

STUDY OF MULTILEVEL VEHICULAR PARKING

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Abstract -Parking plays an important role in mobility access and economic development of cities at the same time it is profitable business. Cars have become a fundamental element of journey and in consequence parking as well. With the increase in population and economic activities, the number of motor vehicles is growing at a faster rate than the proportion of urban space devoted to roads. Due to this increment in road traffic, a lot of problems start occurring. Traffic congestion is a serious problem in the present era which adversely effects on both the quality of life and economy. It results in unnecessary fuel consumption, causes additional wear and tear of vehicles, increasing harmful emissions lowering air quality and it also increases the cost of transport.

Not only in urban areas but also in sub-urban areas the growing commercialization of land has produces a rapid and large increment in land values, to the extent that the use of large areas of land for parking automobiles is uneconomical. The very commercialization which increase the land values create an increased demand for vehicle parking space. It is obvious therefore, that optimum economic use of land can only be achieved through the use of Multi level car parking. Multi-level car parking is a building which is designed specifically for automobile parking and where there are a number of floors or levels on which parking takes place. It is essentially a stacked car park

Key Words: Traffic, parking, multilevel, sujgotra, Congestion, sahil, Chandigarh

1.INTRODUCTION

India being a developing country has one of the largest road network across the globe spanning over 5.5 million km. The road network transport 64.5 percent of all goods in the country and 90 percent of India's total passenger traffic uses road network to commute. Road transportation has gradually increased over the years with the improvement in connectivity between cities, towns and villages in the country.

The automobile industry in India is increasing with a very rapid rate. The Indian auto industry becomes the 4th largest in the world. It was the 7th largest manufacturer of commercial vehicles in 2017. Domestic automobile production increased at 7.02 percent between financial year 13-18 with 29.07 million vehicles manufactured in

the country in financial year 2018. Overall domestic automobile sales increased at 7.01 percent between financial year 2013-2018 with 24.97 million vehicles getting sold in financial year 2018.

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"It is estimated that about 30 percent of the cars circling a city at any given time are doing so as drivers look for parking. These cars are one of the reasons in creating congestion" This is from the international parking institute (IPI) 2012 emerging trends in parking study.

Therefore in order to reduce congestion firstly parking problem is to be eliminated. As much the area of present study regarding Multilevel vehicular parking has been selected the site of Multilevel vehicular parking in sector 17-D, Chandigarh (U.T.).

This parking area constitutes of 3 level basements below the ground level meaning thereby level 1, level 2, level 3 are meant for car parking and part of ground level i.e. roof slab of level 1 is provided for 2 wheelers vehicular parking. Car and two wheeler capacity of the area is about 1050 no. and 200 no. respectively. The two wheeler parking is not permitted in the basement but only on the ground level

Vehicular Parking

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. Different type of situations requires different types of parking.

There are two types of parking patterns:

- I. Off street parking
- II. On street parking

I. **Off street parking:** In urban areas, some areas are exclusively allotted for parking which will be at some distance away from the main road. This type of parking is known as off street parking. This type of parking is either run by government agencies or some private firms. Off-street parking is of following types:

- a) Multilevel car parking
- b) Surface car parking
- c) Roof parking
- d) Mechanical parking
- e) Underground car parking

a) **Multi-level car parking** Multi-level car parking is a building which is designed specifically for automobile parking and where there are a number of floors or levels on which parking takes place. It is essentially a stacked car park. The multi-level car park is a feature that had already come into existence even before World War II but was not so commonly used. The mechanical garage seemed to be the preferred technology at that period. Due to several failures and maintenance challenges, the Multi-level car parking was chosen as an alternative.

The earliest known multi-level car parking was built in 1918. It was built for the Hotel La Salle in Chicago, IL at 215 West Washington Street in the West Loop area of downtown. It was designed by Holabird and Roche. The Hotel La Salle was demolished in 1976 and the parking was later demolished in 2005. A remarkable development in the multi-level car parking was in The Republic of Ireland, though with a population of just over 4 million, it had almost millions private cars. The development of multi-level car parking did not seriously begin until about 1980, and now currently possesses above 70 purpose-built public multi-level car parking which dates back to the last 15 years.

II. **On Street parking:** It means the vehicles are parked on the sides of the street itself.

Common types of on-street parking are as defined below:

a) **Parallel parking:** In this type of parking the vehicles are parked along the length of the road. It is the safest parking from accident perspective but on the other hand, it consumes the maximum curb length and therefore only a few vehicles can be parked in a given length.

b) **Right angle parking:** In this type of parking, vehicles are parked perpendicular to the direction of the road. In this type of parking, the vehicles need complex manoeuvring and this may cause severe accidents.

c) **Angle parking:** In this type of parking the vehicles are parked at some certain angle. It is one of the safest way of parking. It required more space than parallel parking and less from right angle parking. Following are some angles on which vehicles can be parked :

$90^{\circ}, 60^{\circ}, 45^{\circ}, 30^{\circ}$

Parking is one of the serious problems that confront the urban planner and traffic engineer. With the growing population of motor vehicles, the problem of parking has assumed serious proportions. A systematic study of parking characteristics and demand and regulatory measures that are possible for controlling is of great help to a traffic engineer as well as a town planner.

As per the survey carried out in India, it is roughly estimated that out of 8760 hours in a year the car runs for an average for only 400 hours leaving 8310 hours when it is parked. Increasing concentration of human activity on limited land both in terms of residential activity and commercial activity cause the parking problem. Every car owner would wish to park the car as near as possible to his destination so as to minimize the walking distance. This result in great demand for parking space in the central business district (CBT) and other areas where the parking facilities are a major cost to study to society and parking conflicts are among the most common problem facing designers, town planners and other officials. Such problems can be often defined either in terms of supply (too few spaces are available, somebody must build more) or in terms of management (available facilities are used inefficiently and should be better managed).

Due to inadequate parking facilities, problems such as obstructed movements of vehicles, accidents, congestion, pollution and obstruction to emergency services occurs.

Obstructed movements of vehicles: Due to the wrong parking patterns or inadequate parking facilities, there causes an obstruction in the movements of vehicles which in return causes congestion, traffic jam and all other problems.

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 a great economical loss to the community.

Accidents: Careless maneuvering of parking and unparking leads to accidents which are referred to as parking accidents. A common type of parking accidents occurs while driving out a car from the parking area, a careless opening of the doors of parked cars and while bringing the vehicle to the parking lot for parking.

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

Obstructions to emergency services: Parked vehicles may obstruct the movement of emergency services vehicles such as fire fighting vehicles. Sometimes they block access to hydrants and access to buildings.

2 METHODOLOGY AND DATA COLLECTION

2.1 METHODOLOGY

Before taking any consideration for the betterment of condition for future, present data regarding availability of parking space, extent of its usage and parking demand is essential. It is also required to estimate the parking fare also. Parking survey is intended to provide all these information. Since the duration of parking vehicles varies with several parking characteristics and these characteristics are used to access the parking need.

The multilevel vehicular parking which is under consideration is of 3 level. Each level has the capacity of nearly 350 cars and there are three such levels which are named as level 1, level 2, level 3 respectively. To make this study easier the area of each level is divided into three sections and then each section is divided into three sub sections sections.

In first level, the whole area is divided into three sections areas namely section A, section B, and section C. Then section A is sub divided into three more sub sections which are named as section A1, section A2 and section A3 respectively. Section B is divided into three more sub sections which are named as section B1, section B2 and section B3 respectively. Section C is divided into 3 sub sections which are named as section C1, section C2 and

section C3 respectively. Each section contains OTA, stairs and lifts.

Survey summary sheets are prepared by observing the number of vehicles entering the parking and the vehicles leaving the parking. The number of vehicles which entered in the parking lot is written under inflow column and the number vehicles which leave the parking lot are written under outflow column and the accumulation at the end of an hour is written under accumulation column. Accumulation at any time is calculated by subtracting the number of outflow vehicles and adding the number of inflow vehicles to the accumulation numeral for the previous interval, details are tabulated in tables . Each table represents the data of 12 hour interval.

Table 2.1 parking data on Monday

Duration - 12 hours		Monday	
Parking interval -1 hour			
Time (in hours)	Inflow	Outflow	Accumulation per hour
9:00-10:00 am	189	11	178
10:00-11:00 am	147	72	75
11:00-12:00 pm	78	150	-72
12:00-1:00 pm	97	125	-28
1:00-2:00 pm	76	89	-13
2:00-3:00 pm	99	88	11
3:00-4:00 pm	113	59	54
4:00-5:00 pm	156	200	-44
5:00-6:00 pm	96	60	36
6:00-7:00 pm	88	82	6
7:00-8:00 pm	67	64	3
8:00-9:00 pm	54	153	-99

Table 2.2 parking data on Tuesday

Duration – 12 hours		Tuesday	
Parking interval -1 hour			
Time (in hours)	Inflow	Outflow	Accumulation per hour
9:00-10:00 am	187	12	175
10:00-11:00 am	123	48	75
11:00-12:00 pm	113	23	90
12:00-1:00 pm	88	90	-2
1:00-2:00 pm	63	75	-12
2:00-3:00 pm	57	84	-27
3:00-4:00 pm	71	98	-27
4:00-5:00 pm	63	168	-105
5:00-6:00 pm	114	116	-2
6:00-7:00 pm	123	124	-1
7:00-8:00 pm	97	118	-21
8:00-9:00 pm	33	120	-87

3. DATA ANALYSIS

The data collected from parking studies conducted at various parking sub-areas has been analyzed and synthesized to know about present and futuristic conditions.

Parking statistics

Parking Statistics such as parking accumulation, parking volume, parking load, average parking duration, average turnover and parking index for the present study are calculated in this study.

- i. **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.

- ii. **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.
- iii. **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.
- iv. **Average parking duration:** It is the ratio of total vehicle hours to the number of vehicles parked.
- v. **Parking turnover:** It is the ratio of number of vehicles parked in a duration to the number of parking bays available. This can be expressed as number of vehicles per bay per time duration.

After calculating the value of parking load its value is compared with the capacity of the parking lot.

Table 3.1 Table comparing peak parking demand and capacity.

S.NO	PPD	Capacity	ratio	In %age
1.000	264	1050	0.25	74.8
2.000	352	1050	0.33	66.4
3.000	481	1050	0.45	54.1
4.000	225	1050	0.21	78.5
5.000	287	1050	0.27	72.5
6.000	445	1050	0.42	57.6
7	199	1050	0.18	81

Here in this table, PPD means peak parking demand (in PCU) which is calculated by using cumulative accumulation. Capacity (in PCU) is known to us. Ratio is calculated by dividing peak parking demand with capacity.

From the above results, it is found that in the present time, this parking lot is large enough to handle the parking load all alone. As the population is growing at a faster pace, the vehicular population is also growing at a very faster speed in rural as well as urban areas. In cities like Chandigarh the population is growing at a faster speed because of migration and other many reasons. Therefore, if the parking load of next decade is taken into consideration, this parking lot won't be able to handle the vehicular parking load.

4. CONCLUSIONS AND SCOPE OF FUTURE WORK

4.1 CONCLUSIONS

From the studies following conclusions are drawn:-

In this parking lot cars are parked at 90° angles which cause some sort of difficulty to the drivers to park their vehicles. Therefore the parking angle should be decreased from 90° to 70°. Although the space requirement increases by doing this but this can be compromised by increasing in number of floors.

In order to tackle the future parking load, the floors of parking lot can be increased up to 3 floors on surface and in newly constructed floors, jack system is introduced so that every space in the parking lot is utilized.

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Scope for further work

In addition to the present study, more studies can be done on over populated cities like Amritsar, Ludhiana etc where the available land for parking is less as compared to the number of vehicles there.

These types of multilevel vehicular parking lots should be converted into smart parking with the help of IOT based technologies. For consumers, the most significant benefit of a smart parking system is the decrease in the uncertainty of finding a spot. Traditionally parking lots require motorists to drive around in the search of vacant spot leading to a waste of time particularly during peak hours. An IOT enabled system, with its three essential components; sensors, real time monitoring and automated pavement system allows one to find an empty parking spot even before entering the parking.

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