



Qualitative and Quantitative Assessment of Metropolitan Car Parking Method

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Abstract: In big cities because of the rapid development, parking generation rate has increased rapidly. It has been observed that due to shortage of parking supply, improper use of parking space leads to many parking problem at various location of the city. In the city of Bhopal, a research was done to assess car parking using both qualitative and quantitative methods, as well as to assess compliance to parking regulations. Surveys are performed at 5 sections, both on-street and off-street, typically tourist, commercial and shopping areas of Bhopal. License plate method survey is performed to determine the parking characteristics including parking accumulation, parking turnover, parking load, parking volume, peak parking saturation and parking efficiency. Questionnaire survey is performed to find out potential parameter that influence the parking demand and eventually to establish the parking demand model. In past though plenty of research committed on parking study but a few have integrated both qualitative and quantitative approach for parking study.

Keywords: Metropolitan car parking, parking accumulation, Parking load .

1. Introduction

In recent years, India has shown to be one of the fastest expanding economies, and large cities have become the most appealing location for those looking for work, resulting in increasing urban migration. As cities grow in population and living standards rise, an increasing number of individuals will be able to purchase an automobile. Subsidized parking fees and low automobile prices are attracting an increasing number of people to use a private car as their primary means of transportation for the majority of their travels. Due to an enormous rise in the number of automobiles on the road, parking demand cannot be met by available supply in many parts of the city due to a lack of parking facilities and poor parking management. It was discovered that at. Many parking lots have been noted to have haphazard parking due to a lack of effective marking and inefficient administration, resulting in decreased use of parking space.

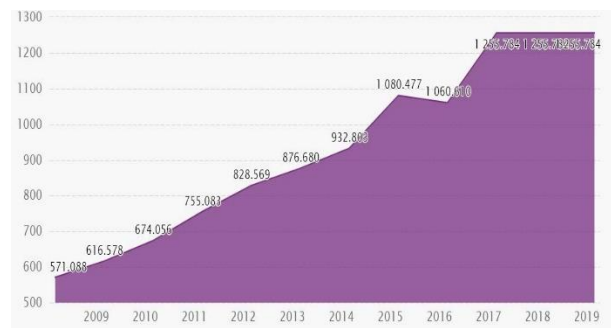


Fig.1

2. Methodology USED

2.1 Introduction

Adopted Methodology for the Study

Figure 1 shows a flowchart of the methodology. A flowchart is a diagram that depicts the steps involved in completing a research assignment. Below is a detailed description of each level. A flowchart is a diagram that depicts the steps involved in completing a research assignment. Below is a detailed description of various level..

- Finalization of the Research Work:
After studying a significant number of papers in order to have a better understanding of existing work and identify research gaps, the topic "Qualitative and Quantitative Evaluation of Urban Car Parking" is decided.
- Finalization of the study area:
A total of five parking bays including Off-Street and On-Street, have been finalised at New Market, MP Nagar, and Lake View based on land use and other key factors.
- Data collection and extraction

To collect data for this study, the following tasks were done. The data is collected via the license plate approach, an In-out survey, and a questionnaire survey.

1. A total of 200 questionnaires were issued to the parkers at the chosen location in order to collect profile information and data for qualitative analysis.
2. License plate and In-out survey are conducted to derive the parking characteristic for the quantitative evaluation.

- Analysis:
Parking characteristics are analysed by adopting quantitative approach. Peak parking saturation, parking occupancy and several other parking characteristics are thoroughly analysed to evaluate the performance of parking facility.

Parking demand model is generated by using multiple regression in SPSS software. Parking demand is expressed in terms of parking duration, no. of visit per month and total parking usage per month. The backward elimination method is adopted so that final function will contain only statically significant variable.

Test Procedure:-

1. The certain summative mock-up is sieve all the way through 12.5mm riddle and retain on 10mm IS filter is full Standard reliability 31.5 border: 5 to 7 mm original setting Time 55 notes Minimum 30 notes Final location Time 165 events Max. 600 Minutes “somewhere else
2. The aggregate retained on 10mm IS sieve is taken and filled the cylinder on 3 equal layers giving 25 strokes on each layer by standard tamping rod and the sample surface is leveled off.
3. Then the hammer is allowed to fall free on the aggregate from a height such that the lower end face of hammer is 38 cms above the upper surface of aggregate.
4. The Crushed aggregate is then removed from the cup and sieved through 2.36 mm sieve
5. The ratio of the weight of aggregate passing through 2.36 mm is sieve to the total weight of the aggregate in the cylinder gives the impact value of the aggregates.

Methodology Chart

The flow of research work is depicted via methodology chart mentioned in Fig.2.

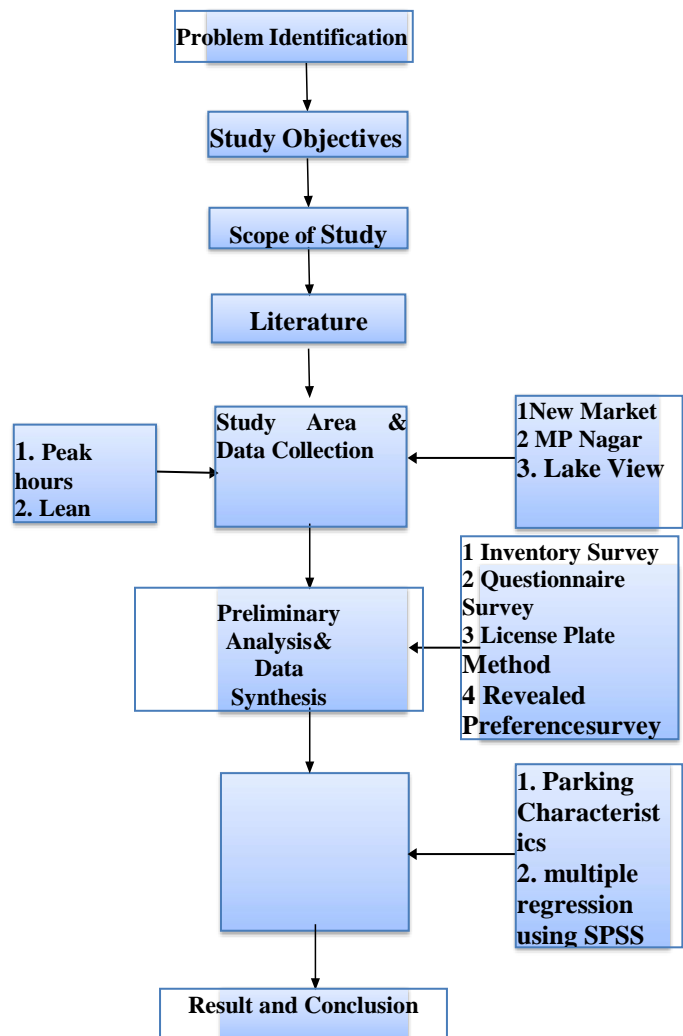


Fig. 2 Methodology Chart

Selected Areas

1. New Market

New Market is one of the most prominent shopping places in Bhopal. There are huge no. of showrooms and outlets situated at New Market.

2. MP Nagar

MP Nagar is the most bustling area of Bhopal. We can call it downtown of Bhopal city as it host most of the business and commercial activities. Additionally, several coaching centres are located in MP Nagar, attracting a student crowd.

3. Lake View

Lake View is the famous tourist attraction of Bhopal. Visitors from all over the Bhopal visit the place for recreation activity. Lake view is situated around the Bhojtal, and people come here for boating and other leisure activities

We chose places in our study that had various types of land use. The location of our research area is depicted in fig4.1 Selected areas are the significant area of Bhopal city. Spill over, haphazard parking, violation of enforcement rules and illegal parking, and parking on carriageways are all issues that are primarily caused by poor parking management, insufficient parking space at some locations, a lack of necessary parking signs, drivers' desire to park as close to their final destination as possible, and indecent parking usage. As a result, these locations have been selected as a study site for analysing and assessing parking characteristics and behavioural traits, as well as suggesting parking rules.

3. General

Data Collection

Field surveys are conducted to collect data for the study, and the surveys are tailored to fit the study's objectives. The data collection process was begun in December 2021 and end in February 2022. Surveys are conducted between the periods of 9 a.m. and 9 p.m. at each location. The study surveys include the following:

Details of Survey

1. Parking inventory survey: The aim of this survey is to assess the size of a parking lot so that we can estimate the amount of parking space/capacity available.

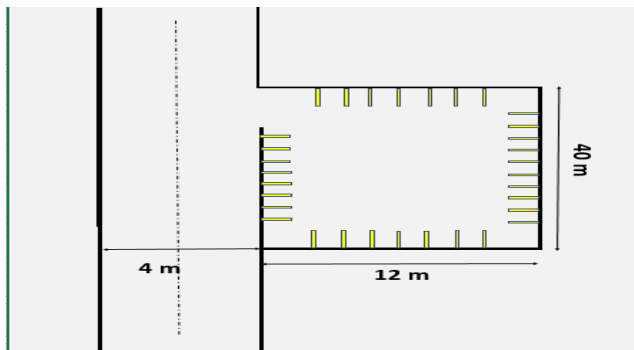


Fig. 3 Layout of Lake View off-street parking lot

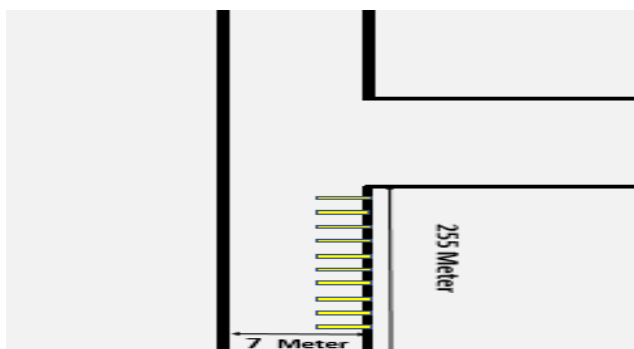


Fig 4 Layout of New Market on-street parking

2. License Plate Method: The licence plate method counts the number of vehicles parked in a parking lot every 15 minutes by capturing the registered licence plate number of each car. The data derived from license plate method gave us information about duration for which vehicle is parked at parking lot and many other parking statistics.

Time	Location - Bay No															Date-
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Fig .5 vehicle registration No. Entry Sheet for License Plate Method

3. In-Out Survey: The in-out survey is carried out in specified regions to determine the parking volume, accumulation board, and parking load. In an in-out survey, a person stands at the parking lot's entrance and exit points and counts the number of cars entering and exiting the lot every 10 minutes. Although an in-out survey requires less labour than a license plate survey but parking statistics such as average parking duration and turnover cannot be determined.

4. Questionnaire Survey: The survey's goal is to gather data on parker profiles and other factors that influence parking demand. A total of 100 questionnaires were collected from the New Market, and 50 from each of MP Nagar and Lake View. The questionnaire displayed in fig. 1 and has a total of 19 questions.

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Parking Survey
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Driver's Profile

1. Age
 Child Young Adult Old

2. Sex
 Male Female

3. Family Size
 One Two Three Four More than Four

4. Income (In Rupees)
 <100000 100000-200000 200000-500000 >500000

5. Purpose of Trip
 Work Commercial Shopping Social Others

6. Profession
 Service Business Student Self Employed Retired
 house wife

Parking Characteristics

1. Search Time (In Min)
 Very Less Less Average Long Too Long

2. Walking Time From Parking To Destination.
 Very Less Less Average Long Too Long

3. Duration of Parking.
 Very Less Less Average Long Too Long

4. Your view point on the parking charges paid.
 Very Less Less Moderate High Very High

5. Time consumed by public transport.
 Very Less Less Moderate Long Too Long

6. Fair Collection Type.
 Manual Automated

7. Ease Time.
 Very less Less Moderate Long Too Long

8. Security In parking area.
 Very unsafe Unsafe Average Good Very good

9. Comfort. (facilities provided , expose to environment)
 Very Poor Poor Satisfactory Good Excellent

10. Level of parking management.
 Poor Satisfactory Good Very Good Excellent

11. Parking space availability at destination.
 Very Less Less Moderate High Very High

12. Vehicle type.
 Hatchback Sedan Compact SUV Van SUV

13. Frequency of visit.
 Daily Twice Thrice Weekly Fortnight monthly

Fig 6 Questionnaire Survey



Fig 9 Lake View off-street Parking

Data is collected through field surveys, and then data is analysed. Data analysis can be divided into two categories in this study: quantitative data analysis and qualitative data analysis. Parking statistics are examined in quantitative data analysis; however, parameters that influence parking demand are examined in qualitative data analysis, and a parking demand model is generated to generate the mathematical relationship between the independent and dependent variables.

Preliminary data analysis

In preliminary data analysis basically we prepare the data for further analysis. In this study, in preliminary analysis we synthesis the data collected from question survey. The resulted data after preliminary analysis is useful for generating parking demand model and crucial for the qualitative assessment of parking facility. Age, gender, family size, purpose of trip, frequency of visit, and other factors are all included in the questionnaire survey. The bar chart depiction of this parameter is shown below:



Fig 7 New Market On-Street Parking



Fig 8 MP Nagar On-Street Parking Fig 9 MP Nagar off-Street Parking

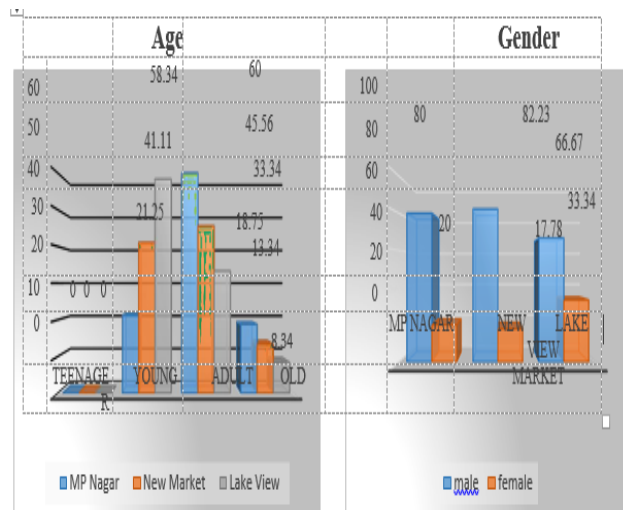


Fig 10 Age

Fig 11 Gender

From fig 10 we can see that MP Nagar parking lot is mainly used by adult age group of people while lake view parking lot is primarily used by young age group of people. We can observe from fig 11 that all of the parking lots are largely used by men. In comparison to New Market and MP Nagar, Lake View has a higher proportion of female parkers.

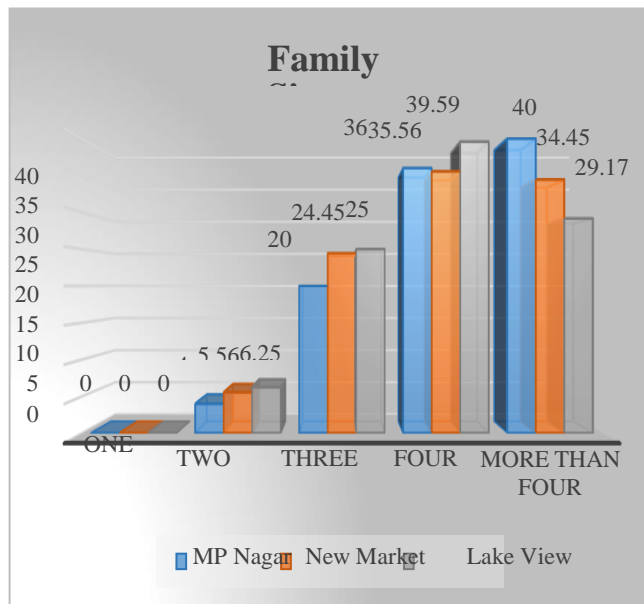


Fig 12 family Size

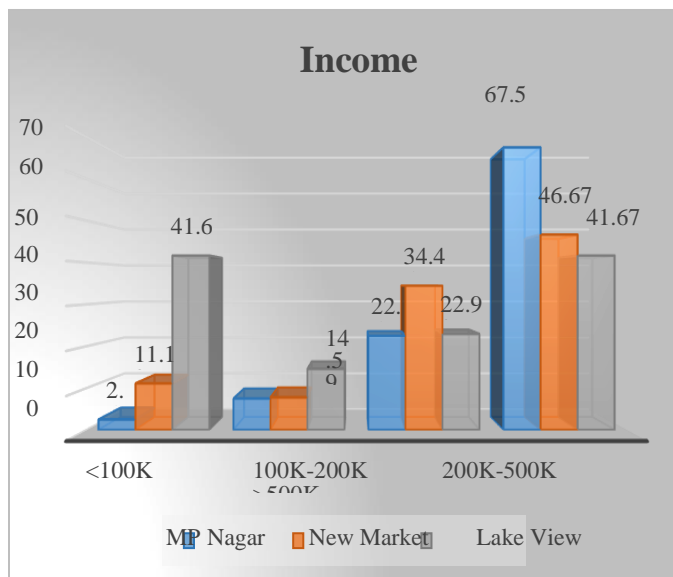


Fig 13 Income

The depiction of family size and income data of parkers at selected locations is shown in Figures 12 and 13 respectively. We can clearly see that the family income of MP Nagar parkers are higher than that of New Market and

Lake View parkers. The family size of Lake View parkers is significantly smaller in fig 13, owing to the presence of a large student population.

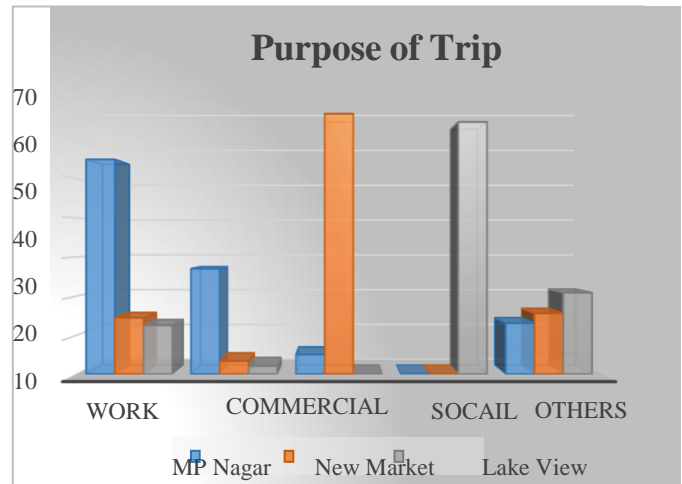


Fig 14 Purpose of Trip

Fig 14 represent the purpose of trip of parkers at selected location, it can be noticed from the bar chart that the New Market is primarily used for the shopping purpose on the other hand lake view is mainly used for recreational activity(social). MP Nagar parking is significantly used for work commercial and shopping purpose.

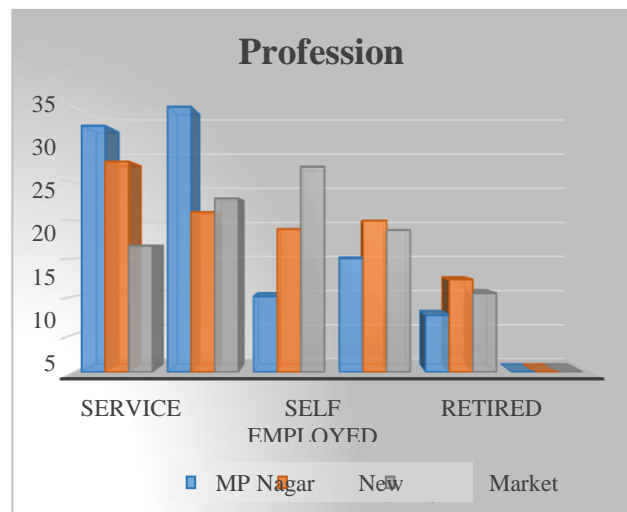


Fig 15 Profession

Parker's profession is shown by a bar chart in Figure 6.6. MP Nagar parkers appear to be mostly involved in service and business, whereas Lake View parking receives a large number of students. Housewives, on the other hand, make no contribution to any parking lot.

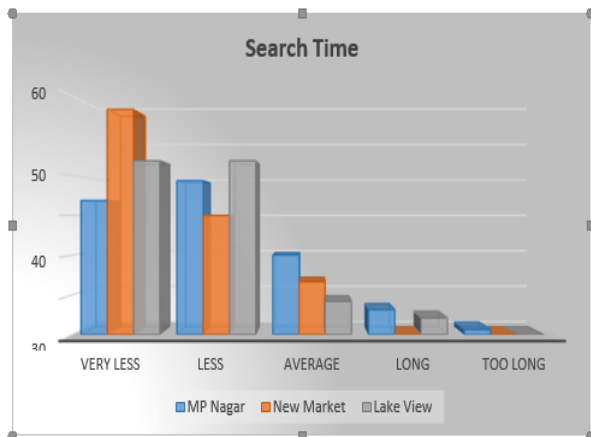


Fig 16 Search Time

The time it takes to find a parking spot after entering the parking lot is depicted in Figure 16. The search time for new market and lake view is comparatively less as compare to MP Nagar.

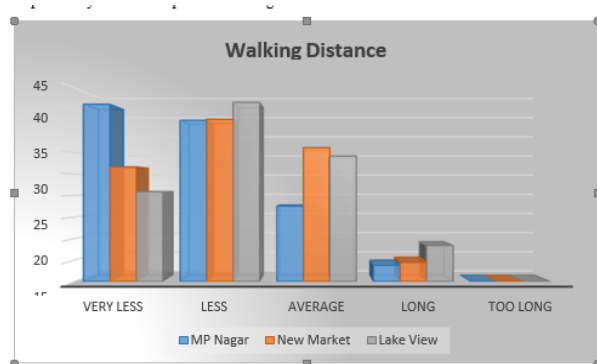


Fig 17 Walking Distance

4. Results and Conclusion

A complete investigation of parking characteristics and behavioral variables was undertaken in this research project. The study's findings are discussed in the preceding section. Peak parking saturation (on-street and off-street) at New Market and Lake View was found to be 1.33 and 1.1, respectively, indicating the presence of spillover. Both parking facilities experience spillover during peak hours (evening). In MP Nagar, on the other hand, peak parking saturation is never greater than one, as authorities do not allow cars to park more than the existing supply. Though it maintains declined parking in the parking facility but the cars that does get the opportunity to park has to roam on the streets to find the parking spot that increase the traffic on roads and sometime car driver ends up with illegal parking. Age, income, search time, family size, ease time, and purpose of trip are important predictors of parking demand

at the selected locations, according to the results of the parking demand model created using the qualitative approach. Parking demand grows with age at MP Nagar and New Market, but declines with age at Lake View. Parking demand appears to be increasing with rising income levels in New Market and MP Nagar. On the other hand, at Lake View parking demand (parking duration) found to be decreasing with increase of income level, while influence of income at parking demand (visit per month and total parking usage) is found to be insignificant at lake view.

Based on the findings of the study, it is apparent that existing parking facilities must be improved in order to maximize the utilization of parking space. To fulfill the parking demand in the designated study area, the parking supply must be increased. Due to the scarcity of space in most metropolitan locations, the introduction of multistory parking facilities can help to enhance parking supply by using less space than surface parking.

It was discovered that parking fees in MP Nagar were very low and independent of the parking duration. Therefore many drivers tended to park for longer periods of time, affecting parking turnover and, as a result, limiting the use of parking facilities. Parking fees must be regulated by policymakers in order for parking spaces to be used efficiently.

Generally it has been found that car driver tends to park the vehicle as close as to destination to reduce the walking distance, for that mostly on-street parking is the first preference of a car driver. Now this leads to the excessive accumulation of cars at parking during peak time, further results in spill over as well. to avoid this situation off-street parking need to be promoted. Policy makers should design the parking

The outcomes of the study shows that search time is the crucial predictor of parking demand at several study area. It was observed that sometimes due to lack of information to the driver the search time to find an empty parking spot increases, it discourage the driver to use off- street parking. It is suggested to install an information display at the parking to Reduce the search time and a digital display should be installed at the entry of parking that will provide information about the availability of parking at the parking lot. The parking management and policy maker should draw the line in way that for longer parking duration cars are diverted to off-street parking and to on-street parking for shorter duration.

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