Parking Studies

civil.iitb.ac.in/tvm/nptel/581_Parking/web/web.html

1 Overview

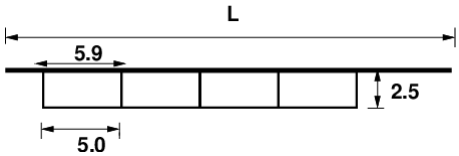
Parking is one of the major problems that is created by the increasing road traffic. It is an impact of transport development. The availability of less space in urban areas has increased the demand for parking space especially in areas like Central business district. This affects the mode choice also. This has a great economical impact.

2 Parking system

2.1 On street parking

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

1. Parallel parking: The vehicles are parked along the length of the road. Here there is no backward movement involved while parking or unparking the vehicle. Hence, it is the most safest parking from the accident perspective. However, it consumes the maximum curb length and therefore only a minimum number of vehicles can be parked for a given kerb length. This method of parking produces least obstruction to the on-going traffic on the road since least road width is used. Parallel parking of



cars is shown in figure 1. Figure 1: Illustration of parallel parking

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The length available to park N number of vehicles, L = $\frac{N}{5.9}$

2. 30° parking: In thirty degree parking, the vehicles are parked at 30° with respect to the road alignment. In this case, more vehicles can be parked compared to parallel parking. Also there is better maneuverability. Delay caused to the traffic is also minimum in this type of parking. An example is shown in figure 2. From the figure,

$$\begin{aligned} AB &= OBsin30° = 1.25, \\ BC &= OPcos30° = 4.33, \\ BD &= DQcos60° = 5, \\ CD &= BD - BC = 5 - 4.33 = 0.67, \\ AB + BC &= 1.25 + 4.33 = 5.58 \end{aligned}$$

For N vehicles, L = AC + (N-1)CE =5.58+(N-1)5 =0.58+5N

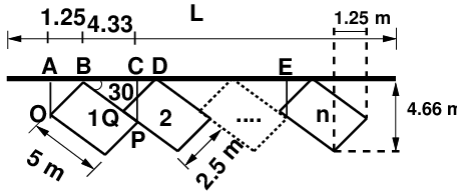

Figure 2: Illustration of 30° parking

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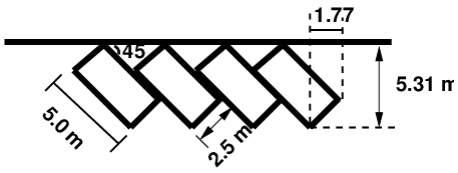
3. 45° parking: As the angle of parking increases, more number of vehicles can be parked. Hence compared to parallel parking and thirty degree parking, more number of vehicles can be accommodated in this type of parking. From figure 3, length of parking space available for parking N number of vehicles in a given kerb is



L = 3.54 N+1.77 Figure 3: Illustration of 45° parking

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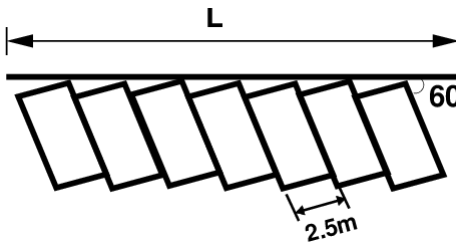
4. 60° parking: The vehicles are parked at 60° to the direction of road. More number of vehicles can be accommodated in this parking type. From the figure 4, length



available for parking N vehicles =2.89N+2.16. Figure 4: Illustration of 60° parking

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

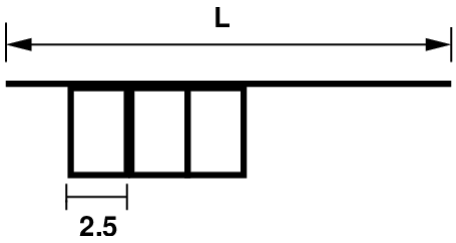


Figure 5: Illustration of 90° parking

2.2 Off street parking

In many urban centers, some areas are exclusively allotted for parking which will be at some distance away from the main stream of traffic. Such a parking is referred to as off-street parking. They may be operated by either public agencies or private firms. A typical layout of an off-street parking is shown in figure 6.

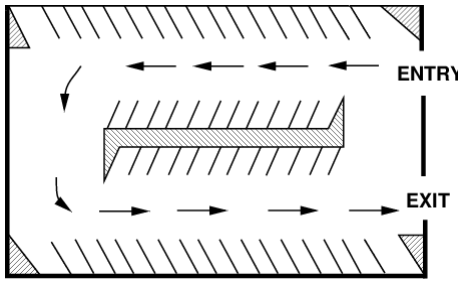


Figure 6: Illustration of off-street parking

2.3 Parking requirements

There are some minimum parking requirements for different types of building. For residential plot area less than 300 sq.m require only community parking space. For residential plot area from 500 to 1000 sq.m, minimum one-fourth of the open area should be reserved for parking. Offices may require at least one space for every 70 sq.m as parking area. One parking space is enough for 10 seats in a restaurant where as theatres and cinema halls need to keep only 1 parking space for 20 seats. Thus, the parking requirements are different for different land use zones.

2.4 Ill effects of parking

Parking has some ill-effects like congestion, accidents, pollution, obstruction to fire-fighting operations etc.

1. 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 great economical loss to the community.
2. Accidents: Careless maneuvering of parking and unparking leads to accidents which are referred to as parking accidents. Common type of parking accidents occur while driving out a car from the parking area, careless opening of the doors of parked cars, and while bringing in the vehicle to the parking lot for parking.
3. 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 creates a feeling that building rises from a plinth of cars.
4. Obstruction to fire fighting operations: Parked vehicles may obstruct the movement of firefighting vehicles. Sometimes they block access to hydrants and access to buildings.

3 Parking statistics

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

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

$$\text{parking duration} = \frac{\text{parking load}}{\text{parking volume}} \tag{1}$$

5. 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.

$$\text{parking turnover} = \frac{\text{parking volume}}{\text{no. of bays available}} \tag{2}$$

6. Parking index: Parking index is also called occupancy or efficiency. It is defined as the ratio of number of bays occupied in a time duration to the total space available. It gives an aggregate measure of how effectively the parking space is utilized. Parking index can be found out as follows

$$\text{parking index} = \frac{\text{parking load}}{\text{parking capacity}} \times 100 \tag{3}$$

3.0.1 Numerical Example

To illustrate the various measures, consider a small example in figure 7, which shows the duration for which each of the bays are occupied(shaded portion). Now the accumulation graph can be plotted by simply noting the number of bays occupied at time interval of 15, 30, 45 etc. minutes is shown in the figure.

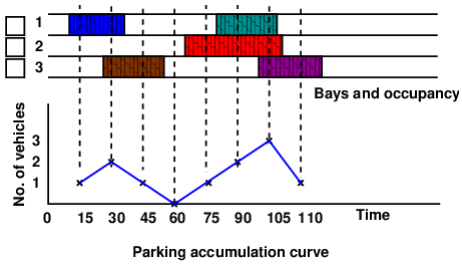


Figure 7: Parking bays and accumulation curve

The various measures are calculated as shown below: Parking volume is given as 5 vehicles. Parking load is given as $(1 + 2 + 1 + 0 + 1 + 2 + 3 + 1)\frac{15}{60} = \frac{11 \times 15}{60}$ = 2.75 veh hour. Average parking duration is computed as

$$\frac{2.75 \text{ veh hours}}{5\text{veh}}$$

= 33 minutes. Parking turnover is obtained as

$$\frac{5 \text{ veh}/2 \text{ hours}}{3\text{bays}}$$

= 0.83 veh/hr/bay. Parking index is calculated as

$$\frac{2.75 \text{ veh hour}}{3 \times 2 \text{ veh hours}}$$

× 100= 45.83%

4 Parking surveys

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

4.1 In-out survey

fixed period sampling can also be done. This is almost similar to in-out survey. All vehicles are counted at the beginning of the survey. Then after a fixed time interval that may vary between 15 minutes to i hour, the count is again taken. Here there are chances of missing the number of vehicles that were parked for a short duration.

5 Summary

Providing suitable parking spaces is a challenge for traffic engineers and planners in the scenario of ever increasing vehicle population. It is essential to conduct traffic surveys in order to design the facilities or plan the fares. Different types of parking layout, surveys and statistics were discussed in this chapter.