ASSESSMENT OF ON-STREET PARKING ISSUES IN CBD AREAS

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Abstract : There has been unprecedented growth of Urban areas in the last decade. As more and more cities and towns are nurturing and expanding, the financial status and revenue is also increasing. More and more people are spending on luxurious amenities like vehicles etc. Thus the numbers of vehicles have increased drastically. Every vehicle irrespective of its size, needs to be parked somewhere, hence requires a parking space. Residentially these can be accommodated in garages and lots, but when in CBD areas these create issues. Parking is a important commodity in CBD areas as a land space is required for parking. In most of the CBD areas there is no or less off street parking facility and vehicles tend to be parked at the kerb, footpath, pavements etc i.e. On-street parking. The paper makes an effort to understand the parking demands in the Indian market place. With the need for parking increasing everyday higher and higher and lack of proper awareness and management, the On-street parking problems have soared. There is a need of urgency to find the most appropriate solution which can be applied in order to control the current parking scenario and make it better. Creating more Off-street parking solutions is not applicable everywhere as land is a very valuable asset and cannot be used unwisely. The focus has been tried to bring forward the fine assessment of parking policies, parking demands and redesigning the current parking scenario in the cities and especially in their CBD areas to meet with the demands.

Keywords: On street parking, accidents, parking survey, delays, accidents, etc.

I. INTRODUCTION

General

Due to the escalation in economical and population growth, the Indian Metros and major cities are undergoing a mobility crisis. It is observed that today, urban areas are facing a tremendous pressure about parking spaces. This has lead to rise of transportation issues such as traffic disruption, congestion, inconsistent demand and supply, accidents and a number of environmental problems. The reason can be considered as poor parking management and policies. Due to lack of enforcement, India faces issues like encroachment over footpaths, illegal parking, double parking as well as criminal activities. The paper tries to observe the root cause of the parking problems and come up with appropriate solutions.

World Wide Scenario

Personal vehicles are the major mode of transportation throughout the world. These vehicles gives freedom of mobility to the person, hence in the recent times there has been a significant increase in the ownership of private vehicles. However these vehicles needs to be parked whenever they reach their desired destination. Studies show that out of 8760 hours in an year, an average vehicles moves for only about 400 hours and is parked for the rest of the time. There has been significant increase in private vehicle ownership at an average rate of 9% per annum. There are more than 2 billion cars in the world and all these require parking spaces. Parking demand in public areas and central business districts has been increasing everyday and this is a prominent scenario in a country like India. Due to lack of parking spaces and lack of management, Kerb parking or On-street parking practices are major parking model used all around the world. Parking signifies the ease of parking in an desired location with easy maneuverability and near to the destination, but this seldom happens.

In Central Business Districts, On street parking is a becoming a major issue due to high demand and lack to parking spaces thus affecting the efficiency of the road and influencing the growth of the business district.

In a city's Central Business District (CBD), much of the economic activity is concentrated in a small area. This leads to the attraction of a large number of people and hence vehicles.

In India, the roads are narrow and the population density is high. Also as India being a developing country the concept of parking plazas etc. are yet to be applicable everywhere. Therefore On street parking is a major parking practice on Indian roads. All major cities and their CBD zones face an issue regarding the Ill effects on On street parking. These not only decrease the width of already narrow roads but leads to other problems like congestions, accidents, delays etc. These also cause a bad impact to the environment both to the air and noise index. On street parking. One major reason for On street parking in India is that it is free, even in CBD areas, hence this promotes the user to use his private vehicles rather than public transport. Drivers in CBD areas in order to reduce the walking distance to their destination, prefer On street parking as it is cheap and lack of enforcement, create and environment of congestion, time delays, high emission level and reduction in efficiency of the region. Most cases it has also been seen that there has been availability of parking space, but lack of education and enforcement has lead to On street parking issues.

Objectives of study

The objective of the study is to assess the On-street parking issues in Central Business Districts of Nagpur city. The main objectives process has been enlisted as follows;

- a. To identify the parking scenario of CBD areas
- b. To analyze the parking scenario and problems in CBD areas
 - Literature Review study

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- Site Analysis
- c. To provide feasible solutions which can be adopted for the region.
- d. To understand the socio-economical concepts for the solutions suggested.

Issues generally includes congestion, reduction in road width, increase in pollution level, increase in journey time, start stop behavior of traffic movement, bottleneck formation, increase in accidents rates etc.

Literature Gap

- After reading a number of papers there are a few gaps which can be analyzed.
- There was a gap between the supply and demand in various papers.
- Most of the paper stated a more detailed study was required as the data obtained is highly variable and needs a study over a longer period.
- There has been a lack in coming up with providing ITS solutions for parking problems.
- The parking data for short durations is not available or inconclusive and thus their effects on traffic flow cannot be properly understood.

II. METHODOLOGY

As observed from the various literature, it seems that their has been some work done on the analysis of parking problems. Parking problem in CBD areas is getting more and more common in all the major cities around the world. With the development of lifestyle, parking has been a side effect of this growth which is now catching the attention of Traffic engineers, designers and planners. Many studies were done regaring the various aspects and types of parking mainly in CBD zones, but there have been certain limitations regarding the availability of data and variations due to changing demand conditions. Most of these roads are undivided thus it has random movement of vehicles and managemnet of such areas becomes difficult. The on street parking characteristic of the region affects the overall road capacity drastically with unexpected delays experienced by the users which are the failure of the system design. Hence, a proper study is to be done in order to understand the heterogeneity and complex behaviour of On street parking systems.

Site Selection and Study Area Profile

CBD areas have common charcteristics all over. These are stretches of roads of 1-2km of length where major commercial market it. Two major CBD areas stretches were considered where on street parking was prominent. All the major components were measured and analysed like road width, footpath, encroachment, crossings etc. The overall traffic was converted into different types of vehicles for ease in the analysis, namely two-wheeler (2W), three-wheeler three-wheeler (3W), small car (SC), big car (BC) and heavy vehicle (HV).

Site A : Ramnagar square to Gokulpeth

This area is situated in the west part of the Nagpur city. It has one of the major commercial area in this region. It has been observed that during working hours this area experiences traffic problems like congetion, delays and sometimes accidents. Hence the area was considered for study. A few images will explain the current scanario of the region.



Figures: Ramnagar Site A location

Site B: Gandhiputla Square to Shahid Square

This site lies in the eastern region of Nagpur city. It is near the major market place of Nagpur i.e. Itwari.this region experiences a high vehicle demand and streets are generally clogged. Thus analysis for this site for considered for the assessment. The images provides a brief idea about the site.



Figure : Gandhiputla Site B location

Table no. 3: Site Details				
Sr. no.	Site	Trip Length	Width	Study timings
1.	Ramnagar Square	2.0 km	10-14 m	3.30 PM to 9.30 PM
2.	Gandhiputla Square	1.6 km	11-14 m	3.30 PM to 9.30 PM

While selection of the site, the whole study area was analyzed. The goal of the study was to observe understand the problems occurring in the region and their root causes. It has to be understood that CBD areas have a high demand almost at all times. This means that parking facilities are in use most of the time.

The major parking behavior of the sites was On street parking with few or no facilities for off street parking. The structures in both the areas are relatively low thus there are very few off street parking spaces available in the structures. the areas experience congestions, delays, accidents, and also causes environmental pollution due to noise and smoke, as on street parking reduces the effective travelling width of the street and decreases the LOS of the street. The major causes of parking problems are enlisted as

follows:

- a) High demand and lack of supply of parking spaces.
- b) No specific parking marking on the street.
- c) Lack of Engineering, Education and Enforcement for On street parking.
- d) Heterogeneous parking type.
- e) Human error.
- f) Double parking.
- g) Short duration parking causes ripple effect or shockwave.
- h) Accidents due to vehicle maneuverability.
- i) Encroachment by hawkers.

Concept Methodology

In order to properly access the On street parking in CBD areas, it becomes important to understand the whole literature and concept of it with its limitations. The figure illustrates the methodology used for the study and focuses on the real life observations and analytical approach that can be studied for the assessment of On street parking. By doing so we can actually compare ground level reality and decision making ability of drivers and pedestrians while parking and walking. Overall we can thus find an optimized solution which may reduce on street parking problems.

The methodology used in this study has been classified into various steps. The first step is to identify the CBD zones and analyze with the characteristics of all the zones are similar in order to analyze for an universal solution. The second step is to go through the literature reviews in order to identify the literature gaps and come up with a proper study area. The literature states that CBD areas all around the globe have similar characteristic i.e. small road width, too many shops, high density, heterogeneous types of vehicles and a high parking demand. The third steps is that data needs to be collected and analyzed on the basis of type, duration, size, peak hour etc. Geometrical features of the study area are also measures such as width of road, number on intersections, length, encroachment areas. And finally the three E's of the areas i.e. Engineering, Education and Enforcement. Fourth, all the accumulated data needs to be processed in order to provide the best possible measure for the parking issues in these zones and working upon the future scopes as these zones are the economical lifeline of the region, hence the socio economic parameter of on street parking in these region can be looked and researched upon.

Computation

The data was collected and computed for a few parking terms required for analysis.

a) Parking Inventory Survey

The inventory survey was done by measurement of the road width and the trip length for the study area. The dimensions of various on street parking spaces we calculated and then the space was converted into ECS or Equivalent Car Space by considering the ECS of On street parking as 20sq.m as per SP-12:2015.

On street ECS = $\frac{\text{Total Parking space in sq.m}}{2000}$

CS _ _ 20 sq.m

b) Parking Demand Survey

The parking demand survey was obtained using "Fixed Period Sampling" where the initially all the number of parked vehicles were calculated and then after regular intervals the parked vehicles were again counted over the length of the study period. The vehicles were then converted in terms of ECS for ease of calculations. Refer **Table no. 2** for ECS conversion factor

Parking Volume c)

The total number of vehicles parked during the study period. It is calculated for each interval and summed up for the total day Parking Volume = Σ Pt

Where Pt = Total parked vehicle at interval "t"

Parking Index d)

It is the actual number of parking bays occupied by parking with respect to the theoretical number of parking spaces available. It provides with the percentage of the ratio to demand and supply

Number of bays occupied Parking Index = $\frac{1}{\text{Theoretical number of bays available}}$ * 100

e) **Parking Turnover**

Number of the handling of the deployable parking places.

Eg. If there are 50 parking spaces used 2000 vehicles in a period of, say 12 hours, then the parking turn over would be = $\frac{2000}{100}$ =

40 vehicles per bay in a time of 12 hours.

DATA ANALYSIS

Parking Surveys

Parking Inventory Survey

The On-street parking inventory data was collected by space inventory survey. For on street parking, the geometrics of the road we calculated. The length and width were measured and the ECS for On street parking is 20sq/mt as per SP-12:2015. On the basis of these measurements the parking supply was calculated. It was noted during ground survey that full length of road is not available for parking due to practical limitations such as intersections, electric poles, encroachment and improper parking. Also because of the entry and exit points into the building on the street, limited parking was available on both the streets.

The parking inventory for both the sites was calculated individually by measuring the parking spaces and converting them into ECS for both the sites.

Parking Demand Survey

The parking demand survey was carried out for 7 days including weekdays and a weekend. The duration was from 3.30pm to 9.30pm during the peak hour conditions. The method of survey used was 'Fixed Period Sampling'. A surveyor at an interval of 30min records all the number of vehicles parked of the desired study area. The data to be collected was:

- 1. The number of Parked vehicles
- 2. Peak hour
- 3. Parking accumulation
- 4. Parking Load
- 5. Parking Volume

During the survey various types of vehicles were encountered so it is important to convert them into a equivalent standards for better understanding. Using SP-12:2015 the ECS had been converted to 0.25 for two wheelers and 0.50 for three wheelers.

Accordingly, the whole demand data was converted into ECS and the overall parking accumulations for the study areas were calculated. Parking accumulation is the count of total number of ECS parked in a particular time, thus the demand can be interpreted as per the requirement for various instances during the study period.

Analysis of parking demand functions

- Parking Volume a.
- Parking Index b.
- Parking Turnover c.

All the data was further analysis and represented in terms of graphs for better understanding.

RESULTS

General

According to the objective of analyzing the On street parking problems of CBD areas, two study areas were selected in Nagpur city. These two area were selected on the basis of their high demand for parking. The study time period for both the areas was of 7 days for 6 hours. The timing was selected considering the peak hour demand timings for both the study regions. First to obtain the parking inventory data, the on street parking spaces were analyzed and the data was converted in terms of ECS and a total available ECS for parking was determined for both the sites.

Similarly, in order to find the demand for parking spaces "Fixed Period Sampling" method was used at an interval of 30 min for a duration of 6 hours for 7 days.

Using this data, parking parameters such as parked vehicle volume, parking index, parking turnover and average parked vehicle volume were calculated.

ECS demand: The Parking inventory data provided us with the available ECS available for parking for the region. With the help a. of ECS demand data, we could figure out the peak demand and supply variations and the average variations for both the sites in order to provide appropriate solutions.

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Figure : ECS demand for Site A and Site B

For the study area Site A, the demand seems to be increasing during the later part of the study time. The parking demand gradually increases and is maximum at 8.00pm and the starts to decrease. Peak ECS is observed at 8.00pm of 184.25 ECS on the 6^{th} day. The chart shows represents the all day parking accumulation which has been merged and analyzed which shows the peak ECS demand and its variations with respect to time.

Similarly, for the study area 2, the demand seems to be increasing during the earlier part of the study time. The parking demand is initially high and is maximum at 5.00pm and then starts to decrease. Peak ECS is observed at 5.00pm of 185.75 ECS on the 7th day. The chart shows represents the all day parking accumulation which has been merged and analyzed which shows the peak ECS demand and its variations with respect to time.

b. Parking Volume: The parking volume graph shows that how many vehicles are parked in the study areas selected. This gives a figure of how many vehicles operate in the region everyday and the facilities required to accommodate them needs to be improved accordingly.

In the study area A the average parking volume for the study period was found to be 1887 ECS per day and for study area B it was 1796.5 ECS per day. This data can be used for designing the traffic regulations in the region. The graph shows the variations in the traffic volume during the study period.



Figure: Parking Volume Site A and Site B

c. Parking Index: Parking index provides us with the data in percentage and here it is observed that the parking index during most of the study period for both the sites are greater than 100% which clearly indicates that the demand is greater than supply. This is not an appropriate scenario as it affects the overall efficiency of the transport network and also leads to accidents.



Figure: Parking Index for Site A and B in percentage.

d. Parking Turnover: This turnover data indicates how many vehicles utilize a bay during the study period. The data provides us with the rate of use of a facility. From the results we can conclude that the average utilization for both the study area was 18 for Site A and 19 for Site B. This is useful information in order to get the efficiency of the overall parking system.



e. Socio-economical aspect: While data collection it was observed that there was no pricing for On street parking in both the study areas. As a result there was no managing authority at the site to control the parking behavior. As On street parking was freely available the ownership of responsibility towards parking and traffic operations was missing from the drivers. Parking was done on the basis of convenience without thinking about the consequences about the traffic movement. The patrolling of law enforcement authorities was also minimal and whenever they did it caused more commotion in the region. Also there was lack of parking signals, parking markings and visible guidelines which made it even difficult to educate the vehicle users. One of the major reason for decrease in road width was encroachment by hawkers. This was one of the major reasons for traffic commotion and pedestrian accidents as the visibility and the walking spaces at footpaths, both were affected.

CONCLUSION

The was conducted by first going through a lot of literature and a few gaps were considered. Then a couple of sites for the assessment of CBD parking problems were considered. It was observed that in Site A, the peak parking demand is 184.25 ECS and the supply of parking space was only 102.3 ECS which is not fulfilling the parking requirement of the region by 81.95 ECS. Peak Parking Index of the region is 180.1075%. Similarly, for Site B, the peak parking demand is 185.75 ECS and the supply of parking space was only 94 ECS. This indicates even worse conditions as gap in supply and demand is 91.75 ECS whereas the peak Parking Index of the region is 197.60%, which is almost twice the supply.

For both the sites the parking index was greater than 100% which means that the parking here is affecting the traffic region as On street parking interferes with the traffic operations hence will lead to traffic congestion and other problems.

In order to overcome the parking problems a few solutions can be suggested.

• Uses of zone based parking system across the city and discourage the use of private vehicles in CBD districts. This can be achieved by optimizing public transport in the region, differentiating parking on the basis of vehicle types and heavy penalties for parking offenders and encroachers.

• It is also observed that on some level parking can be managed in spite of less space but proper education must be imparted to public. Hence the 3 E's i.e. Engineering, Education and Enforcement needs to be worked on.

• If On street parking need to be managed, minimal charges should be levied so that proper management can be done by an independent authority of the parking spaces. This would not only help in better management but would also discourage usage of private vehicles.

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