A Study of Parking Accumulation in Chandigarh City Centre

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*Abstract-***The present study of parking characteristics of sector 17 in Chandigarh is aimed at finding the adequacy of existing parking space and requirement of extra parking lots in future. The problem are discussed at length and probable as well as suitable solutions are suggest to minimise the parking problem in study area. For study purpose the 17 sector of Chandigarh city has been divided into different parking lots. The study has been conducted by change in number of registered vehicle methods with main emphasise on accumulation study method and duration study method. Various parameters of parking like peak accumulation i.e. before and after lunch, parking volume, parking load, vehicle per space and vehicle share in total accumulation, parking average duration in various lots are computed and recorded. The result and recommendation from this study will help the administration in solving the problem of parking in sector 17 in Chandigarh and thereby given the people a problem parking free area in sector 17 in coming years.**

INTRODUCTION

The present study evaluates the performance of existing traffic infrastructure on typical roads in Chandigarh 17 sector. Chandigarh is one of the few cities which was first designed and then constructed. In subsequent sections a general idea about Chandigarh is given along with the details which are of interest to traffic engineer.

Chandigarh can today claim to be one of the best planned cities in the world. Unlike most of the existing cities, it was first planned and then developed. The basic planning unit of the city are sectors. Each sector is intended to be a self contained unit which provides for the basic needs for every family. Shops, educational, health buildings, and open spaces are to be found in each sector to satisfy the needs of the body and mind. The size of the sector (consisting of a rectangular 1.2 km by 0.8 km with a shopping street cutting across it) is such that essential amenities are available within easy walking distance. No house is more than 10 minutes of walking distance from the farthest shop in the sector. The town is initially planned for a total population of 500000.The capital complex which is being used by Government of Punjab and Haryana consists of Secretariat. The Raj bhawan and high court is to the north. The city and District centre in sector 17 is the heart of the town. The zone for under-graduate and post-graduate education is to the West and the industrial are to the East.

Keeping in view the development problems of old and existing cities. The master plan of Chandigarh has been carefully worked out. The plan of the Chandīgarh is biological in its form with provisions for future growth.

OBJECT AND SCOPE OF THE STUDY, Sector- 17

For present investigation, the roads of sector 17 one of the busiest and heavily trafficked sectors of Chandigarh were selected for studying there parking characteristics.

The main purpose of the present study was to assess the parking demand, how to increase the parking facilities and to check the adequacy of the existing parking spaces in commercial areas in sector 17. By the study of sector 17 parking lots it is conclude that the parking demand is maximum in sector 17-e and 17-b on parking lot 18 and 38 respectively, the visitors' do not find any place for parking their vehicles and very difficult for them to find the place for parking.

As parking demand oust rips parking supply in sector 17-e by about 3400 ECS. Additional parking spaces need to be created to meet the demand in the short term and linked to major work centers/ offices/ populated pockets of the urban complex. This will help in stabilizing the park demand. A parking policy should also be evolved for major city centers of the urban complex.

THE PROPORTIONS OF PARKING ARE CLASSIFIED BY LENGTH OF TIME PARKED IN TABLE 1.1.

TABLE 1.1

Population groups of urbanised area.	Parking Duration (Hours) For			
	Shopping	Business	Work	Av. All trips
50,000 – 1,00,000	1	0.8	5.0	2.26
1,00,000 – 2,50,000	1.3	0.9	4.3	2.16
2,50,000 – 5,00,000	1.5	1.0	5.1	2.53
5,00,000 – 10,00,000	2	1.7	5.9	3.2
Over 10,00,000	1.4	1.1	6.0	2.83

TABLE 1.2
Mode wise Parking Duration

S.NO.	LOCATION	LANDMARK	MODE	DURATION (HOURS)					TOTAL
				0-2	2-4	4-6	6-8	>8	
				SHORT TERM	MEDIUM TERM		LONG TERM		
1	SECTION-1	IN FRONT OF SAGAR RATAN RESTURANT SECTOR 17-E	CAR	1512	400	242	259	214	2627
			%	57.56	15.23	9.21	9.86	8.15	100.0
			2 WHLR	389	112	120	127	224	972.0
			%	40.02	11.52	12.35	13.07	23.05	100.0
2	SECTION-2	NEAR NEELAM CENEMA,SECTOR 17-E	CAR	740	191	161	220	230	1542
			%	47.49	12.39	10.44	14.27	14.92	100.00
			2 WHLR	949	319	371	448	459	2546
			%	37.27	12.53	12.57	17.60	18.03	100.00

Multy Storey Car Parks :

These are designed for a capacity of about 400 to 500 cars. Larger capacity tends to increase the time for unparking 3a car. About five floors is also the upper limit for the same reason.

Some of the desirable standards for designing of the multi-storey car parks are:

1) Generally, gradient of the ramp is 1 in 10 and 1 in 8 for very short ramps.
2) Clear height between floors is 2.1 m.
3) Parking stall dimensions 2.5 x 5.0m.
4) Inside radius of the curves 7.0m.
5) Width of the traffic lanes on ramps and entrances 3.75m.
6) Gradient of slopping floors not steeper than 1in 20.
7) Loading standards 400 kg/square meter.

Ramps are made preferably one way. If two ways then they should be divided. Horizontal floors with separate helical entrance and exit ramps have been found to be efficient.

THE LAYOUTS OF THE RAMPS AND THE FLOORS IN THIS TYPE OF PARKS IS SHOWN IN THE FIGURE 2.5

Methods Adopted For The Present Study
GENERAL

To carryout the field parking studies in these sections, they have been divided into conveniently workable sections as given below:

I) SECTOR 17-E: SECTION 1: In front of Sagar Rattan Restaurant to Neelam Theater.

II) *Sector 17-E: Section 2: Taj Hotel Road To Neelam Cenema*

Methodology Of Parking Studies Conducted
Field work for parking studies in different sections was spread over a period of month. Detailed description of the methodology adopted for carrying out the field studies is given below.

Parking Usage Study By Registration Number Method
The most accurate way of carrying out a duration study is to observe parkers continuously at all possible locations. The purpose of this study was to know the peak number of vehicles being parked in each of the two sections under study, to determine parking durations and distribution of the demand for parking during the day time.

The timings for the study were kept from 9:00 A.M. to 8.30 P.M. in all the sections under study. The purpose of Twelve hours count was to find out the time of peak as well as the lowest parking demand in the Sections.

The round trip interval for each section in the present study, estimated after number of initial trials, was fixed at 30 minutes.
Accumulation and duration summary sheet are then separately prepared from the data collected during the parking use studies. It is possible to prepare accumulation summary from the duration study also.

Parking Accumlation And Duration Summary Sheets
The computation of parking duration from a continuous observation programme is a simple matter of subtracting the arrival time from the departure time. Parking accumulation and durations are summarized in tables and presented graphically on curves.

In the present study, the motor vehicles are divided in to the following groups:
a) Four wheelers i.e. cars/Jeeps/Taxis etc.
b) Motorcycles/Scooters/Mopeds
c) Auto-Rickshaws
d) Bi-cycles
e) Rickshaws and
f) Heavy vehicles i.e. Buses and Trucks

Parking Duration Analysis And Discussion
Parking duration summary sheets were prepared from the data collected in vehicle registration plate number method and average parking durations were calculated for short time parkers (vehicles parking for 3 hours or less than 3 hours were considered to be SHORT TIME PARKERS).

The paking duration tables revealed the following observations:
(a) The duration characteristics of different vehicle types are represented by the duration characteristics of all vehicles in each section under study. The duration

characteristics of vehicles are summarized in Tables 1.3 respectively.

(b) Almost in all the sections, more than 45 percent of all the vehicles park for less than one hour (Refer to Table 1.3).

(c) The range of average parking duration for each section under study is given below in Table 1.4.

TABLE -1.3

% OF VEHICLES PARKING FOR LESS THAN ONE HOUR

Section	Date	Car /Jeeps/Taxis	Motor Cycle /Scooter	Heavy Vehicles	All Vehicles
Section 1	18/2/2012(sat) 23/2/2012(thu)	44.15 45.66	46.13 48.73	--- ---	45.14 47.19
Section 2	24/2/2012(Fri.) 27/2/2012(mon)	53.96 51.34	55.85 54.45	--- ---	54.90 52.90
Average		48.77	51.29	---	50.03

TABLE 1.4
AVG. PARKING DURATION RANGE

Section	Day/ date	Range of Average Parking Duration (minutes)
Section 1	18/2/2012(sat) 23/2/2012(thu)	82-92 80-90
Section 2	24/2/2012(Fri.) 27/2/2012(mon)	70-80 65-80
Average		74.25-85.5

Missed Parkers Percentages

. The following are some of the important features related to MISSED PARKERS:

(a) The best method of calculating missed parkers percentage is based upon the trip interval i.e. 30 minutes, and the average parking duration, t as shown in Tables 4.11.

(b) The cumulative curve of the percentage of parkers versus duration of stay is plotted from the data observed for all vehicles during the duration study.

(c) The percent missed parkers is then calculated from the formula K = i/t (Refer Table 4.11).

Projection of Future Parking Demand

For providing long term solutions to the parking problems, it is essential to estimate the future parking demand. In this chapter. Realistic projections have been obtained for future parking demand for the following years

i) by the year 2015

ii) by the year 2020

iii) by the year 2025

iv) by the year 2030

Factors Affecting Future Parking Demand:-

The following are the important factors which affect the future parking demand:

a) Population of the city

b) Vehicle ownership

c) Economic growth of the city

d) Increase in the population of the satellite towns

e) Future importance and attraction of the city centre

f) The future modal split pattern in the city

Technique Of Future Traffic Predictions:-

There are various mathematical models available for future traffic predictions but Logistic Curve Method is commonly used for forecasting the future demand. This method is therefore discussed in detail hereunder.

Logistic Curve Method:-

Logistic Curve Method is a mathematical method which uses the logistic curve. It is assumed that the rate of change of vehicle per head with time is directly proportional to the difference between saturation level and present level of vehicle per head.

Population Of Chandigarh City:-

The population data for the census years of 2001 and 2011 were collected from the census department of U.T., Chandigarh These data have been extrapolated for the years upto the year 2041 and presented below:

TABLE 1.5

S.N.	Year	Population Of the City	Remarks
1.	1991	642015	Census figure
2.	2001	9,60,035	Census figure
3.	2005	1010035	Estimated Fig
4.	2006	1020035	Estimated Fig.
5.	2007	1030035	-----Do -------
6.	2008	1040035	-----Do -------
7.	2009	1045035	-----Do ------
8.	2010	1050035	-----Do ------
9.	2011	1054686	Census figure

Saturation Level

In the Developed Countries like U.S.A., U.K. Germany, France and Italy. The value of saturation level is taken as 0.4. But the value of the saturation level ('a') of vehicle per head is assumed for the city in between 0.4 and 0.5. Since vehicle per head for scooter, motor cycle, moped has already touched 0.4054 in Chandigarh and the rising trend of ownership of motorized two wheelers is still persisting in Chandigarh, the saturation level of 0.5 is assumed for Chandigarh.

Calculation of Logistic Curve For Light Vehicles

Equation (5) is used to calculate the projected vehicle per head for car/jeep/van with the following the initial values:-

Base year 2011 for which t = 0

a = saturation level for vehicle/ head = 0.5

X_o = vehicle per head in 2011 = 0.016

r = growth rate per year in 2011 = 0.30

The calculation for projected vehicle per head for car / jeep / van for future years are done below:-

Table 1.6

S.N.	YEAR	TIME t IN YEARS	$Y=e^{-art/(a-x_o)}$	$x = \dfrac{ax_o}{x_o + (a-x_o)Y}$
1	2011	0	1	0.016
2	2012	1	0.9076	0.025
3	2015	4	0.7097	0.057
4	2020	9	0.4057	0.1482
5	2025	14	0.2226	0.260
6	2030	19	0.1472	0.3524

Calculation of Logistic Curve For Motorised Two-Wheelers:

This is also done as shown above but with the following initial values :-

Base year = 2011 for which t = 0

a = saturation level for vehicle/ head = 0.5

X_o = vehicle per head in 2011 = 0.019

r = growth rate per year in 2011 = 0.22

The calculation for projected vehicle per head for scooters I M.cycles / mopeds for future years is done below :-

Table 1.7

S.N.	YEAR	TIME t IN YEARS	$Y=e^{-art/(a-x_o)}$	$x = \dfrac{ax_o}{x_o + (a-x_o)Y}$
1	2010	0	1	0.019
2	2012	1	0.9939	0.024
3	2015	3	0.9538	0.037
4	2020	8	0.8494	0.064
5	2025	13	0.7592	0.095
6	2030	18	0.6515	0.1311

Calculation of Logistic Curve For Equivalent Cars :-

From the above projected figures of vehicle per head for the future years in respect of cars / jeeps / vans and scooters / M.cycles /mopeds, the total vehicles in terms of equivalent cars are estimated as in Table 17 and the logistic curves of cars! jeeps/vans per head and scooters/M.cycles/Mopeds per head Vs. duration of time are plotted (ref. graphs 16 & 17 of Appendix B):

TABLE 1.8

S.No.	YEAR	No of cars /jeeps /vans	No .of scooters / M. cycles /mopeds	Total in Equivalent PCU
1	2011	17804	20939	26179
2	2012	24665	25901	35025
3	2015	45842	39357	61584
4	2020	80887	62377	105837
5	2025	115932	85397	150090
6	2030	150977	108417	194343

Forecast Of Peak Parking Demand In 17-E:

The growth of vehicles in shopping centers of sector 17-E of Chandigarh shall be raised by the following factors, called "RAISING FACTORS":-

TABLE 1.9

S.N.	YEAR	RAISING FACTOR
1	2012 (start)	1
2	2012 (end)	1.38
3	2015	2.43
4	2020	4.20
5	2025	5.87
6	2030	7.71

TABLE 1.10

S.No.	YEAR	Raising Factor	Peak Parking demand in	
			Sec 1	Sec 2
1	2012(start)	1	900	299
2	2012 (end)	1.38	1242	412
3	2015	2.43	3018	1001
4	2020	4.20	12675	4204
5	2025	5.87	74407	24682
6	2030	7.71	573679	190302

Comparison of available parking capacity and future parking demand is presented below :

TABLE 1.11

S.No.	Particulars	Capacity and demand of all vehicles (in PCU)	
		Sec. 1	Sec. 2
1	Present parking capacity	750	260
2	Present peak parking demand	900	299
3	Projected peak parking demand by		
	I)The year 2015	3018	1001
	II) the year 2020	12675	4204
	III) the year 2025	74407	24682
	IV) the year 2030	573679	190302

So it is clear from the above table that in the section 1, & 2 the future parking demand by the year 2032 shall exceed more than thrice the available parking capacity.

CONCLUSIONS

It is evident from the analysis and interpretation of the data (discussed in Chapter 4) that parking problems in all the sections of shopping centers of Sector 17-e are directly influenced by the different parking generators in the respective sectors. Also, behavior and habits of people are related to their income levels and standard of living which affect the parking practices and characteristics in these sectors. According to the major findings the parking supply in section 1 & 2 is 750 & 260 ECS, where as maximum peak parking demand is 900 and 299 for both sections respectively, and the percentage of missed parkers is 28 %, if we apply following recommendations the maximum parking demand is reached and percentage of missed parkers minimized.

Based on major findings summarized above, the following recommendations can be made:

S. NO.	SECTIONS	MAX. PARKING DEMAND. (ECS)	PARKING SUPPLY (ECS)
1	SECTION 1.	900	750
2	SECTION 2.	299	250

ENFORCEMENT

a) Attention should be paid to eliminate the illegal parking in public corridors and encouraging the use of proper parking lots.

b) Curb parking should be eliminated at "NO PARKING STREETS" and vehicle owners must know how to use properly the parking facilities provided for them.

c) The underground parking must be made in 17-e, with the future consideration.

d) The parking fee would be increased, by this there would be decreasing in the congestion.

e) Making the parking of sector 17-e fully automated.

f) There should be change in the market hours; the market should open in late night hours.

g) The public transport should made more convenient for the journey of the people so that they prefer public transport in spite of their own vehicle.

Provision of Additional Parking Facilities

(a) In order to prevent the existing parking demand surplus, additional parking lots which were proposed and planned, be Constructed as soon as possible.

(b) This recommendation should be immediately applied to the section 1 & 2 of sector 17 –e where the percent utilization of parking has been found to be more than 100 percent.

(c) Stalls should be marked in order to control the wrong and haphazard parking.

(d) Provision of underground parking is a must in all the buildings coming up in the main shopping centers.

(e) Separate lots should be provided, especially in all the sections under study for bicycles and rickshaws, since their number predominates in these sections in contrast to automobiles.

(f) The separate off-street parking lots should be provided for show room owners, employees and employees of the various organizations, as the same often park their vehicles for long time as compared to customers and visitors which park their vehicles for a short time period.

Parking Restrictions

As reflected by average duration ranges calculated for different shopping centers in this investigation, it is suggested that parking in different sections should be quite limited for certain durations of time viz. 50 to 60 minutes and in no case, should it exceed 60 minutes. In fact, 1 hour parking limit may be considered a reasonable upper limit of parking duration and it should be enforced on a stringent measure to increase the utilization of parking space and improve parking turnover in Chandigarh's different shopping centre's.

Parking Fees

In congested shopping complexes, in this case where there are many people, who wish to park for more than one hour, measures like imposition of parking fee (for parking duration over one hour) should be considered and applied voluntarily. Installation of parking meters should also be tried with success in parking lots in shopping areas in the near future.

Parking Signs

(a) "No Parking" sins should be installed at places where parking is prohibited, such as road side curbs and other relevant localities.

(b) Separate entry and exit signs are necessary be installed at all parking lots in order confusion, conflicts and over-crowding of parkers and improve traffic circulation therein.

Zoning Regulations

Zoning controls should be used to ensure adequate developed parking as a part of all new developments or renovation of existing buildings. The off-street requirements of zoning ordinances should be realistically related to actual experiences and thus to supplement the zoning controls, local studies are strongly recommended to measure the parking needs of different land uses in each zoning district.

Efective Public Transport System:

There is a constant increase in the number of two wheelers and four wheelers every year on the streets in Chandigarh. There is a trend with people to purchase their own vehicles rather than use available methods of public transport. Not only the pulic transport system more economical it also reduces the vehicle ratio on roads and in parking lots, and it also being effective in reducing pollution. Though there are buses for public transport on various routs in Chandigarh, the same are are not being put to effective use. The use of public transport can be encouraged by govt. by introducing luxury air conditioned shuttle services from all over Chandigarh. Provision of comfortable and effective public transportation encourages the citizen to use such services more often.

Provision of Sky Rail / Metro Services

In addition to mass transport system of the buses already available in the city of Chandigarh connecting it to the neighboring satellite towns there is a urgent need to plan and execute a project providing for elevated monorail / sky rail or metro rail service. Due to the horizontal growth in he periphery of Chandigarh the distances between the residential colonies and the place of work including govt. offices has increased manifold in the last few years. People are traveling from as far as Ambala and Patiala to reach their work place in Chandigarh. In these circumstances, bus services may not be the beast answer to the requirement of the public. Fast mass rapid transport systems like sky / metro rail can cater to the growing requirement of transporting large no. of people from far off places to their work place which is an everyday requirement. This would also result in taking off the load of congestion from the parking lots and from roads also and has been a successful model in other metro cities like Delhi, Mumbai, and Calcutta.

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