

# A Study on Enhancing the Efficiency of Parking System Using Angled Parking

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**ABSTRACT:** The growing number of students in the study area has created a lot of problems for the college infrastructure; one of the most challenging ones is in the Student parking area i.e. **Location #1** which we confront every single day. Besides the problem of limited space for the vehicles moving inside, greater is the problems of space for the already parked vehicles as most of them occupy it for most of the college hours. While the staff parking i.e. **Location #2** escapes major problems because of day to day maintenance and better infrastructure, the real problems lie with the Location #1 which suffers from poor management.

Multi-level parking systems may provide relief since they come with several advantages – optimal utilization of space, lower maintenance, operational cost, lower construction cost, secure and environment-friendly nature, comfortable for students but leaves the institution with a huge disadvantage as it requires a huge capital investment and the closure of present Location #1 during its construction.

As an alternative several other **economic solutions** can be taken underway to cope up with the growing demand of the required space in Location #1, one of them is **Angled Parking**. It serves various advantages like safety, saves space, time, faster traffic flow, less capital investment and can be implemented easily.

**KEYWORDS:** Angled Parking, Traffic Survey, User Survey, Congestion.

## I. INTRODUCTION

### Parking

The Location #1 is in front of the civil block which only allows two-wheelers to enter has a maximum capacity of 800 vehicles. In the last 5 years, whereas the number of students in the college has increased substantially, the capacity of the Location #1 has only been increased by 100 spaces. This may be a 1/8th increase in the total capacity, but it compares meagerly with the number of new students enrolled in the last 5 years. The potential space which can be used for parking is limited and can barely be expanded as the area is surrounded by buildings on all sides.

### Parking Studies

Before taking any measures for the improving the conditions, data regarding availability of parking space, the extent of its use, and parking demands are essential. Parking surveys are intended to provide all the information. Since the duration of parking varies with different vehicles, several statistics are used to figure out the parking demands.

### Parking Statistics

- Parking accumulation – It is defined as the number of vehicles parked at a given instant of time. Normally this is expressed by an accumulation curve.
- Parking Volume- Parking volume is the total number of vehicles parked at a given duration of time. This does not account for the repetition of vehicles.
- Average Parking Duration – It is the ratio of total vehicle hours to the number of vehicles parked.
- Parking Turnover- It is the ratio of vehicles parked in duration to the number of parking bays. This can be expressed as the number of vehicles per bay per time duration.
- Parking Index- Parking index is also called occupancy or efficiency. It is defined as the ratio of the number of bays occupied in time duration to the total space available. Parking index can be calculated by =

$$\text{Parking Index} = \text{Parking load} / \text{Parking Capacity} \times 100$$

## TYPES OF PARKING

There are two types of major parking systems which are can be practiced in our parking Area-

### Perpendicular Parking

Perpendicular parking means parking the vehicle side by side, perpendicular to a wall, curb, or another vehicle. In this type of parking, vehicles need complex maneuvering, and this causes various congestion problems. This type of parking is widely practiced in our parking lot as it is easy to execute and requires the least maintenance.

### Angled Parking

Angled parking is similar to perpendicular parking, except the vehicles are aligned in an angle. Normally the angle is aligned with the direction vehicles approach the parking space. Not only it is easier to park, but it is also faster, and the parking spaces are smaller, making it possible to add more parking spaces in the same size area. There are three types of angular parking –

- ◆ **30 Degree Parking** – In 30-degree parking, the vehicles are parked at 30 degrees with respect to the road alignment. In this case, more vehicles can be parked compared to Perpendicular parking.
- ◆ **45 Degree Parking**– As the angle increases, a greater number of vehicles can be parked. Hence this parking increases the capacity of the area.
- ◆ **60 Degree Parking**– The vehicles are parked at 60 degrees to the direction of the road. More vehicles can be accommodated in this parking space.

## II. OBJECTIVES

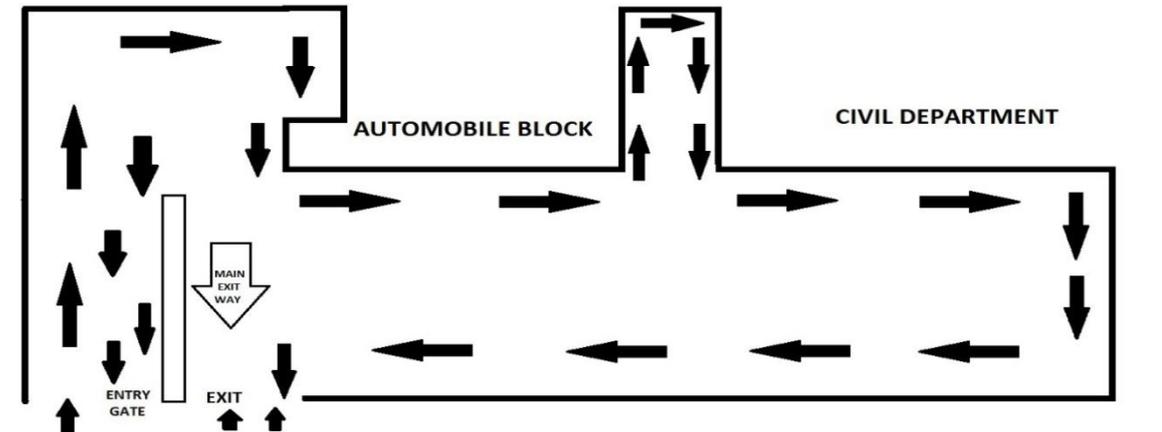
The Objectives of this study are –

- To study the present parking scenario in **Location #1** and compare it to **Location #2**.
- To highlight the most severe problem in **Location #1** by carrying out Traffic and User Survey.
- To study the improvements which can be achieved by practicing **Angular Parking** in **Location #1**.

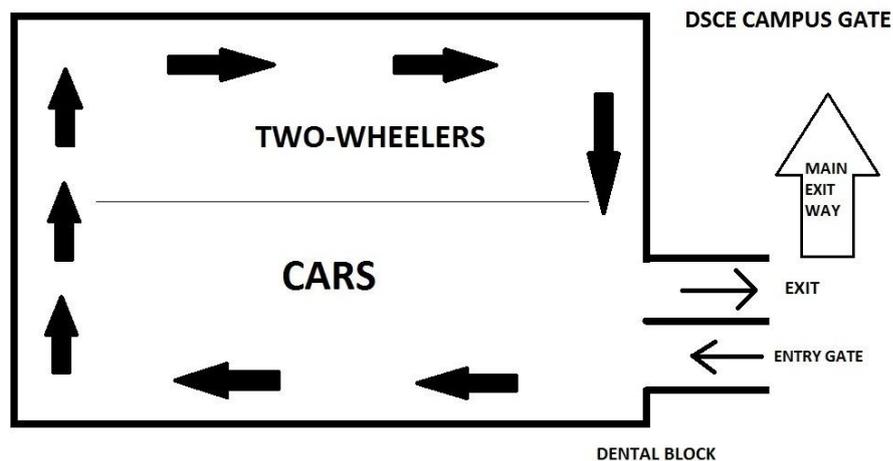
## III. SURVEYS CONDUCTED

There were two types of surveys conducted in our study-

- Traffic Survey
  - User survey
- **Traffic Survey** – Traffic Survey was conducted in Location #1 and Location #2 and following results were observed –
- **Flow Characteristics** – By carrying out a traffic survey in **Location #1** and **Location #2**, the flow characteristics were mapped.



(a) Location #1– The traffic flow is slow and haphazard as there are no fixed entry/exit gates.



(b) Location #2– The traffic flow is fast and arranged manner as there are fixed entry/exit gates.

Figure 1: Traffic-flow surveys (a) Location #1 (b) Location #2

- **Parking Practised**

**Location #2** in the college premises has marked parking bays and a proper system to deal with the surplus vehicles. Whereas, **Location #1** lacks marked bay spaces. As a result, the system which is widely practiced in our parking lot is a mix of Perpendicular and Angled parking, vehicles are parked wherever the space is available and in a haphazard manner.

This leads to the formation of unauthorized lanes, congestion, accidents, and often decreases the width of the main exit way of the parking.



**FIGURE 2:** This problem is at its worst during the time period 11:00am-11:30am every day (break time in the morning classes).

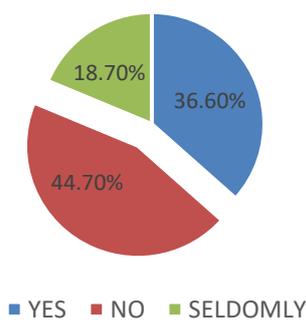
➤ **USER SURVEY IN Location #1**

A user survey was conducted in among the users of Location #1 in the study area and a total of 300 different responses were recorded, some of the important questions related were as follows-

- Total number of responses collected—**300**
- Study Area —**LOCATION #1**(Student's Parking Lot)
- Survey Type — **Questionnaire Survey**

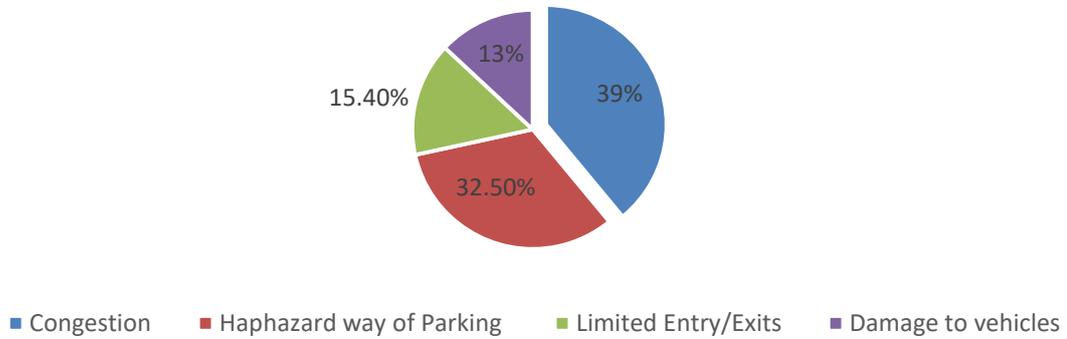
Some of the questions which were asked in the Questionnaire surveys were –

1) Do You exit the parking lot during the Morning break (11:00 am - 11:15 am ) and come back -



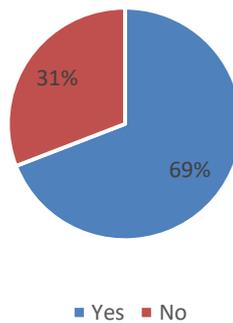
(a)

2) What is the most severe problem in the parking lot -



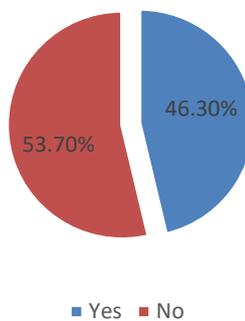
(b)

3) Has your vehicle been slightly/seriously damaged in the parking lot -

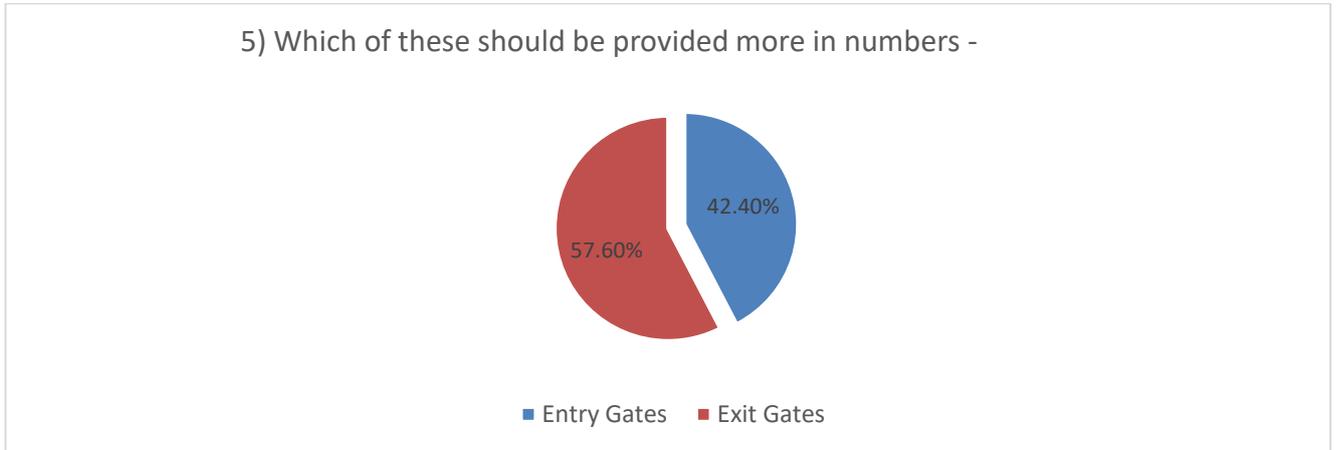


(c)

4) Will you be willing to accept that only a limited number of vehicles are allowed (First Come first serve basis) to enter the parking -



(d)



(e)

Figure 3: (a) User Survey question (b) User Survey question (c) User Survey question (d) User Survey questions (e) User Survey question

Some of the conclusions which can be drawn by this User survey are –

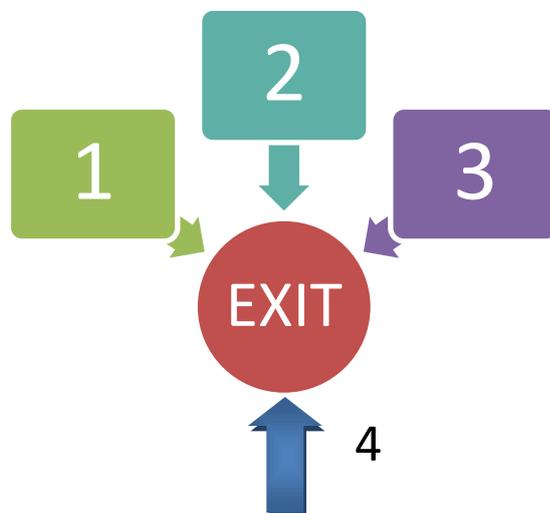
- 1) The most severe problem of the Location #1 is **Congestion**.
- 2) The most probable cause of this congestion is the **morning break** given to the students between **11:00 am – 11:15 am**.
- 3) The problem of congestion also gives rise to the slight/serious damage of vehicles standing in the Parking lot.
- 4) The **surplus vehicles over the maximum capacity** are hindrance to the fast- flow of traffic within the parking lot.
- 5) The number of **Exit Gates** should be increased.

#### IV. DISCUSSION

- **Congestion – The Major Problem**

The major problem of Location #1 is **Congestion**, which is caused by the constant flow of vehicles entering and exiting the area from a common entry-exit. This not only increases the time required to exit the parking area but also obstructs the flow of incoming vehicles.

#### THE 11:00 AM PROBLEM



#### **LEGEND**

##### **Vehicles coming from-**

- 1- Area behind the Automobile block
- 2- Area in front of the Automobile block
- 3- Area in front of the Civil Department
- 4- Vehicles **entering** from the same **"EXIT"** Gate

FIGURE 4: The Major Causes of Congestion problem at 11:00am-11:30am.

The following problems arise as a result of congestion on the premises –

- Too many vehicles accumulate near the exit gate, hence increasing the average parking entry/exit time.
- The size of the main exit pathway is reduced to 1.2 m, a total decrease of .3m from the original size.
- Congestion also leads to accidents and in turn causes several fights among students daily.
- Students haphazardly park their vehicles to stay close to the exit and avoid congestion, which ultimately leads to more congestion
- One - Directional flow of traffic is not maintained.

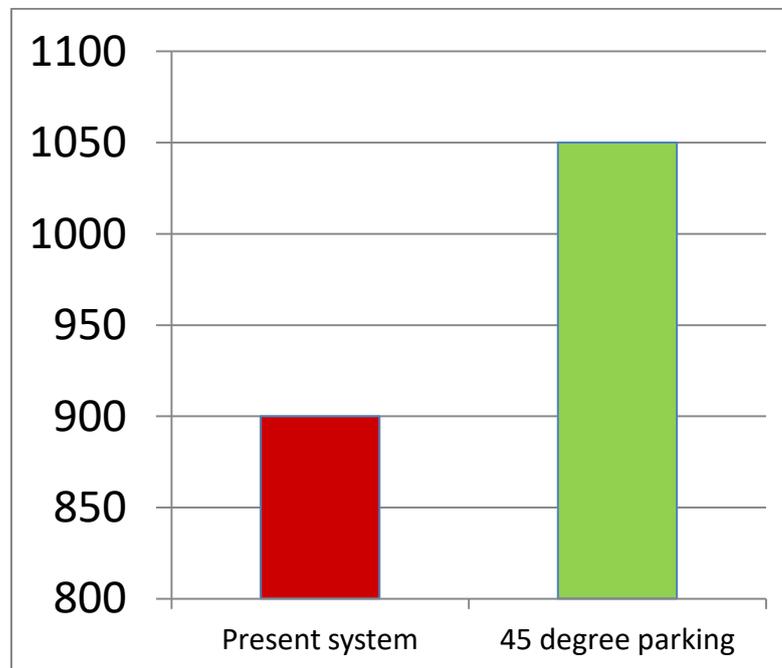
➤ **What Can Be Done?**

Keeping in mind the economic and capital constraints of the college, there are still many things that can be adopted in the basic infrastructure of parking with a comparatively small investment required. One of them is Angled Parking.

**Angled Parking** is the answer to the following problems –

- **The Problem of Space**

- With the help of chain and tape survey, it was found that the area of the parking lot excluding the obstructions and the pathways for the flow of vehicles is 3100m<sup>2</sup>.
- Average space is taken by a two-wheeler – 2.5m<sup>2</sup>
- At this trend, the maximum capacity of the lot should be around 1200 vehicles, but at the present: the maximum capacity touches barely 900.
- This is due to the haphazard parking system practiced by the students.
- A study conducted by **Innovary Tech** shows that if **45<sup>0</sup>** Angled parking is practiced in any parking lot having area >1000m<sup>2</sup>, it can increase the total capacity by 20%.



**Figure 5:** 45<sup>0</sup> Parking will increase the present maximum capacity of the parking area by 250 spaces.

- **The Problem of Congestion**

- One of the most important advantages of the 45<sup>0</sup> degree parking system is that it ensures the **one-way flow of the traffic**.
- When the bay lines are aligned with the road in such a way that vehicles are allowed to enter from only one gate and made to exit from the other gate.
- Using this system will eventually decrease the accumulation of vehicles near the exit gate and **fasten the traffic flow** inside the premises. Hence **saving** valuable time.

- **Obstruction to Exit Pathway**

- As pointed out earlier the obstruction of the main exit way not only leads to congestion but also leads to accidents.
- This can be countered by the angled parking as the method includes assigning, **every vehicle its own designated space**.
- The ones who do not follow the rules and park their vehicles out of the assigned spaces can be **fined** or their **ID Cards** can be taken away by the college.
- This will also allow the security guard to **close the parking entry gate** once all the assigned spaces are filled, which will prevent the overflow of vehicles in the parking lot.

## V. CONCLUSION

In this paper, it was highlighted the major problems in Location #1 and Projected 45<sup>0</sup> Angled parking as the solution to many of them as it **solves** –

- **Cost-Effective** – Angled parking requires minimal capital investment when compared to the other alternatives like Multi – level parking, acquiring new space and developing Smart Parking Applications.
- **The problem of Space**– 45<sup>0</sup>Angled parking **increases the capacity from 900 to1050**; an increase of 250 vehicles in the maximum capacity.
- **The problem of Congestion**–Angled parking **ensures one-way flow** of traffic and reduces the chances of the driver getting blocked if the next vehicle is parked too close, in turn reducing congestion.
- **The problem of obstruction of the Exit Pathway** –As the **bay spaces are** marked in 45<sup>0</sup> Angled Parking, it does not let them park vehicles near the Exit Pathway.
- **The problem of collision** – Angled parking spaces don't require vehicles to make a sharp turn when parking, making it **easier for cars to maneuver** in and out of the parking space. This also reduces the chances of a collision as drivers stay within the lines of their parking space.

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