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“An Integrated Approach To Parking Management And Traffic Congestion Mitigation In Small Cities: The Sanawad City Experience”

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ABSTRACT

Sanawad city (9.42 sq.km) which is a subdivision headquarter is a small urban area of Madhya Pradesh state with population of 44,009. One of the problems created by road traffic in urban areas is parking. It has an impact on the overall transport development system. Vehicle requires sufficient street space to move and to park, where occupant can be loaded and unloaded. Traffic congestion and parking are synonymous to each other because failure to meet parking results in traffic congestion. With the growing population of motor vehicles the problem of parking has assumed serious proportions. The availability of less space in urban areas has increased the demand for parking space specially in central business areas. A systematic study of parking demand and characteristics are done for controlling parking activities which would be of help to the traffic engineer and town planner.

Four major centers in arteries in the heart of Sanawad city which have insufficient parking space namely Triangle square to Mortakka Chauraha, Bharat Petrol Pump to Mortakka Chauraha, Subhash chowk to Vegetable market and Bus Station to Subhash Chowk. Extensive surveys are being done at these four places to determine the demand and supply of parking. To find the mean parking time of the vehicle, graphs are also plotted between cumulative parked vehicle and their parking duration. Parking demand model is also developed by regression analysis. To obtain a higher value of R^2 , linear and non-linear models are also used.

Keywords : Traffic Management, Parking Arrangement, On Street Parking Facility, Parking Demand Model.

1.GENERAL

1.1 Introduction

Parking are of two types one is on- street parking and other is off- street parking . On- street parking means parking a vehicle on the street along a street curb. Many times we park our vehicle on the street, but sometimes there are restrictions . Sometimes we are allowed to park our vehicle only on one side of the street and sometimes we are not allowed to park vehicles anywhere on the street. Off- street parking means parking our vehicle anywhere but not on the street.

1.2 WHY ON-STREET PARKING SYSTEM

A number of ways by which on-street parking could be of importance. These are:

Higher efficiency: Users of the downtowns consistently select on-street parking spaces over off-street surface lots and garage parking. The on-street spaces experience the most use and the highest turnover.

Better land use: Medium-sized town centers can save an average of more than two acres of land by providing street parking. This efficiency can allow for much higher-density for commercial development than the center to rely solely on off-street surface lots.

Increased safety: Drivers tend to travel at significantly slower speeds in the presence of features such as on- street parking and small building setbacks. Slower vehicle speeds provide pedestrians, cyclists and drivers more time to react, and when a crash occurs, the chance of it being life-threatening is greatly reduced.

1.3 COMMON METHODS OF ON-STREET PARKING

On-street parking is known for its efficiency in terms of land use and convenience to motorists as it allows them to park their vehicles nearer to their destinations.

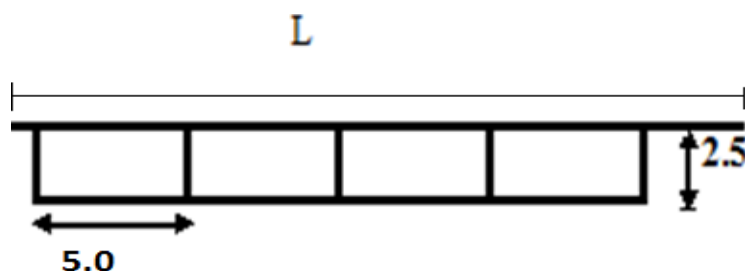
Common methods of on- street parking are -

- a)Parallel parking
- b)Angular parking
- c)Right angle parking
- d)Parallel parking

The vehicles are parked one behind the other. The Parking lot is designed as per the area required if Parallel Parking is adopted. It has been surveyed that the area required for Parallel Parking is much less than required for Angular Parking. Therefore, more vehicles can be parked in this Parking System. For this reason, this Parking system is generally adopted.

a)Parallel parking

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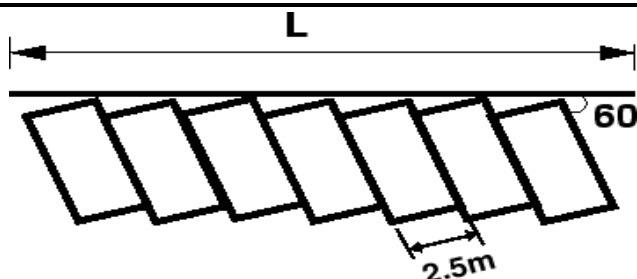


Fig. 2(c) - 60° parking system

c.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. However, it can accommodate a maximum number of vehicles for a given kerb length. An example of Right angle parking is shown in figure 5 . Length available for parking the number of vehicles is $= 2.5N$.

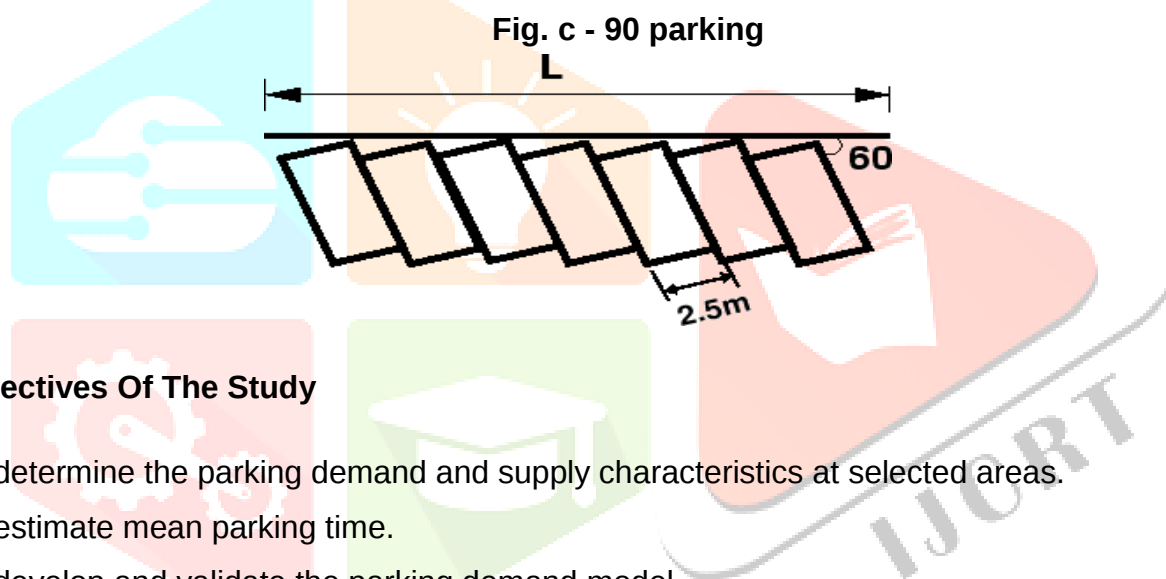


Fig. c - 90 parking

II.Objectives Of The Study

- 1.To determine the parking demand and supply characteristics at selected areas.
- 2.To estimate mean parking time.
- 3.To develop and validate the parking demand model.
- 4.To assess the parking characteristics including parking duration and accumulation.
- 5.Analyze the main street traffic flow condition.

Area Selection

Four major commercial places in Sanawad city were selected for the study. They were -

a.Triangle square to Mortakka Chauraha

b.Bharat Petrol Pump to Mortakka Chauraha

c.Subhash chowk Market to Vegetable market

d Bus Station to Subhash Chowk

III.MODEL DEVELOPMENT

3.1Methodology

Parking demand models were developed for all selected areas – Triangle square to Mortakka chouraha,Bharat Petrol Pump to Mortakka Chauraha,Subhash chowk to Vegetable Market,Bus Station to Subhash Chowk with the help of Datafit-9 software. Both linear and Non-linear models were developed .

3.2 Survey

Surveys were carried out to identify the different land use patterns and to measure the area of each land use at the four places .

At sarafa market ,an extensive survey was conducted on both sides of the road extending from Subhash chowk to Vegetable Market and Subhash chowk to Bus station.

At Mortakka chouraha ,two routes were considered for survey. These were Mortakka chowraha to Triangle square and Bharat Petrol Pump to Mortakka Chauraha.

Near the Bus station two routes are considered for survey . One is from the Bus station to Subhash chowk and the other from the Bus Station to Jardar Chowk .

3.3 PARKING SURVEY

The survey included counts of parked vehicles at regular intervals through a period , covering both the morning and evening peak period . The survey was carried out continuously from 10 AM to 7 PM at these four places .

IV.Analysis Of Data

4.1Cumulative Frequency Curve

In order to show the relationship between time and cumulative frequency in terms of the percentage of car and two wheelers at the four places , different graphs were plotted as shown in fig.

Table 4.1 - Cumulative Frequency % for Parking Duration of Two wheeler at Triangle square to Mortakka chouraha

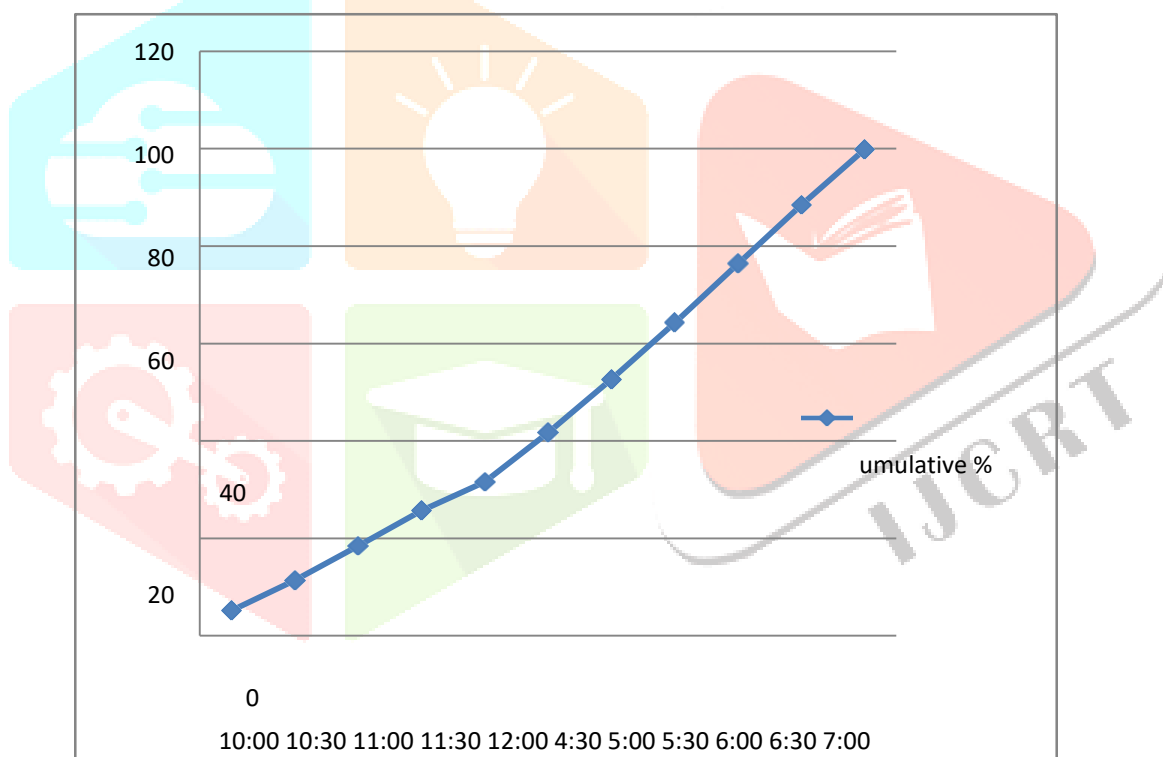
Duration (AM to PM)	Two wheeler	X %	Cumulative %
10:00 AM	160	3.17	3.17
10:30 AM	210	4.16	7.33
11:00 AM	288	5.71	13.04
11:30 AM	346	6.86	19.90
12:00 AM	297	5.89	25.79
12:30 PM	236	4.60	30.39
1:00 PM	190	3.76	34.15
4:30 PM	268	5.31	39.46
5:00 PM	318	6.30	45.76

5:30 PM	390	7.73	53.49
6:00 PM	438	8.70	62.19
6:30 PM	462	9.16	71.35
7:00 PM	400	7.90	79.25
7:30 PM	358	7.10	86.35
8:00 PM	301	5.97	92.32
8:30 PM	212	4.20	96.52
9:00 PM	177	3.50	100.02

Where –

$$\text{TWO WHEELER} = \sum \text{TWO WHEELER} * X\% \quad X\% = \frac{\text{TWO WHEELER}}{\sum \text{TWO WHEELER}}$$

X% = Frequency of vehicle at a particular area at a particular time.



Graph 4.1(b) – Cumulative Frequency Curve for Parking Duration of Two wheeler at Triangle square to Mortakka chouraha

Similar cumulative frequency curves were plotted for cars and two wheeler for all other selected stretches.

Parking Demand Model
Table 6.- Parking Demand Model

Area	Model	R ²
Triangle square to Mortakka Chouraha	$d = -103 + Cc^{.56} + Cn^{.56}$	0.96
Bharat Petrol Pump to Mortakka Chauraha	$d = -163 + Cc^{.6} + Cn^{.44} + OB^{.56} + HS^{.26}$	0.97
Subhash chowk Market to Vegetable market	$d = -110 + Cc^{.58} + Cn^{.53} + OB^{.47}$	0.98
Bus Station to Subhash Chowk	$d = -139 + Cc^{.58} + Cn^{.53} + OB^{.53}$	0.97

Where,

d =demand for parking space in ECS.

Cc=area of Type I Commercial centers in m²

Cn=area of Type II Commercial centers in m²

OB=area of Type II Office Buildings in m²

HS=area of health services in m²

Model Validation

Model development for Post office carfax is validated using the data collected from another major commercial center Bus station . Land use pattern at Bus station is similar to that of Mortakka Chouraha. Parking data from four nearby locations in Bus station were collected and were used to validate the model. The results are shown in Table 7.Land use pattern is an independent variable in this model which can be vary based on other factors.

Table 7 - CHI-SQUARE Test Result

Observed demand in ECS	Calculated demand in ECS	χ^2 Observed
88	78	1.94
154	153	
309	300	
87	81	

V. Conclusions

The paper dwelt in length, the problems associated with parking along the influence area of Sanawad city and extent of parking activities. Based on the land use profile of selected stretches, extent of present parking activities and parking needs were worked out.

1. The mean duration of two wheelers at Triangle square to Mortakka chauraha route was 3 minute and Bharat Petrol Pump to Mortakka Chauraha route, Subhash chowk to Vegetable Market And Bus station to Jardhar Chowk route was 4 minute, 3 minute, and 2 minute respectively.
2. Two wheelers were found to possess less parking duration than that of cars.
3. Nonlinear parking demand models possess higher coefficients of determination than linear models.
4. Commercial centers need around nine times more parking space than that for offices with the same working space.
5. Type I commercial centers required 2.5 times more parking space than Type II centers with the same area.
6. As per research it is found that the variation of X% of vehicles for two wheeler and all other vehicles in a particular area is high at 10:30 AM to 12:30 PM and 5:30 PM to 8:00 PM, it is due to high traffic volume.
7. From the chi-square test result table it is clear that the model is significant at 95% of confidence level.

VI. Future Scopes

- Proper on-street parking management decreases the rate of accidents.
- It will provide easy traffic flow and reduce time duration.
- The increased capacity of existing parking facilities means that parking supply increases without using more land or major construction.
- Small parking spaces for motorcycles, allow and encourage motorcycles to share parking spaces where possible.

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