International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-8, June 2020

# Parking Space Efficiency Monitoring Near Metro Stations in Noida

**Mohammad Nazim, Mohd. Alam, Sitesh Kumar Singh**

***Abstract*: This Study was based on data collection and calculation of the parking statistics such as occupancy, accumulation, parking volume, duration of parking, parking load. The study was performed in Noida of Gautam Budh Nagar which includes three parking's. The two were for NA staff parking (two and four wheelers), and third for auto rickshaw stands. The parking data was collected by license plate method for five days and statically analyzed for off street parking. After the analysis it was found that the overall average parking efficiency of comes out to be 68.75 %, 65.22% and 69.22% for parking- 1, parking- 2 and parking- 3 (auto stand parking) respectively. It was found that efficiencies for all the parking were more than 65%. This concluded that these parking can be considered as satisfactory parking.***

***Keywords* : Occupancy, Accumulation, Parking Volume, Parking Load, Efficiency**

## I. INTRODUCTION

Parking is characterized as the demonstration of uncoupling and halting autos and leaving those jobless. Stopping is done either on both or one side of a street is regularly permitted and in some cases isn't permitted. For Proper great transportation framework, a legitimate plan of the stopping is significant. If there is a deficiency of parking spot it will be a problematic circumstance for everybody. Be that as it may, the effective plan of parking spot isn't a simple undertaking. Several parameters are required for an appropriate plan of the parking spot and discover them with any method with a piece of basic information. A methodical investigation of vehicle qualities and requests and administrative measures to control cross might be helpful to leave designers and traffic organizer.

## II. LITERATURE REVIEW

The purpose of this literature review is to provide background information, the current state of parking study, and to compile a comprehensive collection of applicable works to support this research.

**Revised Manuscript Received on June 30, 2020.**
***** Correspondence Author
**Mohammad Nazim***, M.Tech Scholar, Department of Civil Engineering, Lingaya's Vidyapeeth, Faridabad, India. Email: mohammadnazimm@gmail.com
**Mohd. Alam**, M.Tech Scholar, Department of Civil Engineering, Lingaya's Vidyapeeth, Faridabad, India. Email: mdalam.sespl@gmail.com
**Dr. Sitesh Kumar Singh**, Assistant Professor, department, Department of Civil Engineering, Lingaya's Vidyapeeth, Faridabad, India. Email: siteshlpu@gmail.com



**[5]** Two kinds of overviews check the volume that is utilized, for example, video recording, land use, and stopping review that likewise had been utilized for the enrolment of recording systems. He investigated the given information of Amul Dairy street. Traffic piece gave the detail of the most noteworthy proportion of 2 wheels than others. The investigation of information shows that the proprietor leaves the vehicle for the present moment and long haul are least. In road, stopping is denied all through the segment of the overview.

**[1]** This examination paper gives the significance of receiving stopping the executives' approaches to guarantee productive utilization of parking spots, adjusting stopping supply and stopping requests, and creating pay to take care of the expense of stopping. Be that as it may, the arrangement of stopping and request streams inside the UC grounds is determined. The outcomes show that stopping is blocked and inadequate. These issues think and recognize the examination regions to address financial applications, strategy recommendations, however hypothetically take an interest in an even-minded manner. The creators talked about the usage of off-road leaving guidelines and their commitment to the diminishing of private vehicle traffic from the street.

**[6]** A case of India, the main focus should be on distributing the parking spaces, rather than restricting the parking spaces that are major attraction points that cannot be done. This is only achieved by promoting using non- motorized transport mixed land use, and other options. Accumulating parking spaces over a small area creates a public domain that portrays itself and the problem in which parking restriction seems to be a solution. Parking spaces should be provided, throughout the city in such a way that they fulfill the requirement of every individual. Some areas should not be clustered of these spaces because their space should be provided for other activities. The preference should be given to pedestrians mainly in large locations. The major concern provides to the problems faced by the Indian cities due to the increasing congestion the parking facilities should provide.

**[7]** Right now that parking spot request gives a total consideration in the physical and land-use improvement of networks and urban communities. In college grounds such sort patterns exist, which pull in higher rush hour gridlock volume, and outcome produces considerable proportions of stopping requests. In the college of Ibadan parking spot requests in the chose offices examines through stopping use overview and stopping offices clients conduct review. Discovering insufficiency of assigned stopping offices for staff and understudies.

The investigation predicts the need all the more stopping supply for staff, understudies and guests dependent on the present stopping request overabundances over the current stopping supply, and the stopping age capacities of the workforce exercises and prescribes that enhancement for existing stopping offices and the arranging and development of new stopping offices.

**[2]** Transport optimized for addiction because of the show, and the attacks by the high-rise building process which may require more parking spaces, because the increasing number of vehicles, built to function as a separate and, as a result, by the way, as a rule, is to stop the car takes place in the way, so the increase in illegal parking and road space to see the city, traffic congestion is decreased. However, due to the auto-adapted population policy, Cox began to turn, but the car will ensure in the future to stop illegal parking in the city by the laws and regulations.

**[3]** Achievement and acknowledgment of new research-based instruments have taken into consideration the usage of the after-effects of the effective examination in the Vienna, Burgenland districts of Austria and Niederoesterreich. This technique has been used to analyze the elasticity of street stops. There was a telephone survey of why motorists turned to buying cars. This will reduce time consumption, traffic congestion, and provide the mall to users.

**[4]** Investigates the issues of contemporary parking practices with the supply survey in Dharwad and parking accumulation. WTP survey becomes conducted to recognize the willingness of users that suitable parking rates for the new services. Uncommonly stopping control strategies for (brief timeframe period, medium-term and long haul) are actualized are examined. The charges of proposed stopping offices, money related investment funds, and enhancements that impact an improved stopping the board. SPSS programming created the Parking request model. To comprehend the present stopping issues promptly, transient arrangements are energized with clog-free as, support and activity cost is particularly less for on-road stopping the executives in inclination to off-road and the internal expense of return might be exceptionally high on the road stopping the board. Be that as it may, because of on the future stopping interest for the long haul the board plan staggered stopping must be completed.

## III. METHODS AND METHODOLOGY

The data collected by license plate method is analyzed to evaluate parking volume, average parking duration, average parking duration, average occupancy, parking accumulation, parking capacity, parking load and efficiency of all three parking were calculated. Parking count was conducted, noted the number of parked vehicles in each parking area under study. Whole survey time is divided into 30 minutes interval in order to determine the length of time for which the vehicles stay at each parking area. During the actual survey, the parking data is collected through license plate method is very convenient method for parking data collection. This method is helpful in characterizing the type of vehicle such as commercial vehicles and personal vehicles. Data collected manually on tally sheet for arbitrary five working days i.e. Monday to Friday, because during week days numbers of trips attracted rather weekends are more.

The data is collected at various parking sites under study with following schedule: - Monday to Friday

Staff parking (Two-Wheeler) -6$^{Th}$ January – 10$^{Th}$ January

Staff parking (Four-Wheeler) -13$^{Th}$ January – 17$^{Th}$ January

Parking site (Auto Stand) – 20$^{Th}$ January – 24$^{Th}$ January

Preliminary data regarding parking site in study area is collected during the Survey of the site. There are total three parking lots and the dimensions of NA Staff parking (two wheelers) are 30 metre in length and 15 metre in width while the dimensions of NA (four wheelers) are 20 metre in length and 15 metre in width while the dimension of parking (auto stand) are 30 metre in length and 15 metre in width. Parking entry and exit gates are same, it causes congestion on the road and becomes obstruction to high speed traffic movement there is no safe road crossing facilities for these peoples who parked their vehicles in parking lot and want to cross the road.

### A. TYPES OF PARKING

- ON-STREET PARKING
  - Parallel parking
  - 30-degree parking
  - 45-degree parking
  - 60-degree parking
  - Right angle parking
- OFF- STREET PARKING

### B. APPROACH AND METHODOLOGY

- The Reconnaissance Survey of Study Area
- Collection of Preliminary Data at Site
- Parking Data collection by License Plate Method
- Analysis of Parking Data
- Conclusion & Recommendations

### C. PARKING STATISTCS

- **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 the graph obtained by plotting the number of bays occupied with respect to time.
- **Parking volume: -** Parking volume is defined as the total number of vehicles parked at a given duration of time. This does not account for repetition of vehicles.
- **Parking load: -** Parking load gives the area under the accumulation curve. It can also be obtained by simply multiplying the number of vehicles occupying the parking area at each time interval with the time interval. It is expressed as vehicle hours.
- **Average parking: -** duration is defined as the ratio of total vehicle hours to the number of vehicles parked.
- **Parking turnover: -** is defined as the ratio of number of vehicles parked in duration to the number of parking bays. This can be expressed as number of vehicles per bay per time duration.

- **Parking index: -** is also called occupancy or efficiency. It is defined as the ratio of number of bays occupied in time duration to the total space available.

## IV. STUDY AREA AND DATA COLLECTION

Accurate comprehensive data collection is very important for the analysis of parking study. The parking data is collected near the metro station of two wheelers, four wheelers and auto stand parking in Gautam Buddh Nagar, Utter Pradesh.
The data collected by license plate method is analysed to evaluate parking volume, average parking duration, average parking duration, average occupancy, parking accumulation, parking capacity, parking load and efficiency of all three parking were calculated.

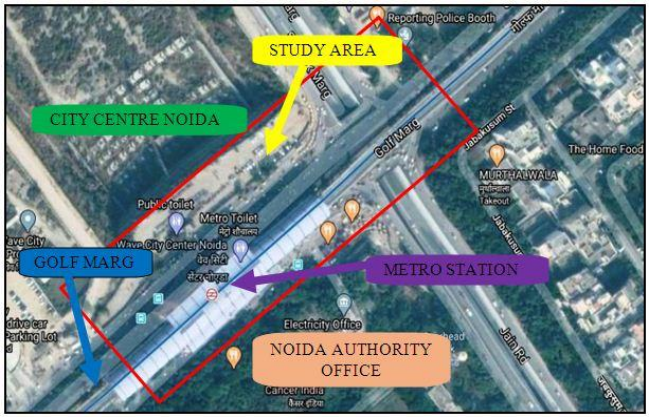


**Fig. 1. Study Area Location Map**

## V. DATA ANALYSIS AND RESULTS

The data collected by licence plate method is analysed to evaluate parking volume, average parking duration, average parking duration, average occupancy, parking accumulation, parking capacity, parking load and efficiency of all three parking were calculated.

### ➢ STAFF PARKING (TWO-WHEELER)

The data analyzed for accumulation, occupancy, parking load and efficiency. Staff parking allotted for the two wheelers and following data was analysis: -

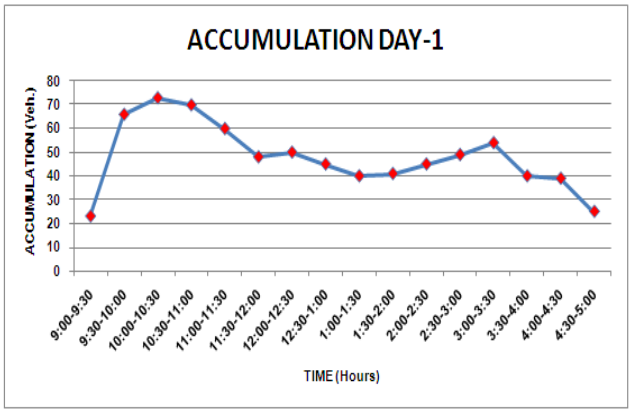


**Fig. 2. Accumulation of two-wheeler day-1**

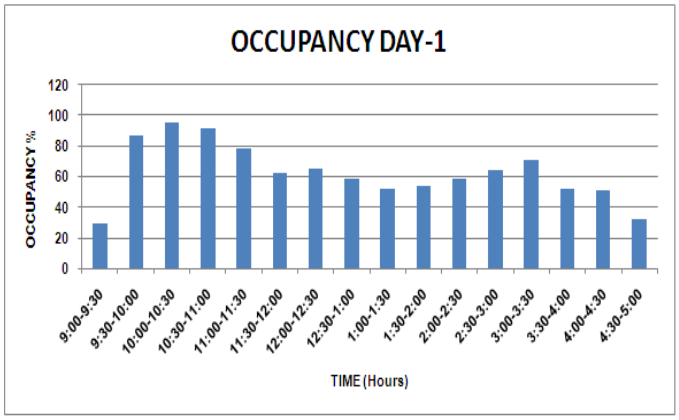


**Fig. 3. Occupancy of two-wheeler day-1**

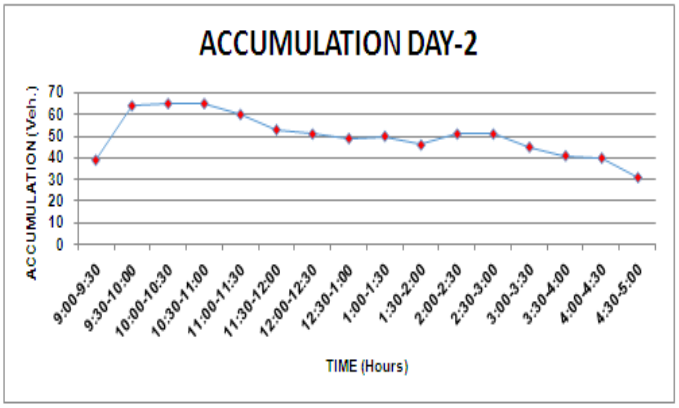


**Fig. 4. Accumulation of two-wheeler day-2**

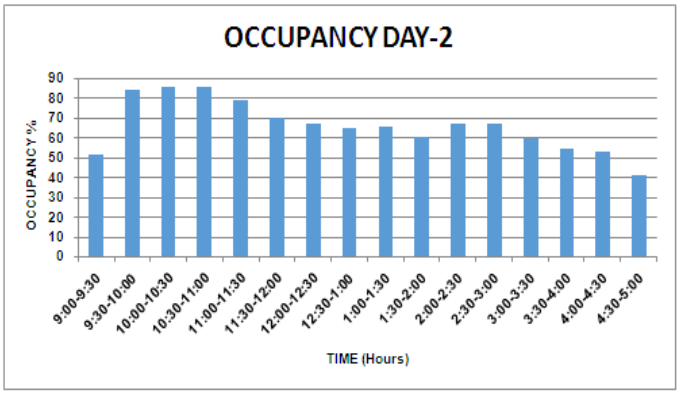


**Fig. 5. Occupancy of two-wheeler day-2**

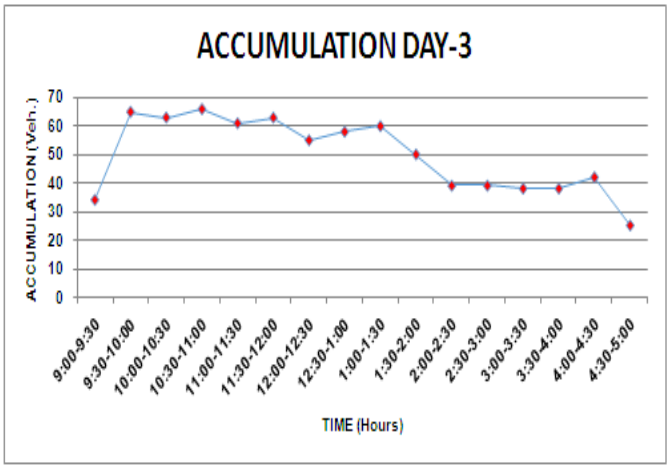


**Fig. 6. Accumulation of two-wheeler day-3**

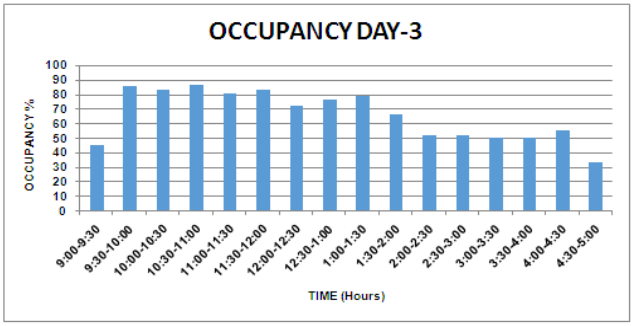


**Fig. 7. Occupancy of two-wheeler day-3**

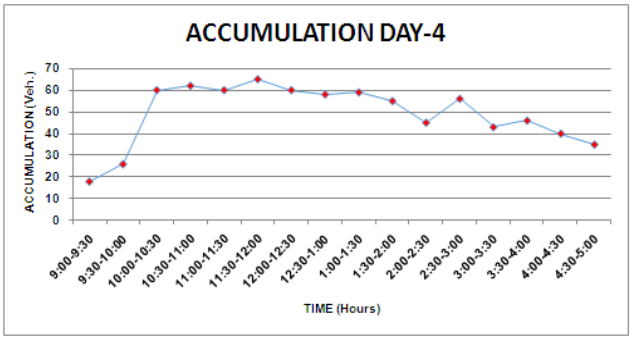


**Fig. 8. Accumulation of two-wheeler day-4**

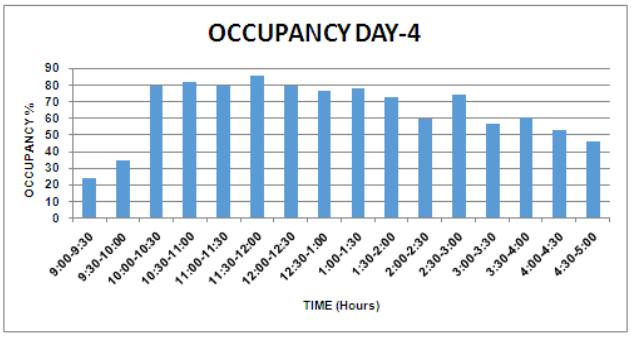


**Fig. 9. Occupancy of two-wheeler day-4**

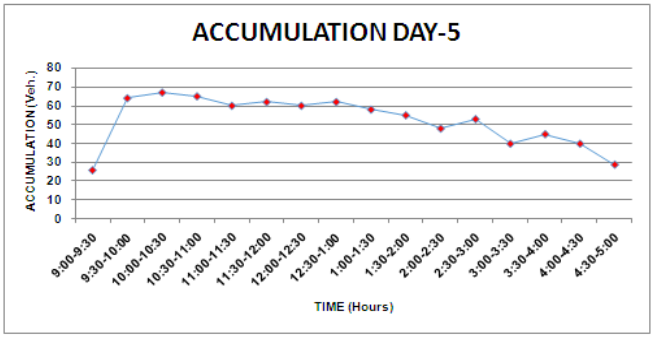


**Fig. 10. Accumulation of two-wheeler day-5**

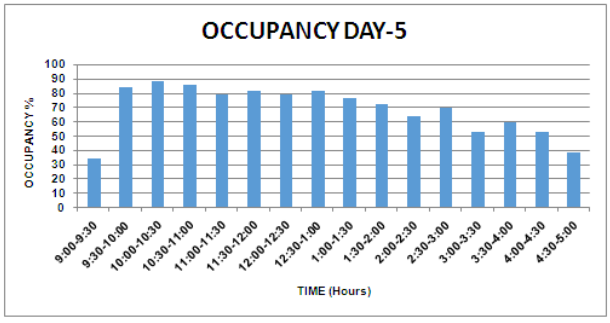


**Fig. 10. Occupancy of two-wheeler day-5**

### ➢ STAFF PARKING (FOUR-WHEELER)

The data analyzed for accumulation, occupancy, parking load and efficiency. Staff parking allotted for the four wheelers and following data was analysis: -

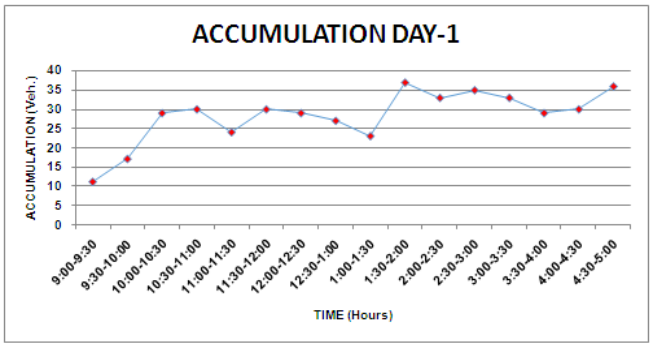


**Fig. 11. Accumulation of four-wheeler day-1**

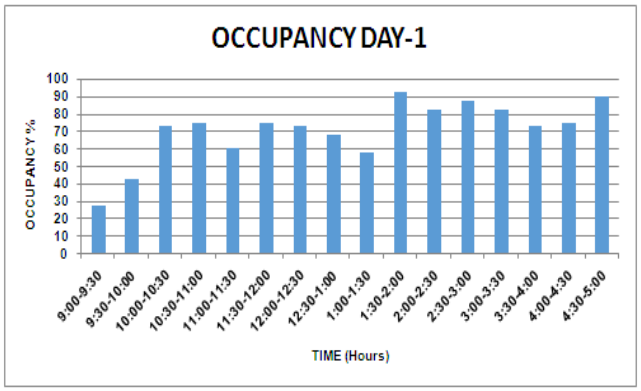


**Fig. 12. Occupancy of four-wheeler day-1**

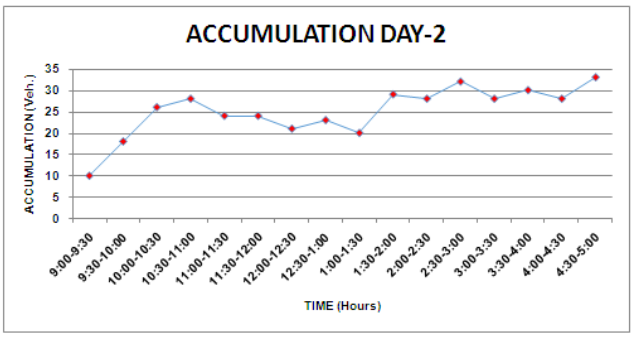


**Fig. 13. Accumulation of four-wheeler day-2**

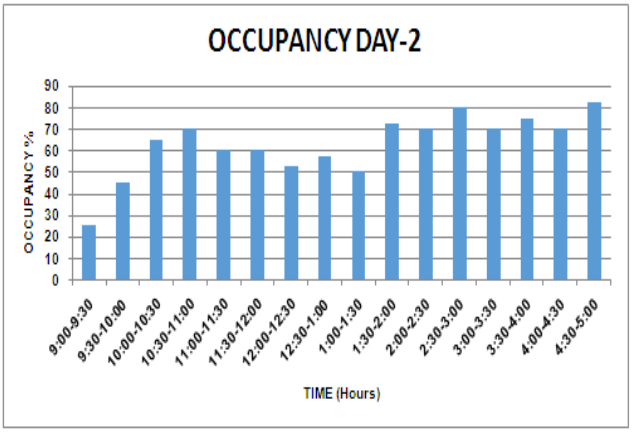


**Fig. 14. Occupancy of four-wheeler day-2**

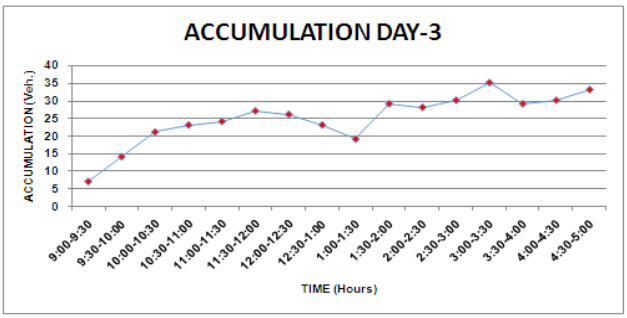


**Fig. 15. Accumulation of four-wheeler day-3**

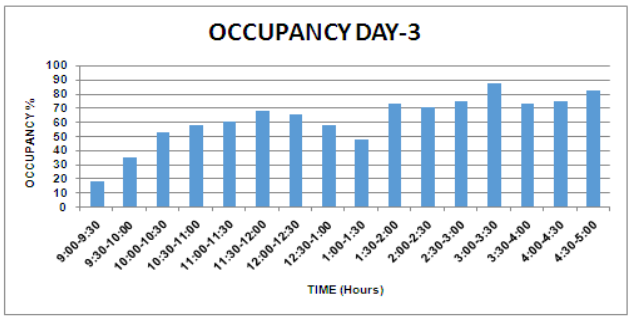


**Fig. 16. Occupancy of four-wheeler day-3**

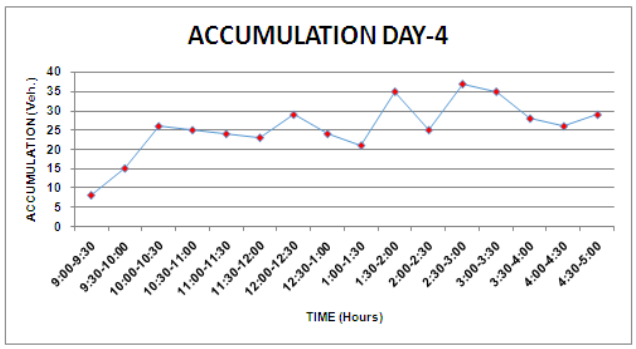


**Fig. 17. Accumulation of four-wheeler day-4**

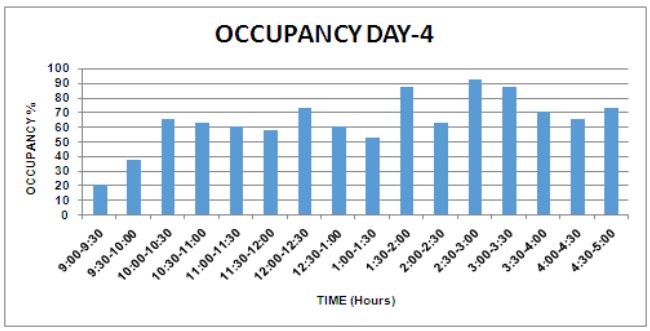


**Fig. 18. Occupancy of four-wheeler day-4**

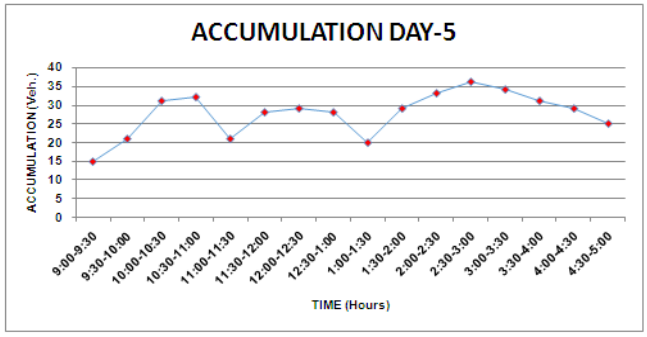


**Fig. 19. Accumulation of four-wheeler day-5**

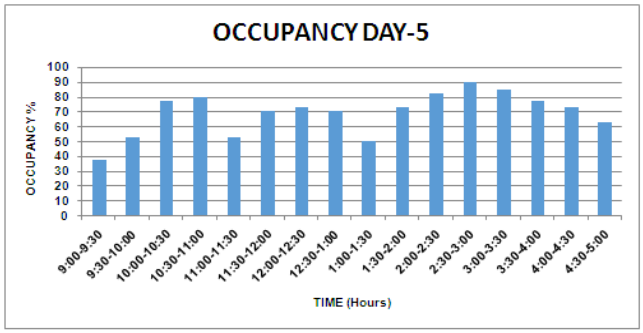


**Fig. 20. Occupancy of four-wheeler day-5**

## ➢ AUTO STAND PARKING

The data analyzed for accumulation, occupancy, parking load and efficiency. Auto stand Parking allotted for the Auto Stand.

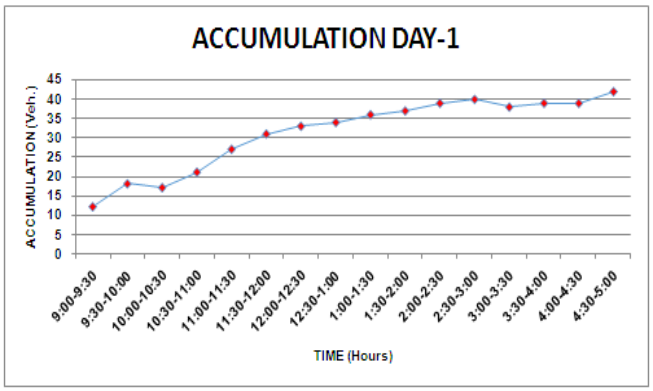


**Fig. 21. Accumulation of auto day-1**

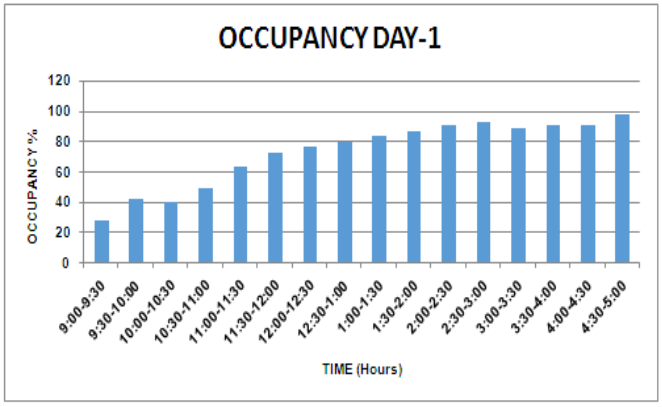


**Fig. 22. Occupancy of auto day-1**

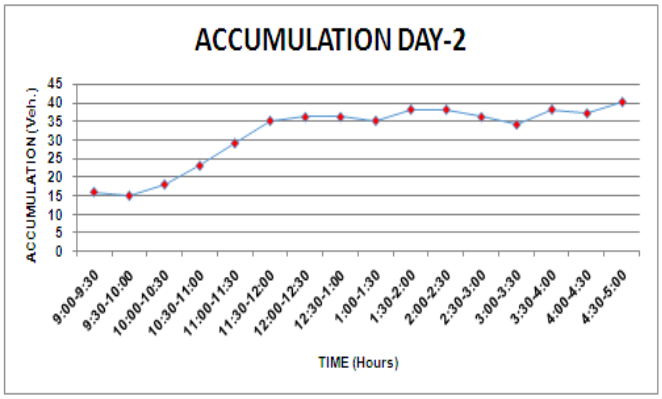


**Fig. 23. Accumulation of auto day-2**

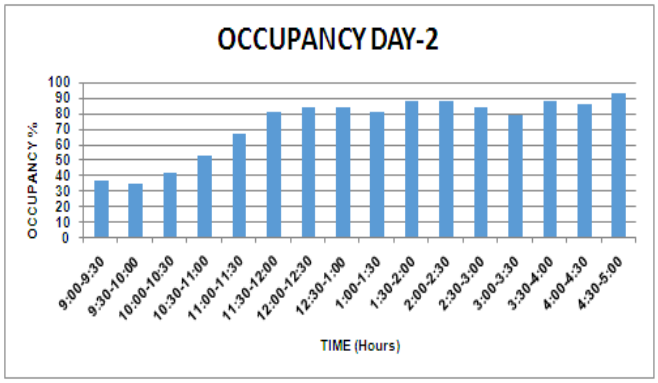


**Fig. 24. Occupancy of auto day-2**

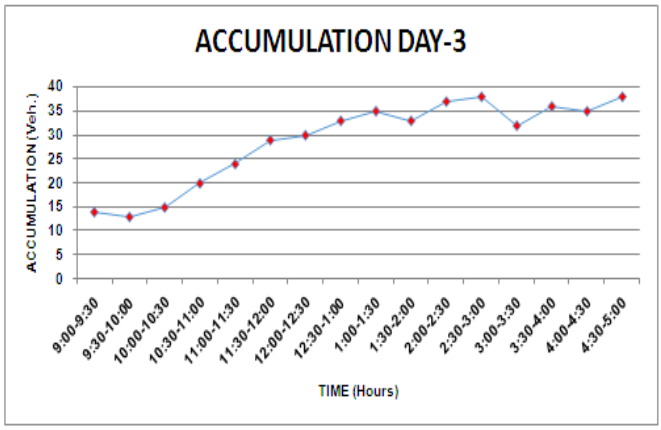


**Fig. 25. Accumulation of auto day-3**

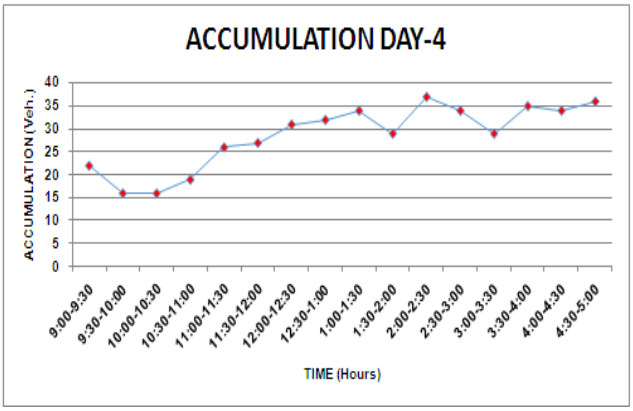


**Fig. 26. Accumulation of auto day-4**

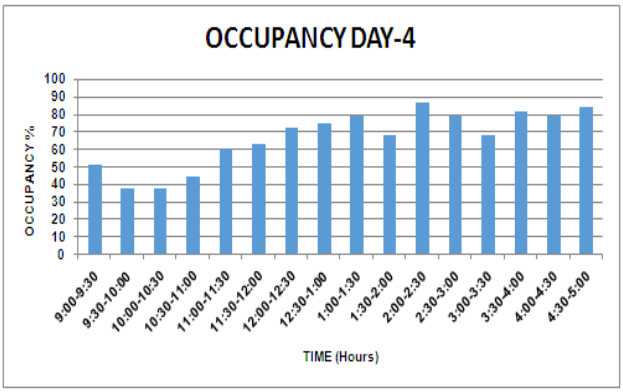


**Fig. 27. Occupancy of auto day-4**

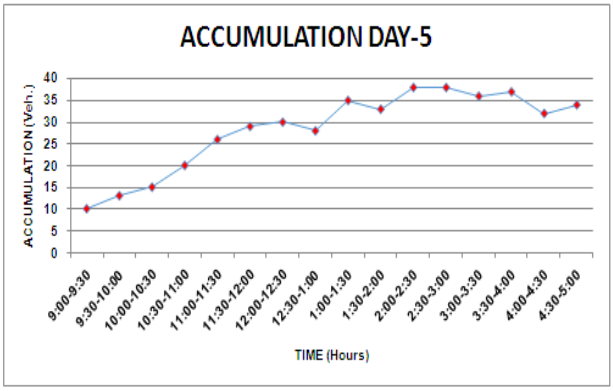


**Fig. 28. Accumulation of auto day-5**

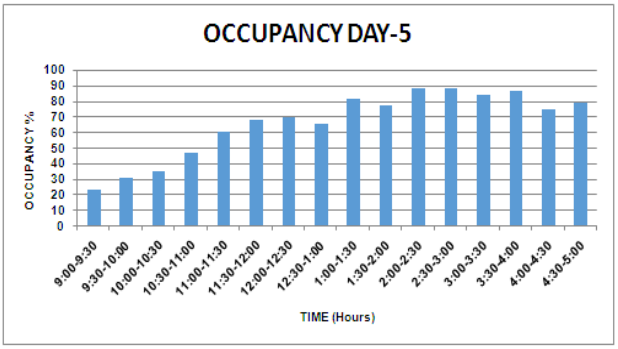


**Fig. 29. Occupancy of auto day-5**

## GRAPHICAL REPRESENTATION OF RESULT

Parking Volume, Parking Load, and Efficiency is of five days were calculated as follow: -

### ➢ STAFF PARKING (Two-Wheeler)

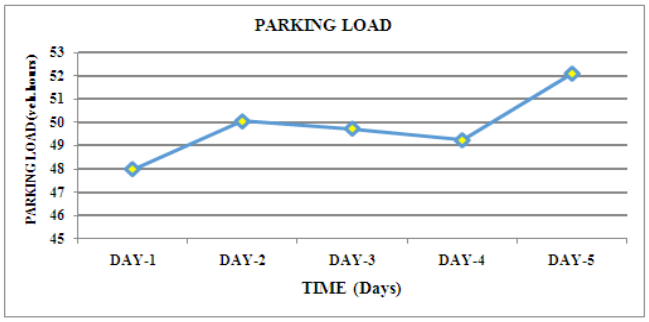


**Fig. 30. Parking Load result for staff parking two-wheeler**

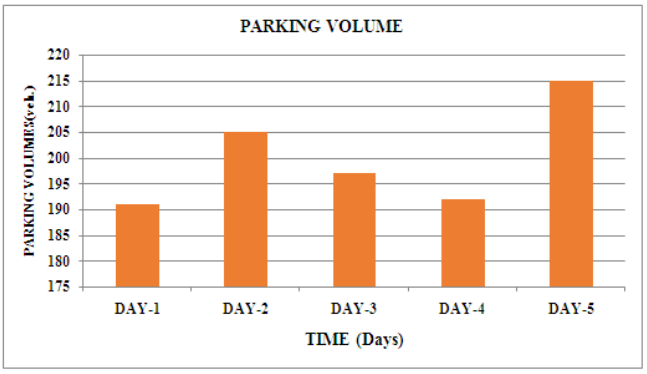


**Fig. 31. Parking Volume result for staff parking two-wheeler**

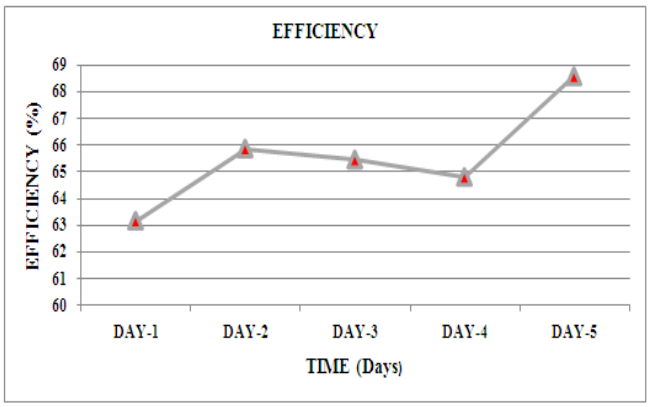


**Fig. 32. Parking Efficiency result for staff parking two-wheeler**

- For two-wheeler NA staff parking through observation & analysis, it is found that parking accumulation is 834 vehicles, which is observed as maximum on Friday while the minimum parking accumulation is observed on Monday 768 vehicles. On an average of five days the parking accumulation is 797 vehicles.
- Peak hours are from 9:30am to 11:00am, during these peak hours on an average of five days the parking efficiency is found 89% parking occupancy is 85% and parking load is 65 vehicle hours. Off peak hours are from 9:00-9:30am, 4:00-4:30pm, 4:30-5:00pm during these off-peak hours parking efficiency is found 41.30% parking occupancy is 43.53% and parking load 30 vehicle hours.

➢ **STAFF PARKING (Four-Wheeler)**

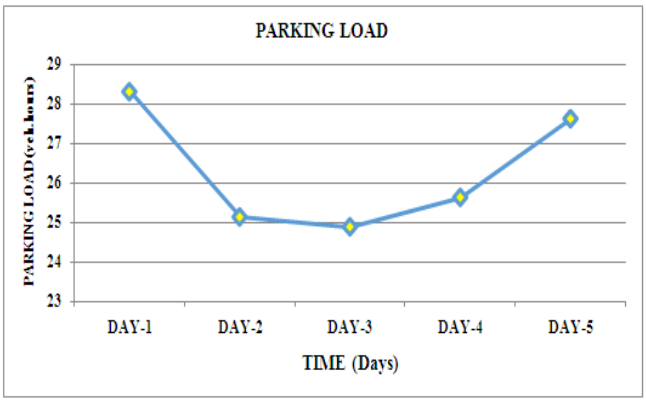


**Fig. 33. Parking Load result for staff parking four-wheeler**

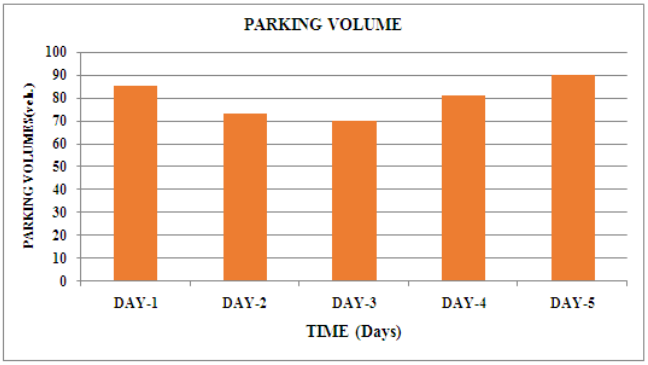


**Fig. 34. Parking Volume result for staff parking four-wheeler**

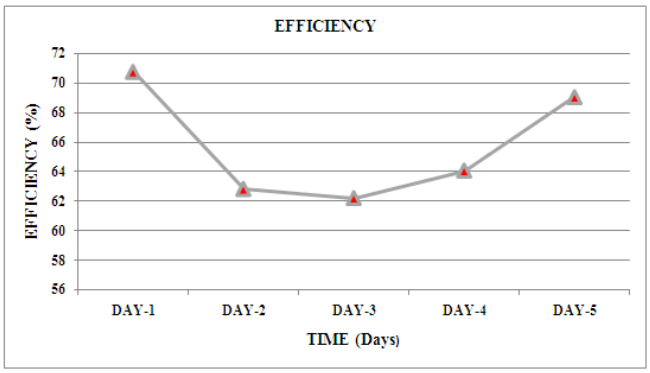


**Fig. 35. Parking Efficiency result for staff parking four wheeler**

- For four-wheeler NA staff parking through observation & analysis, it is found that parking accumulation of vehicles is 453 which were observed as maximum on Monday while the minimum parking accumulation was on Wednesday. On an average of five days the parking accumulation is 421 vehicles
- Peak hours are from 1:00pm to 2:30pm during these peak hours on an average of five days the efficiency is found is 75.06%, parking occupancy is 83% and parking load is 32.28vehicle hours. Off peak hours are from 9:00am to 10.30am, parking efficiency 42.05%, parking occupancy is 43.46% and parking load is 16vehicle hours.

➢ **AUTO STAND PARKING**

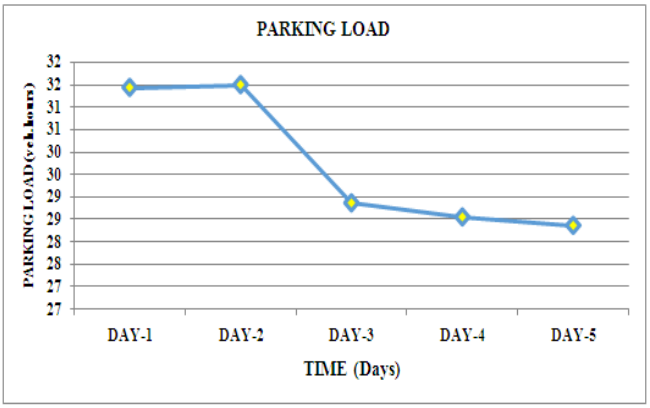


**Fig. 36. Parking Load result for auto stand parking**

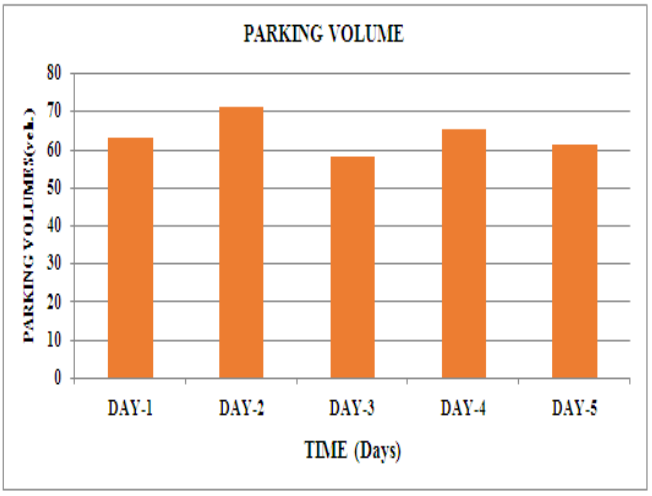


**Fig. 37. Parking Volume result for auto stand parking**

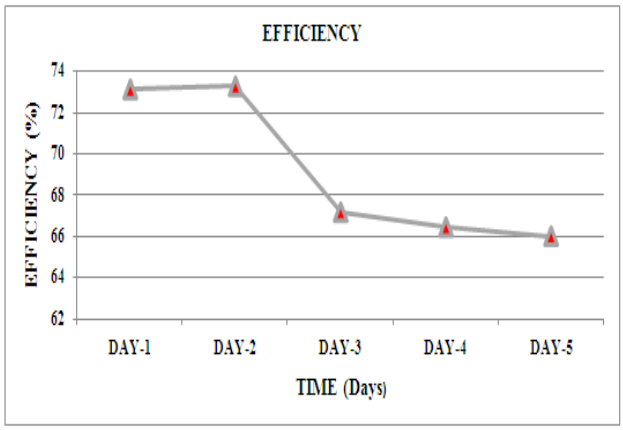


Fig. 38. Parking Efficiency result for auto stand parking

- For four-wheeler NA staff parking through observation & analysis, it is found that parking accumulation of vehicles is 453 which were observed as maximum on Monday while the minimum parking accumulation was on Wednesday. On an average of five days the parking accumulation is 421 vehicles
- Peak hours are from 1:00pm to 2:30pm, during these peak hours on an average of five days the efficiency is found is 75.06%, parking occupancy is 83% and parking load is 32.28vehicle hours. Off peak hours are from 9:00am to 10.30am, parking efficiency 42.05%, parking occupancy is 43.46% and parking load is 16vehicle hours.

## VI. CONCLUSION AND RECOMMENDATIONS

The continuous growth of population, intensive urbanization and commercial activities has resulted in transport problems like congestion, increased Travel Time, Noise Pollution and pollution etc.

- During the observation it is found that the Parking Bays are not marked at all observed sites. It is recommended that the Parking Bays should be marked properly so that the observed Parking Space can accommodate maximum numbers of vehicles at a given time.
- During the analysis it is found that the overall average Parking Efficiency of five days comes out to be 68.75 % for parking (two-wheeler) and Efficiency for parking (four-wheeler) & Auto Parking are 65.22% and 69.22% respectively, which can be considered as satisfactory Parking Efficiency. Though parking is designated for NA staff and the number of working staff at NA is fixed, so parking lot for NA staff parking is likely to be less fluctuated in future.
- During observation it is found that the vehicles are parked in haphazard manner at four-wheeler and auto parking, which causes reduction in Parking Efficiency. Parking entry and exit are provided directly at main carriage way, vehicles coming or exiting from parking space causes congestion and conflicting situation with thorough traffic movement. It is recommended that the parking entry or exit should be provided at mid of U –turn under the bridge.
- Some autos are parked outside the parking space which causes congestion, traffic police should be deployed to keep control over such type of illegal parking by auto drivers. Through parking plays a vital role in performing the efficiency of road network and accessibility to different land use. However, inadequate or improper management of Parking Spaces, ineffective law enforcement has compelled many to pack along road. Such behaviour causes above mentioned traffic problems. Strategies such as effective communication Parking enforcement, Operational Efficiency and provision of Parking Signage for better & efficient management of Off-street Parking should be adopted in study area.

## APPENDIX

Data collection sheet are attached, in this sheet data was collected during day time from 9 AM to 5 PM total 8 hours for 5days, data of staff parking (two-wheeler & four-wheeler) and auto stand parking.

Table-I Parking data collected at various study location Staff parking (two wheeler, four wheeler) and Auto parking

| | 9:00-9:30 | 9:30-10:00 | 10:00-10:30 | 10:30-11:00 | 11:00-11:30 | 11:30-12:00 | 12:00-12:30 | 12:30-1:00 | 1:00-1:30 | 1:30-2:00 | 2:00-2:30 | 2:30-3:00 | 3:00-3:30 | 3:30-4:00 | 4:00-4:30 | 4:30-5:00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DAY-1 | 23 | 66 | 73 | 70 | 60 | 48 | 50 | 45 | 40 | 41 | 45 | 49 | 54 | 40 | 39 | 25 |
| DAY-2 | 39 | 64 | 65 | 65 | 60 | 53 | 51 | 49 | 50 | 46 | 51 | 51 | 45 | 41 | 40 | 31 |
| DAY-3 | 34 | 65 | 63 | 66 | 61 | 63 | 55 | 58 | 60 | 50 | 39 | 39 | 38 | 38 | 42 | 25 |
| DAY-4 | 18 | 26 | 60 | 62 | 60 | 65 | 60 | 58 | 59 | 55 | 45 | 56 | 43 | 46 | 40 | 35 |
| DAY-5 | 26 | 64 | 67 | 65 | 60 | 62 | 60 | 62 | 58 | 55 | 48 | 53 | 40 | 45 | 40 | 29 |

| PARKING DATA-FOUR WHEELER NOIDA AUTHORITY STAFF PARKING | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 9:00-9:30 | 9:30-10:00 | 10:00-10:30 | 10:30-11:00 | 11:00-11:30 | 11:30-12:00 | 12:00-12:30 | 12:30-1:00 | 1:00-1:30 | 1:30-2:00 | 2:00-2:30 | 2:30-3:00 | 3:00-3:30 | 3:30-4:00 | 4:00-4:30 | 4:30-5:00 |
| DAY-1 | 11 | 17 | 29 | 30 | 24 | 30 | 29 | 27 | 23 | 37 | 33 | 35 | 33 | 29 | 30 | 36 |
| DAY-2 | 10 | 18 | 26 | 28 | 24 | 24 | 21 | 23 | 20 | 29 | 28 | 32 | 28 | 30 | 28 | 33 |
| DAY-3 | 7 | 14 | 21 | 23 | 24 | 27 | 26 | 23 | 19 | 29 | 28 | 30 | 35 | 29 | 30 | 33 |
| DAY-4 | 8 | 15 | 26 | 25 | 24 | 23 | 29 | 24 | 21 | 35 | 25 | 37 | 35 | 28 | 26 | 29 |
| DAY-5 | 15 | 21 | 31 | 32 | 21 | 28 | 29 | 28 | 20 | 29 | 33 | 36 | 34 | 31 | 29 | 25 |

| PARKING DATA-AUTO STAND PARKING | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 9:00-9:30 | 9:30-10:00 | 10:00-10:30 | 10:30-11:00 | 11:00-11:30 | 11:30-12:00 | 12:00-12:30 | 12:30-1:00 | 1:00-1:30 | 1:30-2:00 | 2:00-2:30 | 2:30-3:00 | 3:00-3:30 | 3:30-4:00 | 4:00-4:30 | 4:30-5:00 |
| DAY-1 | 12 | 18 | 17 | 21 | 27 | 31 | 33 | 34 | 36 | 37 | 39 | 40 | 38 | 39 | 39 | 42 |
| DAY-2 | 16 | 15 | 18 | 23 | 29 | 35 | 36 | 36 | 35 | 38 | 38 | 36 | 34 | 38 | 37 | 40 |
| DAY-3 | 14 | 13 | 15 | 20 | 24 | 29 | 30 | 33 | 35 | 33 | 37 | 38 | 32 | 36 | 35 | 38 |
| DAY-4 | 22 | 16 | 16 | 19 | 26 | 27 | 31 | 32 | 34 | 29 | 37 | 34 | 29 | 35 | 34 | 36 |
| DAY-5 | 10 | 13 | 15 | 20 | 26 | 29 | 30 | 28 | 35 | 33 | 38 | 38 | 36 | 37 | 32 | 34 |

## REFERENCES

1. Eduardo B. (2010) Parking Problem at UC Campus: 12th WCTR, July 11-15, 2010, Lisbon, Portugal
2. Indrajit R. (2015) Scenario of On-street parking demand A Case Study of Kolkata city, India. Research Journal of Recent Science Vol V, 2015
3. Juliane Stark et al. (2008) Off-street Parking Regulations for Shopping Facilities Journal of Urban and Development (ASCE) Vol 135, 173-179
4. Kolhar (2012) Off-street Parking Management Plan of Dharwad city, Karnataka, India. JERS/Vol III April 2012
5. L.B. Zala (2012) Parking Evaluation: A Case Study of Amul Diary road Indian Journal of Research Vol 1 issue 5, 177-180
6. Mahak D. et al. (2017) A case study: Growing parking issues and effective parking management strategies International Journal of Scientific and Engineering Research Vol VI, January 2017
7. Olugbenga et al. (2015) Assessment of Parking Space Demand in University of Ibadan, Nigeria. International Journal of Scientific and Engineering Research Vol VI, January 2015

## AUTHORS PROFILE

**Mohammad Nazim,** Civil Engineer, M.Tech Scholar, Department Of Civil Engineering Lingaya's Vidyapeeth Faridabad – 121002, Haryana (India)

**Mohd. Alam,** Civil Engineer, M.Tech Scholar, Department Of Civil Engineering Lingaya's Vidyapeeth Faridabad – 121002, Haryana (India)

**Dr. Sitesh Kumar Singh, C.Eng.(I)** is a Consultant, Chartered Engineer, an Author, Assistant Professor. He is also the member of Professional Societies. He has authored 02 books, has presented 10 papers in various national & international conferences, published 27 papers in various national & international journals of repute and has 02 patents registered.