ sq.m}$	$2.5 \times 0.85 = 2.125 \text{ sq.m}$
Land cost	Rs 24000 / sq.m	Rs 19500 / sq.m	Rs 41500 / sq.m
Calculation (land cost # x area of two wheeler)	$24000 \times 2.125 =$ Rs.51000	$19500 \times 2.125 =$ Rs.41438	$41500 \times 2.125 =$ Rs.88187
Rent as per land cost (10% of land value*)	Rs.5100	Rs.4144	Rs.8819
Parking charge per Hr. Rent / month(12) x days(30) x normal parking hr.(7)	Rs.2.1 per hour	Rs.1.6 per hour	Rs.3.5 per hour

As per VUDA Jantri. *As per GDCR Norms.

Table-2. Parking cost calculation 4w

CALCULATION FOR FOUR WHEELER			
Type	Faculty of commerce	Polytechnic college	Faculty of technology
Area of two wheeler	$5.0 \times 2.5 = 12.5 \text{ sq.m}$	$5.0 \times 2.5 = 12.5 \text{ sq.m}$	$5.0 \times 2.5 = 12.5 \text{ sq.m}$
Land cost	Rs 24000 / sq.m	Rs 19500 / sq.m	Rs 41500 / sq.m
Calculation (land cost x area of two wheeler)	$24000 \times 12.5 =$ Rs.300000	$19500 \times 12.5 =$ Rs.243750	$41500 \times 12.5 =$ Rs.518750
Rent as per land cost (10% of land value)	Rs.30000	Rs.24375	Rs.51875
Parking charge per Hr. Rent / month(12) x days(30) x normal parking hr.(7)	Rs.11.2 per hour	Rs.9.7 per hour	Rs.20.0 per hour

As per VUDA Jantri. * As per GDCR Norms.

NOMINAL CHARGES (RS.) FOR PARKING.							
SR. NO.	PARKING DURATION	Faculty of technology		Faculty of commerce		Polytechnic college	
		2W	4W	2W	4W	2W	4W
1	< 3 hr.	29	169	19	113	11	67.5
2	Up to 5 hr.	19	113	13	76	8	45
3	Up To 7hr.	19	113	13	76	8	45
4	Day	67	395	45	265	27	158

Parking charges (adjusted as per calculation.)

As per IRC (Indian road congress) parking area for 2W is 2.185 sq.m. (0.85m X 1.5m) and for 4W is 12.5 sq.m.(2.5m X 5.0m). Land cost of three different colleges is taken from VMC Jantri. Land area of parked vehicle is calculated by multiplying with land cost. Then as per guideline of rent policy, 10% of total cost consider as yearly rent of that parked vehicle land. Then to find hourly cost, divide cost by month, days maximum parking hour of the day.(normally vehicle parked for maximum 7 hour)

4. CONCLUSIONS

1. Demand of the parking in this selected faculty of selected area is exceeding the available provided space.
2. The present free parking policy without regulation has resulted in chaotic parking behavior in most of the faculties.
3. Parking inventory survey reveal that demand steals over the supply in faculty of commerce and faculty of technology whereas it just meets with the supply in Polytechnic College.
4. The parking demand estimation indicate that shows that the though the timing of commerce and polytechnic are same, there was a variation in the peak demand timing of the both. Hence appropriate public transport scheduling can be worked out to encourage appreciable model shift in favor of public transport.
5. The proposed park and pay policy is likely to make positive effect on the demand management of the available parking space as highest responses are obtained in favor of shift to shared vehicle.
6. The revenue generated from the proposed paid parking policy may be utilized in improving and regulating existing parking facility.
7. Positive response for the bicycle use on account of the paid parking policy can be tested by compulsion use of bicycle on particular days of the week.

5. REFERENCES

- [1]. <https://www.aboutcivil.org/traffic-volume-study.html>
- [2]. <https://en.wikipedia.org>
- [3]. www.lgam.info