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 R2, linear and non-linear models are also used.

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

INTRODUCTION

Population of all cities in India is increasing day by day because of this all cities face various parking problems. Parking is an essential component of the transport system. It plays an important role in traffic management. Nowadays parking problems are related to space, so we minimize the space to reduce the parking problem. Every vehicle user would wish to park his vehicle as closely as possible from his destination in order to minimize walking. It is roughly estimated that out of 365*24 hours in a year, a car runs on an average only 400 hours, while for the remaining 8, 360 hours it remains parked. Therefore it is very essential that these should be a proper parking arrangement.

Parking studies are essential to minimize road congestion and accidents. Improper parking arrangements become an obstacle to effective traffic management. Parking studies are essential to know parking demand and for development plans and terminal facilities. These studies help in improving regulations for existing parking facilities . A proper parking system also increases the efficiency of roads.

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 can 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 on the street. Generally these types of parking like garages and lots . Off street parking can be divided into two parts as indoors outdoors. Private lots and garages are also included in off street parking.

METHODS AND MATERIAL

Various Causes of Parking Problem

Availability of fewer parking spaces.

- Too many cars for the roadway due to inadequate mass transit options or other reasons.
- Fundamentally parking is a problem of space.
- Demand for space for parks is growing with the infrastructural growth of our city.
- Obstacles in the road causing blockage and merge.

Objectives of the Proposed Study

- To determine the parking demand and supply characteristics at selected areas.
- To estimate mean parking time.
- To develop and validate the parking demand model.
- To assess the parking characteristics including parking duration and accumulation.
- Analyze the main street traffic flow condition.
- With the help of Proper survey at selected areas to provide a good on-street parking system.

Literature Review

Nilesh,Harvish Kumar & Deepak Soni,(2022),The study concluded that Sonipat City faces significant on-street parking issues that exacerbate congestion. Proper off-street parking facilities and parallel parking should be prioritized, along with stricter enforcement of parking regulations.This research highlights the need for comprehensive urban planning and policy changes to resolve parking challenges in rapidly growing urban areas like Sonipat.

Diyora,M.H. & Dhameliya,H.M.(2020),The study focuses on the on-street parking issues in the CBD area of Vadodara, India, where insufficient data and a lack of proper parking policies have exacerbated the problem. A 12-hour parking survey using the license plate method was conducted on two busy streets, revealing that demand exceeded supply, with low turnover rates. The study aimed to model vehicle parkers' responses to a policy measure based on the National Urban Transport Policy (NUTP 2014). Analysis using fuzzy techniques showed that factors like household income, trip frequency, and parking duration influenced drivers' parking

Ratul, M. & Diyora, H. (2020),The research leads to the following conclusions: None of the areas chosen for analysis had enough curb and off-street facilities. Each of the sites that were chosen had a significant issue with curb parking for cars and motorcycles. Each of the sites that were chosen has a roadway width of 9.3 meters, after which it takes a motorbike around 2-4 meters before congestion becomes an issue. When parking is full, Reliance Mall provides off-street parking. Panipat Station parking clogs the entry and exit gate, whereas Tulip Point Mall parking is for personnel only. People are prepared to pay parking fees for pleasure activities like viewing a movie at a mall, but for business activities like short-term office work or shopping, they strive to avoid it. Even in places with correct curb parking,

there is still a strong demand for parking, and there is very little space available during peak hours, suggesting that the parking issue should be solved by building separate parking lots on the open lots near to the examined areas.

Hamid, A.E. & Muzhar, R.R. (2019),The study investigates on-street parking in Al-Najaf City, focusing on two congested areas: Al-Rawan and Al-Iskan. Using drones, video cameras, and manual counts, the researchers analyzed parking turnover, waiting times, and parking types. Findings show peak parking times occur after 4:00 PM, with over 80% of vehicles parking for more than 30 minutes, often illegally. The study suggests improvements like regulating on-street parking and providing off-street parking to reduce traffic congestion.

Pritikana, D., Farhat, A. & Parmar, J. (2019),The study in Delhi examines parking challenges in nine commercial and shopping areas, focusing on both on-street and off-street parking characteristics such as accumulation, occupancy, load, and efficiency. Despite sufficient parking spaces in some areas, poor management and lack of proper signage lead to congestion. At Nehru Place, parking saturation levels reached near-optimal (0.97 and 0.98), but high overflow occurred for cars and bikes. Similar issues were found at Bhikaji Cama Place and Atta Market. Based on these findings, guidelines for better parking space utilization are suggested, providing useful insights for engineers, planners, and policymakers.

"**Tentative Recommendation on the provision of parking space for urban areas" New Delhi**, Growing urbanization, increased demand of space for parking of vehicles in the city areas, whether for short and long-term parking. The parking demand is likely to increase still further at a higher rate in future.

Desirable parking space standards for different land use

S.No.	Land use	Parking space standard
1.	Residential	
I	Detached ,semi-detached row houses: plot area upto 100 sq.m.	No private or community parking space is required.
	Plot area from 101 to 200 sq.m.	Only community parking space is required
	Plot area from 201 to 300 sq. m.	Only community parking space is required
	Plot area from 301 to 500sq.m.	Minimum one –third of the open area should be earmarked for parking.
	Plot area from 501 to 1000 sq.m.	Minimum one- fourth of the open area should be earmarked for parking
	Plot area 1001 sq.m. and above	Minimum one-sixth of the open area should be earmarked for parking.
Ii	Flats	One space for every two flats of 50 to 99 sq.m.or more floor area.

Iii	Special, costly developed area	One space for every two flats of 50 to 100 sq.m.of floor area. One and a half spaces for every flat of 100 to 150 sq. m. of floor area two spaces for every flat of above 150 sq.m.of floor area.
Iv	Multi-storeyed group housing schemes	One space for every four dwelling except in cities like Calcutta and Bombay where demand may be more.
2.	Offices	One space for every 70 sq.m.of floor area
3.	Industrial premises	One space for upto 200 sq.m. of initial floor area. Additional spaces at the rate of one for every subsequent 200 sq.m. of fraction thereof.
4.	Shops and market	One space for every 80 sq.m.of floor area.
5.	Restaurants	One space for every 10 seats.
6.	Theaters and cinemas	One space for every 20 seats.
7.	Hotels and motels	
i	Five and four star hotels	One space for every 4 guest rooms.
ii	Three star hotels	One space for every 8 guest rooms.
iii	Two star hotels	One space for every 10 guest rooms.
iv	Motels	One space for each guest room
8.	Hospitals	One space for every 10 beds.

4.Ill Effect of Parking On Road Traffic

Accident

The maneuvers associated with packing and unpacking are known to cause road accidents. Careless opening of the doors of parked vehicles, moving out of parked position and bringing a car are common causes of parking accidents.

Congestion

The loss of street space and traffic attendant congestion is one of the serious ill effects of parking .The capacity of streets is reduced, the journey speed drops down and delays increase.

Environment

The environment of the town center is degraded by Parked vehicles. Stopping and starting of vehicles result in nose and fumes. Over the years many organizations and research reports demonstrated the link between traffic and the environment. Noise, exhaust pollution, visual intrusion, vibration, and effects on animal, plant life and buildings are some of the negative consequences of traffic on the environment.

On street parking on state roads Virginia P.SISIOPIKU, Ph.d. The focus of the literature search was on the impacts from the conversion of traffic lanes into on street
parking on:
Capacity,
Safety,
Accessibility,
Development and economic growth,
Traffic calming, and
The environment

Capacity

The effect of on-street parking on roadway capacity is well known. Substitution of a road lane by a parking lane has an important impact on capacity and a potential effect on traffic operations. This is expected to be the case when on-street parking is introduced to the state trunkline system. On-street parking limits street capacity in two ways. First, it preempts lanes that otherwise would be used by moving traffic. Second, parking and unparking maneuvers frequently reduce the capacity of the adjacent lanes. Even a single vehicle parked within a curb lane can effectively close the lane to moving traffic.

Safety

(Highway Research Board, 1971) On-street parking adversely affects the safety of the street system. Early sources estimated that about 20% of all urban crashes are related to on-street parking . (Weant R.A. and Levinson H.S., 1990) More recent reports attribute approximately 15% of all crashes to the presence of parked vehicles. About 5% of all pedestrian fatalities involve people who entered the roadway from between parked cars . These proportions vary from city to city. An early study in Chicago examined the frequency of crashes involving parking (Chicago Police Department, 1974). It was found that moving vehicles striking parked vehicles accounted for 2% of all fatal crashes, 6% of all injury crashes, and 26% of all property damage crashes.

Emergency Vehicle Access

Chick C., 1996, On-street parking constitutes a serious emergency hazard wherever cars block fire hydrants or obstruct fire apparatus. Parking restrictions in the vicinity of fire stations and fire hydrants are essential public safety requirements. When placement of on-street parking is necessary or desirable, available street space must meet requirements for emergency vehicle maneuvering and fire hose laying. Alternatively, on-street parking bays may be designated for use by ambulances or police, where proper road markings alongside the bay are used to indicate the type of vehicle allowed to use the bay .

Economic Development

There is a strong argument that convenient parking fosters economic growth and development. The placement of on-street parking near businesses and retail uses improves accessibility and convenience to customers and has been used

as a strategy for revitalization of central business districts and attraction of renewed consumer patronage to the downtown areas. A number of behavioral studies cited availability of parking as a factor affecting shoppers' travel Decisions.

Traffic Calming

(Residential Streets Task Force, 1990) For many years replacement of on-street parking by traffic lanes was a common practice as a countermeasure to reduce congestion and increase road capacity. However, a 1990 ASCE report admits that "the tendency of many communities to equate wider streets with better streets and to design traffic and parking lanes as if the street were a 'micro freeway' is a highly questionable practice" . Urban planners promoting new urbanism and neo-traditional street designs, as well as advocates of livable and walkable communities and proponents of traffic calming all agree that use of on-street parking can have many benefits. On-street parking is viewed as part of the strategy to reduce motorists speeding through increased side friction. Replacement of traffic lanes by parking lanes, or reduction of traffic lane widths to allow for on-street parking show reduction in motorists speeds and better compliance with posted speed limits. Moreover, alternating on- street parking from one side of the road to another can create a chicane-like effect in residential settings. This technique is a proven traffic calming measure that can reduce travel speed and result in benefits similar to those of actual chicanes at a fraction of the cost (Ewing, R., 1999). Among other benefits cited in the literature, properly designed and placed on-street parking is viewed as a means to create conditions where large vehicles can use the added space at intersections to improve their effective turning radii. Sight lines are preserved at intersections with 30- to 50-foot parking setbacks from intersecting legs (Burden D., 1999; ITE, 1995). Finally, on-street parking supplements off-street parking and thereby reduces the need for large parking lots. For the reasons listed above, reports on desirable features for pedestrian-oriented neighborhoods recommend the use of on-street parking (Duany A., 1990; Lerner-Lam E., 1992). Still, the use of on-street parking as a traffic calming measure should be restricted to facilities with speed limits at or below 25 miles per hour and shall be avoided on major arterial and collector streets.

Proposed Methodology

Selected Area For Study

(a) Triangle square to Mortakka houraha

(b) Bharat Petrol Pump to Mortakka Chauraha

(c) Subhash chowk Market to Vegetable market

(d) Bus Station to Subhash Chowk

III.RESULTS AND DISCUSSION

Selection of Independent Variables

According to the land uses, the parking accumulation may vary . So in order to develop the parking demand model, different land use variables should be considered . Commercial centers attract more people towards them than most other land uses. At the same time, the parking requirements of different commercial centers are not the same. Some commercial centers attract more consumers than others. Commercial centers are divided into two types, as – Type I and type II . Type I is a commercial center with more consumer attraction and Type II is a commercial center with less consumer attraction. The nature of the commercial was decided by observing at the particular site for 5 hours. Commercial center with more than 5 customers on an average per unit area visited within one hour was taken as a Type I commercial center, otherwise it was taken as a Type II commercial center.
Table 1 shows the various examples of commercial shops belonging to each type.

Table 1. Classification of Shop

S.No.	Type	Shops
1	Type 1	Textiles, jewelry ,fancy shop, cosmetic shop, provision shop, stationary shop, internet cafe , utensil shop, Auto parts and garage , Restaurants, canteen, hotel, ATM, medical shops, petrol pump, Photostat shop ,wine shop, Electronics shop, Betel shop etc.
2	Type 2	Shoes shop ,watch point , optical, tailoring shop, Repairing shop, Residency hotels , Bike showroom, Furniture shop

Offices were also classified into two categories type I and type II. Type I offices offer greater attraction than type II. The details are shown in table 2.

Table 4.2(b) – Classification of Office

S.no.	Type	offices
1	Type 1	Union bank , SBI bank , HDFC bank, Maharashtra bank , Jila sahkarita bank, Punjab national bank
2	Type 2	Dainik bhaskar office , construction offices, consultancies, Nayi duniya office, Finance office, Agriculture office etc.

Some Independent Variables

- Demand for parking space, d
- Area of commercial center in $m2$, c
- Area of office in $m2$, of
- Area of Type I commercial centers in $m2$, cc
- Area of Type II commercial centers in $m2$, cN
- Area of Type I office in $m2$, ofN
- Area of Type II office in $m2$, ofC
- Area of health service in $m2$, h

CONCLUSION

Expected Outcome

- We can get the mean duration of two wheeler at all selected areas.
- Parking demand model will be developed .
- Daily traffic volume at particular areas will be determined.
- Parking volume at selected stretches will be determined.

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