

# **PARKING ANALYSIS OF SADDAR AREA IN PESHAWAR**



**FINAL YEAR PROJECT UG 2017**

BY

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**PARKING MANAGEMENT FOR SADDAR PESHAWAR**

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# **DEDICATION**

We dedicate this project to our parents and teachers.

## **ACKNOWLEDGEMENTS**

“In the name of Allah, the Most Beneficent, the Most Merciful”

We are indeed highly obliged to our respected supervisor, Dr. M Bilal Khurshid, who gave us his precious time and shared his life-long hard earned knowledge with us. Without his guidance and keen interest, it would have been almost impossible for us to attain the desired results in specified timeframe.

Lastly, we thank our parents and families, as they prayed for us and motivated us in the hard times. Their support and affection was among the things that kept us going.

## **ABSTRACT**

The study 'Parking Management for Peshawar Saddar' was carried out to learn and analyse the methodology and mitigation techniques of parking problems in Peshawar saddar. The growing population demands of roads and traffic structures. For the past 10 to 15 years there has been a lot of development and progress in Peshawar Saddar. Mainly because of construction of new business Centers and shopping malls that have further worsened the traffic and parking situation of Saddar. A realistic approach and chronological methodology was followed to deal with the area under study. It was recognized that the major reason for the traffic congestion in Peshawar saddar was due to insufficient parking spaces during peak hours.

The whole saddar area was divided into four zones for analyzing the problem in detail. The parking conditions were observed in each zone and measurements were taken for each road in these zones. On-street and off-street capacity of Saddar was calculated according to these measurements. Moreover, to find out the parking demand in Saddar, the businesses in all zones were divided into different categories. The survey was carried out for each category. Mainly two types of surveys were carried out i.e Business Owner Survey and General Public Survey. The analysis of results acquired from these surveys paved a way to understand the rational approach involved for calculating the demand. The analysis helped to extract various results such as Passenger factor, multi-category factor, timing schedule.

After applying the rotation factor on demand, it was compared with the existing capacity of Saddar Peshawar. As per anticipation, the demand exceeded the capacity and there was a requirement to cater for the excess parkings spaces. The solution suggested for this problem was the construction of parking places in Saddar at empty spaces available.

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# CHAPTER 1

## INTRODUCTION

### 1.1 Background

In cities around Pakistan the population is on a rise due to which vehicular traffic is increasing consequently leading to congestion problems. The problem has been magnified due to increase in the number of automobiles on the road whereas the capacity of the roads to influx remains the same over the years. The problem is being faced world over becoming a major concern for governments, private sector, transportation engineers and international environmental organizations. As a result , more fuel is consumed by all vehicles caught in traffic jams. The traffic congestion is greatly responsible for the increased accident rates resulting in human casualties, time loss, air pollution and expensive repairs and maintenance cost.

In Pakistan also, over the years, traffic congestion in bigger cities has become one of the major problems. Intersections are becoming increasingly congested throughout the urban areas in Pakistan. Peshawar City's Saddar area being the business town and the busiest place has been considered for study of parking management. Peshawar city is one of the most congested and polluted cities of Pakistan as far as traffic and parking spaces is concerned. The residents of the city are found complaining the existing traffic and parking conditions as this costs them important time consumption at the peak hours. Due to ineffective parking management and security concerns, customers park their vehicles near the shopping malls, restaurants, wedding halls and important installations.

This paper examines the overall existing conditions related to parking in Peshawar sadder based upon an extensive survey and calculations made for the demand and capacity. For this paper includes seven chapters covering introduction, literature review, methodology, project location , data collection and surveying, results and analysis and conclusion.

### 1.1.1 Tackling Traffic Congestion Around Pakistan

Pakistan being a growing economy and fastly developing country is trying to deal with the increasing traffic congestion in its major cities. In the past few decades many different projects have been initialized and some have also been partially implemented. Considering the major cities of Pakistan, efforts pertaining to mitigating congestion problems are largely seen as constructing parking plazas, making roads one way and signalized intersections.

Taking an example of traffic jams in Lahore, to effectively come up with solutions for the choked roads and congestion problems a comprehensive study of the city's transportation system was carried out by Japan International Cooperation Agency (JICA).



Fig.1.1. Functional Metro Bus System in Lahore

The “Preliminary Information Memorandum for Chief Minister’s Bus Rapid Transit System for Lahore City” stated that this study formulated a transportation plan for the city for next 20 years, the master plan for which identified Ferozpur Road Corridor and Multan Road Corridor as those requiring a mass transit system.

Lahore Metro Bus Project – has received a mixed response and has been in the news ever since its construction went underway almost six years ago. The Metro bus in Lahore is utilized for around 180,000 trips per day, which in its own right is an impressive number, but judging from a broader perspective, rapidly falls into virtual insignificance. There are 5.3

Million trips per day in Lahore, and 180,000 amounts to only 3.3 percent of all of them. For a mass transit system to be sufficiently effective, it should furnish to at least 20% of the city's daily ridership, and the 3.3 percent figure does not even come closer to it – which makes the Lahore Metro bus a somewhat unjust spending. This shows that the resulting 16.7% of the trips cause significant traffic problems in the city regardless of what this system was set to achieve.

In Peshawar, the authorities have many vital plans to deal with the congestion. The construction of flyovers at Gulbahar and Rehman Baba Chowk, and the extension of Ring Road have largely catered for increased traffic.



Fig.1.2. Expansion project of Ring Road Peshawar

The Chief Minister of Khyber Pakhtunkhwa was reported stating that these projects would help in minimizing traffic problems in the city.

In Islamabad, the administration of Rawal Town has also dealt with congestion and parking problems. Many busy roads were made one way and encroachments were removed. Parking spaces along all roads were provided with parking ticket booths installed, charging Rs. 20/hour. The authorities have also worked on proper lane and road marking, 'no parking' and 'one-way' signboards, two-way roads, etc.

### 1.1.2 Peshawar – Intolerable Congestion

As a matter of fact no major steps have been undertaken previously to manage the traffic flow within the Peshawar and specifically saddar Peshawar.



Fig. 1.3. A View of Traffic Jam in Peshawar

However the traffic management authority has taken firm steps to ensure smooth traffic flow on the roads and has set up phone help lines and SMS service for public to inform the traffic police control about any traffic blockade in order to get help for regulation of the system. The traffic police have also planned to introduce traffic wardens to improve the functioning of the department and get the citizens rid of the disturbed situation. The Mufti Mehmud Flyover has finally been opened to traffic and the people might have felt a little bit Change in the traffic system. However, regulating the disorderly traffic is still a enormous task. The recent changes, especially the reshaping of U-turns, have eased the pressure on some busy roads, but in many areas the problem of traffic congestion still remains unresolved. No doubt, the security checkpoints, encroachments, untrained drivers, protest demonstrations, rallies, increasing

population and small roads contribute to the traffic problem, but lack of sound planning, negligence and corrupt practices on the part of various departments have been the main cause of the dreadful situation.

### 1.1.3 Study Area:



Fig.1.4. Study Area

### 1.2 Problem Statement:

Traffic growth is almost 60% in Pakistan. Population is growing at the rate of 2.1% measured last in 2014. This overwhelming increase in population has resulted in more people owning more vehicles traffic as a result more traffic on the road. Peshawar being the capital of a province and fourth largest city, is not an exception to this ever worsening issue.

Over the years the number of private vehicles has dramatically increased. In 1998, there were 2.4 million private vehicles licensed in Pakistan. In 2007 this figure had increased nearly to 19.8 million. This has resulted in problems of pollution, parking, accidents and more importantly traffic congestion. As the number of traffic vehicles have increased these require

more space, better traffic control system and sufficient parking space to have uniform smooth flow.

In order to address the issue On-street parking was introduced in all major cities but this has aggravated the problem in more encroached parking, because of huge difference between parking capacity and demand. As the demand for these places exceeded supply so Off-street parking should be introduced by building parking plaza's and allocating spaces away from the center of hub as to avoid congestion.

Saddar area in Peshawar paints a gloomy picture when it comes to traffic and parking management. No of vehicles are growing at an alarming rate with their influx to saddar being a commercial hub is on an increase with every passing day. With no improvement in road conditions and no new service roads in place, there seems to be no solution in sight. Encroachments are present on every street corner. These encroachments have resulted in parking delays that are the major cause of traffic congestion. Instead of one lane On-street parking two lanes are being used. Food stalls and hawkers are also present on On-street which is a clear violatin of the rules.

Due to the traffic congestion at any place huge inconvenience is caused to users and also involves significant amount of travel time, additional wear and tear of vehicles. With the construction of new markets and shopping malls, availability of parking place has become a major source of concern. Almost all the new business centers in Peshawar Saddar have been constructed without giving due consideration to traffic and parking aspects.

During the past decade there has been so much construction of malls, plaza's, clothes shops, food streets. These have resulted in issues i.e. a little delay while parking cars results in excessive congestion leading to accidents or chaos. Huge difference between traffic demand and capacity requires the construction of parking plazas and delineating the markings of on-street parking on roads etc.

In order to build new parking plazas, the required area need to be analyzed i.e. to find the major causes responsible for congestion related problems. There are irregularities in traffic management including parking and pedestrians. Major problems arise due to encroachments



which the people do because they don't have sufficient space to park so parking places needed to be built at locations that can easily be accessed from the center of Saddar.

This research aims at both off-street and on-street parking as well as traffic management of whole Peshawar sadder area. For on-street parking markings should be established based on required standards so that there are no longer encroachments. The successful utilization of off street car parking in the form of multi-story car parking plazas in urban design would also substantially contribute towards reducing the traffic congestion and saving time and effort.

This research aims at carrying out a detailed analysis of the existing traffic and parking management problems in Peshawar Saddar with a view to present traffic and parking management plan. This study may be taken as a reference to manage traffic and parking problems through other cities of Pakistan.

### **1.3 Objectives**

1. To analyze the existing traffic management and parking problems in sadder area of Peshawar.
2. To identify the root causes responsible for the related traffic and management problems.
3. To suggest a solution that is viable and accommodates future needs of the city.

### **1.4 Scope:**

The scope of the study is as following:-

1. Collection of Data through site visits and surveys.
2. Calculation of existing capacity (Off-street and On-street) using measurements taken from site visits and Google earth.

Calculation of Demand using the data obtained from survey forms (general public survey and business owner survey).

Construction of a parking plazas based on the difference between demand and capacity.

To recommend a comprehensive traffic and parking management plan till 2035.

### **1.5 Limitations:**

This study is based on the data obtained from site visits, Google earth and different official and private authorities. Furthermore, the data collected through general public and business owner surveys is based on the answers and responses given by the individuals. Also

many projects are still under construction so assumptions are also being used in their place e.g. Peshawar RBT parking place and construction of new building plazas for clothing and food etc.

There may be slight error in the calculation of existing parking places and demand. Keeping this in view a factor of safety has been added in both the existing capacity and demand.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Important Definitions**

##### **2.1.1 Traffic Engineering**

It is the planning, checking, geometric design and traffic operations of roads, streets, motorways, their networks and their relationships with other modes of transportation for the safe, effective and useful movement of people and goods (Mustafizur et al. 2012).

##### **2.1.2 Traffic Congestion**

Traffic congestion is a condition on road networks that occurs as its use increases and is characterized by slower speeds, longer trip timings, and augmented vehicular queuing. The most common example is the physical use of roads by vehicles. When traffic demand is great enough that the interface between vehicles slows the speed of the traffic stream this results in some congestion. As demand approaches the capacity of a road (or of the intersections along the road) harsh traffic congestion sets in. When vehicles are fully stopped for periods of time, this is colloquially known as a traffic jam. (Anurag et al. 1992).).

##### **2.1.3 Parking Duration**

It is the total length of time a particular vehicle is parked at a parking bay. (Mustafizur et al. 2012).

##### **2.1.4 Parking Turnover**

The number of vehicles parked in duration to the number of parking Bays vacant. It is a ratio. (Tom et al. 2008)

### **2.1.5 On-Street Parking Facilities**

alongside the curb parking bays are provided on one or both sides of the street. These are called the curb facilities. (Mustafizur et al. 2012).

### **2.1.6 Off-Street Parking Facilities**

The facilities which are privately or publicly owned, including surface lots and garages. (Mustafizur et al. 2012).

### **2.1.7 Space-Hour**

It is a unit of parking, defining the use of a single parking space for a period of 1 hour. (Mustafizur et al. 2012).

### **2.1.8 Parking Accumulation**

At any specified time the number of parked vehicles in a study is called parking accumulation . (Mustafizur et al. 2012).

### **2.1.9 Accessory Parking**

Accessory parking spaces are those built on-site to support access to a specific building. (Mustafizur et al. 2012).

### **2.1.10 Demand Management and Transportation Demand Management/TDM**

A set of strategies designed to influence the mode-choice, frequency, timing route-selection, or trip-length of travel behavior to promote efficient and sustainable use of transportation resources. (Mustafizur et al. 2012).

### **2.1.11 Gross Floor Area/ GFA**

Outside walls of a building the area within the perimeter, regularly utilized in determining the number of parking spaces. (Mustafizur et al.2012).

### **2.1.12 Multi-Space Meters**

A device used to manage several parking spaces in a one-block area, particularly in regards to collecting any fees associated with parking in a specific space. (Mustafizur et al. 2012).

### **2.1.13 Public Parking**

Parking that is not restricted to the occupants or visitors of any building. (Jayasaree et al. 1994).

### **2.1.14 Reserved Parking**

Spaces that are set aside specifically for certain users rather than spaces that can be used by anyone. (Jayasaree et al. 1994).

### **2.1.15 Shared Parking**

The parking that is available as public parking during particular periods of time. (Jayasaree et al. 1994).

## **2.2 REQUIREMENT OF A MULTISTOREY CAR PARK**

Parking Plazas allow widespread development or growth of a land use area that otherwise would not have been possible. The need for a parking structure occurs when parking spaces are limited, the owners have not made suitable supplies for accommodating their share of the customer traffic and the local authority takes no notice of the congestion. This results in parking along the sections of a road, maddening the already worsen situation. Moreover, in crowded areas parking of vehicles is time consuming and often expensive. Urban planners thus must consider ways of accommodating parked vehicles in small geographic areas that are both appropriate and nearby.

### **2.2.1 Capacity of Multi-Storey Car Parks**

300-500 car parking plaza was considered to be average, whereas a capacity of more than 1000 was seen very huge. However, nowadays it is normal to see plazas with over 10000 vehicle capacity.

## **2.3 CATEGORIES OF PARKERS**

### **2.3.1 Short Stay Parkers (Less than 4 Hours)**

Shoppers/tourists

Visitors to hospitals, mosques, business

Service and support

### **2.3.2 Long Stay Parkers (More than 4 Hours)**

Commuters , workers – 8/ 9 hours for 5 days per week

Students

Residents - evenings, weekends and some 24/7 parking

Air Travelers

Car dealerships

## **2.4 PARKING LAYOUT**

### **2.4.1 Parallel**

This parking requires experience, self-confidence, and patience.

Parking spaces is (min); 20 ft long 8 ft wide

#### **Advantages**

Works good in extremely narrow, linear spaces.

Minimum pavement area is required.

#### **Disadvantages**

Difficulty in maneuvering for most the drivers.

Less than ideal visibility of nearby traffic.

Ineffective use of on-street space.

### **2.4.2 Angle 90**

For this configuration standard dimensions are:

Parking width is: 8'6" ft.

Parking length is: 18 ft.

Driving aisle width (2-way): 21 ft.

### **Advantages**

For one-or two-way aisles it works well with.

The most vehicles per square meter of pavement are handled.

Most vehicles per linear meter are handled.

### **Disadvantages**

Difficulty in maneuvering for some drivers.

It requires widest area.

Some visibility problems can be created for two-way traffic.

### **2.4.3 Angle 60**

It is ideal for a fast turnover rate or predominantly short term use.

Often offset by difficulties of ineffective circulation patterns and one-way aisles.

For this configuration the standard dimensions are given as under:

Parking width is: 8 ft.

Parking length is: 18 ft.

Driving aisle width (I-way) is: 15 ft.

### **Advantages**

In and out of parking spaces.

It lends itself to either one-or two-way aisles.

The most common short term parking configuration.

### **Disadvantages**

Than perpendicular configuration it requires more pavement per vehicle.

Per linear meter it handles less vehicles.

### **2.4.4 Angle 45°**

Configuration for this parking displays similar benefits and limitations as 60 degree.

Parking width is: 8 ft.

Parking length is: 18 ft.

Driving aisle width (I-way) is: 13 ft.

### **Advantages**

For layout it has reduced width requirements.

For in and out of parking spaces it has easy maneuvering.

To the rear It has very good visibility.

### **Disadvantages**

With two-way aisles It doesn't work well.

Than perpendicular parking configuration it requires more pavement per vehicle.

### **2.4.5 Angle 30°**

Parking width: 8 ft.

Parking length: 18 ft.

Driving aisle width (I-way): 16 ft.

### **Advantages**

It has very easy parking.

For layout it has reduced width requirements.

### **Disadvantages**

Most pavement per vehicle is required.

With two-way aisles it doesn't work well.



## **2.5 CASE STUDYS**

### **A. Central Business District Parking Study**

#### **City of Rye ( New York)**

The aim of this study was to review the existing and future parking conditions in the study area and to suggest solutions to improve existing conditions. Gor this, the study included the following mechanism which are explained in detail :

As per the inventory of on-street and off-street parking in the study area, the city contains 1600 parking spaces. Out of these spaces, 1230 (77%) are located in off-street parking fields and 370 (23%) are on-street parking spaces.

To access the peak and average occupancies on weekdays and Saturdays, they conducted parking occupancy and turnover surveys on two weekdays and two Saturdays in November 2000 and averaged the results. March 2001, they conducted additional surveys of parking areas north of the MNRN tracks and New York Thruway. These results of the surveys indicate that on average, 94% of the off-street parking, 26% of the northern on-street parking, and 84% of the southern on street parking is occupied on a typical weekday.

To determine the amount of the existing parking shortage, BFJ developed a parking demand Estimate based on peak period parking ratios for various land use categories and the square footage currently dedicated to these uses as estimated by the City of Rye.

For the understanding of the attitudes held by shoppers and other visitors about parking conditions, we conducted sidewalk surveys randomly on Tuesday, January 16 and Saturday, January 13, 2001 at various locations on Purchase Street. We collected 210 responses during the weekday survey and 87 responses during the Saturday survey. The following section summarizes the responses to the survey questions.

The high parking occupancy rates and survey results confirm that a shortage of parking exists in Rye particularly on the weekdays. Parking organization strategies are to improve the efficiency of the existing parking supply, opportunities for expanding the parking supply and strategies for reducing the demand for parking. Whilst the management and demand reduction strategies alone will not resolve the parking problems, they

recommend these strategies be implemented first and allowed time to show results before large public expenditures are made to add to supply.

## CHAPTER 3

### METHODOLOGY

#### 3.1 Overview of the Methodology

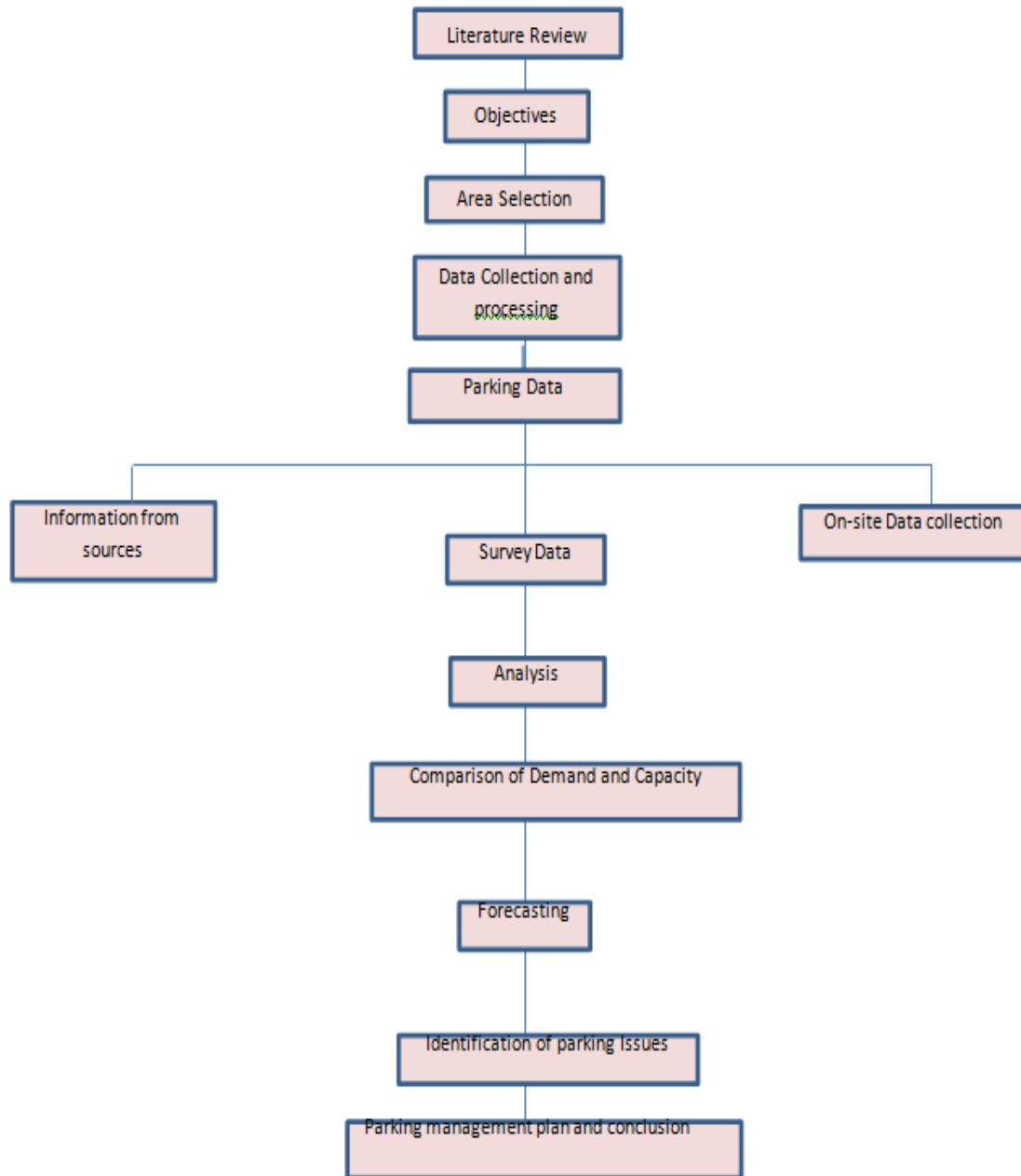
1. Peshawar Saddar is a main business district and since the area was large so it has been divided into zones for our convenience.
2. We divided the study area into different zones. The main reason was to divide the area on a further smaller scale that ultimately helped in studying area in a better way.
3. Data was collected zone wise. Also different kinds of surveys were conducted.
4. Field measurements of road widths, shoulders, presence of curbs were done. It was then used to calculate the on street capacity based on parking standards.
5. Off street areas were also located on map.
6. Existing parking capacity of each zone including On-street parking and Off-street parking were calculated using parking standards for cars and motor bikes.
7. Both off street and on street capacities were added to calculate the total capacity.
8. Manual Capacity was cross checked by using Google earth and excel.
9. Occupancy factor was then applied to further reduce the capacity as one space of car is occupied by many cars in a working day.
10. Occupancy factors converted the unit of capacity from stalls to vehicle.
11. Working day was assumed to be of 12 hours.
12. The two different kinds of surveys were conducted :
  - General Public Survey.
  - Business Owner Survey
13. The demand was calculated on the basis of surveys conducted.
14. Total three types of factors were applied on the demand (that too was on the basis of data obtained by the surveys)
15. The demand and capacity was then compared and solution was proposed based on the difference between capacity and demand.
16. The parking plaza's need to be built at different locations in Saddar.

17. The demand was forecasted up to 2030 using growth factor of 3% and thus changes in stories of plazas accordingly.

### **3.1.1 Hierarchy of Methodology:**

As a first step literature review was undertaken to get the full understanding and background of ongoing situation prevailing. Lot of work has been done by engineers and researches on solving traffic congestion and parking problem in particular. This helped in getting full understanding with the way traffic congestion leads to parking problems. After obtaining full understanding of the way study is to be carried out, the main focus was on selecting the vital objectives for the project.

The major emphasis was on solving parking related issues in Peshawar Sadder (Area under consideration). In order to solve parking issues a methodology was devised which helped in finding out ways in which the grave situation can be handled. Following were the main points that were considered while undertaking this study.



### **3.2 Literature Review:**

For understanding the project and its scope literature review of relevant studies was undertaken. A lot of work has been done by engineers and researches on solving parking problems. It has been explained in literature review in Chapter 2 above.

### **3.3 Selection of study area:**

As Peshawar Saddar is a very vast area, therefore to make our study more accurate and specific we limited our area that is already mentioned in Chapter No 04.

### **3.4 Selection of objectives:**

For the purpose of scope some objectives were set in the beginning of our studies and data collection. Main emphasis was to solve the parking problems in the study area Peshawar Saddar.

### **3.5 Dividing study area into different Zones:**

Area under consideration was divided into 4 zones. Since the extensive survey and data collection was involved, the area was divided to ease out the analysis since extensive surveys and data collection was involved. Zones were formed according to ease of accessibility. One of the considerations was that each zone is having enough on street and off-street parking space available. In case of difference between demand and on street parking space available there is a need to construct off-street parking plaza as per the standards predefined.

### **3.6 Getting to know the Area of Study:**

To get to know with the area under consideration several onsite visits were conducted. A number of surveys were done to get the required information.

A number of web applications and tools were used in order to make analysis easier and logical. Following websites helped in this regard.

1. GOOGLE MAPS.
2. GOOGLE Earth.
3. GOOGLE STREET VIEW.
4. GOOGL AREA CALCULATOR.

5. GOOGLE DISTANCE CALCULATOR.
6. GOOGLE OPEN VIEW.

## CHAPTER 4

### Location of the project and its Conditions

#### 4.1 Project Location:

The site is located in Peshawar. It is a commercial activity center and main hub of Peshawar. It is located between the Mall Road in North West and Sunehri Masjid Road in South East. The area consists of some major business and commercial center, shopping mall, banks, plazas, restaurants, local manufacturers.

The area under our study lies as under :



Fig 4.1. Project Location



#### 4.2 Existing Site Conditions:

Central Business District (CBD) Peshawar is a commercial hub of a city which provides general public with all daily life and is a market for everything to be sold and bought.

Being a central business District (CBD) Peshawar City Centre has experienced a remarkable increase in traffic thus leading to traffic problems. This congestion reaches too high during the peak hour causes problem to public and traffic block conditions.



Fig 4.2. Rush conditions at Saddar

#### 4.3 Study Area:

We carried out our study in those portion of Peshawar that show remarkable increase in market, shopping malls that were most severely affected by parking problem.

#### 4.3.1 Major roads in Our Study Area:

On site measurements were taken using measuring tape and google earth results of which are given below.

##### 1) SADDAR ROAD:

Total Width=70'

Angle Used= Parallel/45 Degree

Allotted Parking=8'+14'=22'

Road Width=40'

Pedestrian Walkways=8'

##### 2) SUNEHRI MASJID ROAD:

Total Width=76'

Angle Used=45 Degree

Allotted Parking=14'+14'=28'

Road Width=40'

Pedestrian Walkways=8'

##### 3) ARBAB ROAD:

Total Width=65'

Angle Used=45 degree

Allotted Parking=10'+10'=20'

Road Width=33'

Pedestrian Walkway=12

##### 4) FAKHR-E-ALAM ROAD:

Total Width=68'

Angle Used=45 degree

Allotted Parking=10'+10'=20'

Road Width=40'

Pedestrian Walkways=8

**5) ISLAMIA ROAD:**

Total Width=40'

Road Width=30'

Pedestrian Walkways=10'

**6) MALL ROAD:**

Total Width=80'

Road Width=34'+34'=64'

Pedestrian Walkways=12' (30' service lane)

**7) KHADIM HUSSAIN ROAD:**

Total Width=60'

Road Width=48'

Pedestrian Walkways=12'

#### 4.4 Zoning of our study area:

For our convenience, we divided our study area into four different zones based on geography of that area and the major roads intersection. Study was carried out in these four zones separately.



Fig 4.3. Different Zones

We also defined different kind of categories to make our work more efficient and convenient. Zoning of the area was done in the following way.

##### 4.4.1 Zone 1:

Zone 1 is defined by the area between Mall Road in NW and Saddar Road in SE, which includes Auxiliary Roads such as Arbab Road and (NW-SE) and Khadim Hussain Road. This area forms the edge portion of Saddar. The area covers 171000 metre squares.

##### 4.4.2 Zone 2:

Zone 2 is defined by the area between Saddar Road in NE and Sunehri Masjid Road in SW. The eastern side of the area is bounded by Fawara chowk Road. The area covers 44000 metre squares.

#### 4.4.3 Zone 3:

Zone 3 is defined by the area between Saddar Road in NE and Sunehri Masjid Road in SW.

Western side of the area is bounded by Fawara chowk Road while Fakhr-e- Alam road bounds the area in the west. The area covers 84000 metre squares.

#### 4.4.4 Zone 4:

Zone 4 is defined by Saddar road in NW and Sunehri Masjid road in SW. Islamia Road bounds the area in NE and Fakhr-e-Alam bounds the area in SW. The area covers 60000 metre squares.

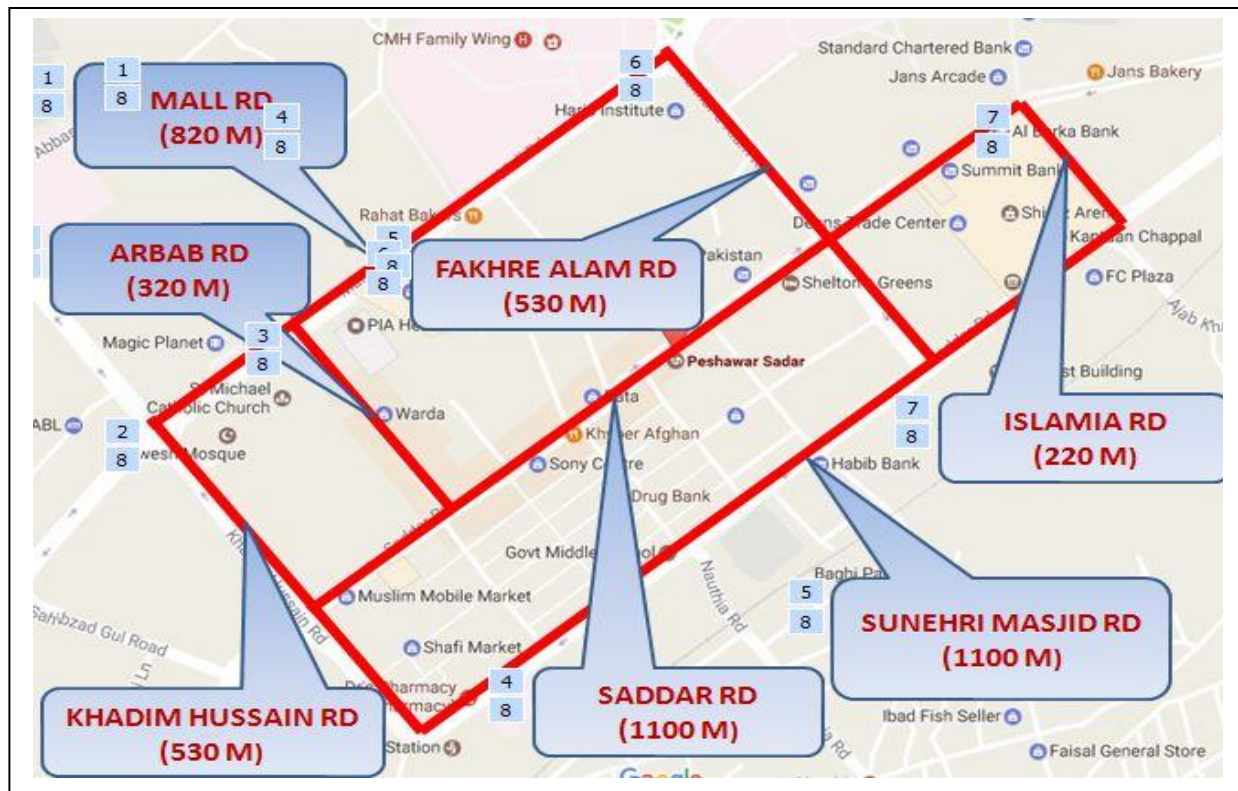


Fig 4.4 Zoning

## CHAPTER 5

### Data Collection

#### 5.1 Data Collection:

To determine the capacity and demand of vehicles collection of data was needed. There are two types of Capacity which were to be determined i.e On Street Capacity and Off Street Capacity. Data was obtained by on site measurements with measuring tape and measurement using Google Earth for determining capacity. Using this data capacity was calculated based on parking standards.

A number of surveys were under taken in area under study for the demand calculations . The method of survey conducted was basing on the zones.

Main type of surveys that were conducted:

General Public Survey.

Business Owner Survey

Business owner survey was conducted according to the zones . due to the large number of shops survey was conducted through sampling. Categories are determined on the basis of type of purpose it serves.

Individuals were approached and questioned during conduct of general public survey. In each zone 50 general Public surveys were conducted. With the help of this data graphs were plotted which were then used for the calculation of demand.

Two main questionnaires were prepared and were distributed on a large scale in whole Peshawar Sadder as per respective zones. The response from public was unpredictable. Some people were helpful in survey and a few even resisted giving even 5 minutes. An extensive survey was conducted throughout the area of study.



Figure 5.1 General Public Survey



Figure 5.2 General Public Survey



Figure 5.3 Business owner Survey

## 5.2 Existing Parking Availability:

There are Two types of Capacity which are available:

- On street parking.
- Off street parking.

A number of surveys are undertaken to find existing situation of parking. With the help of following, calculation of existing parking situation was carried out:

Google earth pro.

Google maps

On Site Measurements



### 5.3 On Street Capacity

The standards used for parking facilities are as follows:

Parallel parking (90 degree)

At the angle of 45 degree.

At the angle of 65 degree.

At the angle of 30 degree..

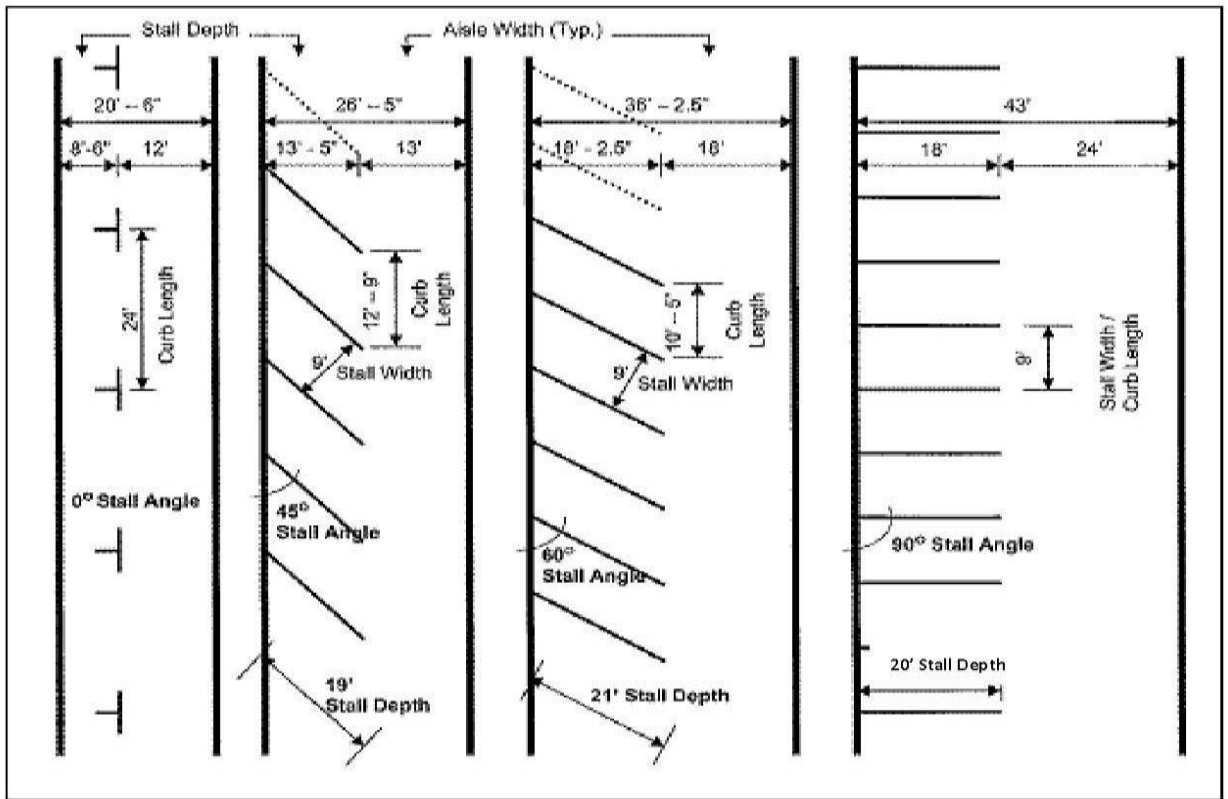


Figure 5.4 Parking Standards Utilize

Parking angle used are 45 and 60 degrees basing on spacing available, occupancy of a single vehicle and number of vehicles that can be accommodated along the roads for the on street capacity.

ANGLE	STALL DEPTH	STALL WIDTH	CURB LEGTH	AISLE WIDTH
45	19'	9'	12'-9"	13'
60	21'	9'	10'5"	18'

Table 5.1 Parking Standards Utilized

Parking of vehicles is permitted on both sides of road. With the help Google earth and manual calculation, total number of stalls were determined.

Number of stalls = Area Available / Area occupied by one car

Area Available = strip area of road = length\*width

Area of one car = Area of parallelogram = 0.5\*(height) (base average)

#### 5.4 Lengths and angles used:

The lengths and angles used for various roads in different Zones is as under:-

##### 5.4.1 ZONE I

ZONE 1	LENGTH (FT)	DIRECTION	CAR's	ANGLES(Degrees)
<b>SADDAR ROAD</b>	2700	NEB	148	Parallel
	2700	SWB	148	Parallel
<b>ARBAB ROAD</b>	960	NWB	53	Parallel
	960	SEB	53	Parallel
<b>FAKHRE ALAM ROAD</b>	1040	NWB	70	60
	1040	SEB	70	60
<b>KHADIM HUSAIN ROAD</b>	1036	NEB	56	45
	1036	SWB	56	45
<b>Total capacity</b>			<b>654</b>	

Table 5.2 Lengths of Roads and Angle used in Zone I.

### 5.4.2 ZONE II

ZONE 2	LENGTH	DIRECTION	CAR's	ANGLES(Degrees)
SUNEHRI MASJID ROAD	1360	NB/SB	75	Parallel
	1360	SB	75	45
KHADIM HUSSAIN ROAD	695	SB	39	45
	695	NB	39	45
SADDAR ROAD	1400	SWB	77	Parallel
<b>Total capacity</b>			<b>305</b>	

Table 5.3 Lengths of Roads and Angle used in Zone II.

### 5.4.3 ZONE III

ZONE 3	LENGTH	DIRECTION	CAR's	ANGLES(Degrees)
SUNEHRI MASJID ROAD	1240	NB	38	45
	1240	SB	83	60
FAKHRE ALAM ROAD	705	NB	39	45
	705	SB	47	Parallel
SADDAR ROAD	1280	SWB	71	Parallel
<b>Total capacity</b>			<b>278</b>	

Table 5.4 Lengths of Roads and Angle used in Zone II.

#### 5.4.4 ZONE IV

ZONE 4	LENGTH	DIRECTION	CAR's	ANGLES(Degrees)
SUNEHRI MASJID ROAD	945'	NB	52	Parallel
	945'	SB	52	Parallel
ISLAMIA ROAD	685'	NB	35	45
	685'	SB	35	45
SADDAR RAOD	1020'	NB	56	Parallel
<b>Total capacity</b>			<b>230</b>	

Table 5.5 Lengths of Roads and Angle used in Zone II.

#### **BIKES:**

##### **Assumption:**

For the parking of bikes, two cars slots were left after every 20<sup>th</sup> car slot space allotted.

1 \* Bike slot=Two cars slot combined

One car slot = 12\* bikes accommodation

Total number of bike in one bike slot= 24

Total number of bike slots in zone1= (Total car slots x 2) / (22x2 ) = 23

Total number of bikes= bike slots x bikes in one slot = 23 x 24 = 552

Total number of cars = 505 – (23x2) = 459

### 5.5 Results:

On Street Parking Capacities of Zones were compiled on excel sheet to cross check:

<b>ZONE 1</b>	
<b>Total Parking Spaces Available =</b>	<b>654</b>
<b>Parking Spaces Reserved For Bikes =</b>	<b>2</b>
<b>No. of Bikes in 1 Space interval =</b>	<b>12</b>
<b>No. of Bikes in 2 Space Interval =</b>	<b>24</b>
<b>No. of Parking Spaces b/w 2 Bike Slot=</b>	<b>20</b>
<b>Total No. of Bike Slots Required =</b>	<b>30</b>
<b>On-Street Capacity for Bikes in Zone 1 =</b>	<b>720</b>
<b>Remaining On-Street Capacity for Cars in Zone 1 =</b>	<b>594</b>

Table 5.6 On Street Capacity for cars and bikes in zone I

<b>ZONE 2</b>	
<b>Total Parking Spaces Available =</b>	<b>305</b>
<b>Parking Spaces Reserved For Bikes =</b>	<b>2</b>
<b>No. of Bikes in 1 Space interval =</b>	<b>12</b>
<b>No. of Bikes in 2 Space Interval =</b>	<b>24</b>
<b>No. of Parking Spaces b/w 2 Bike Slot=</b>	<b>20</b>
<b>Total No. of Bike Slots Required =</b>	<b>14</b>
<b>On-Street Capacity for Bikes in Zone 1 =</b>	<b>336</b>
<b>Remaining On-Street Capacity for Cars in Zone 2 =</b>	<b>277</b>

Table 5.7 On Street Capacity for cars and bikes in Zone II

<b>ZONE 3</b>	
<b>Total Parking Spaces Available =</b>	<b>278</b>
<b>Parking Spaces Reserved For Bikes =</b>	<b>2</b>
<b>No. of Bikes in 1 Space interval =</b>	<b>12</b>
<b>No. of Bikes in 2 Space Interval =</b>	<b>24</b>
<b>No. of Parking Spaces b/w 2 Bike Slot=</b>	<b>20</b>
<b>Total No. of Bike Slots Required =</b>	<b>13</b>
<b>On-Street Capacity for Bikes in Zone 1 =</b>	<b>312</b>
<b>Remaining On-Street Capacity for Cars in Zone 3 =</b>	<b>252</b>

Table 5.8 On Street Capacity for cars and bikes in Zone III

<b>ZONE 4</b>	
<b>Total Parking Spaces Available =</b>	<b>230</b>
<b>Parking Spaces Reserved For Bikes =</b>	<b>2</b>
<b>No. of Bikes in 1 Space interval =</b>	<b>12</b>
<b>No. of Bikes in 2 Space Interval =</b>	<b>24</b>
<b>No. of Parking Spaces b/w 2 Bike Slot=</b>	<b>20</b>
<b>Total No. of Bike Slots Required =</b>	<b>10</b>
<b>On-Street Capacity for Bikes in Zone 1 =</b>	<b>240</b>
<b>Remaining On-Street Capacity for Cars in Zone 4 =</b>	<b>210</b>

Table 5.9 On Street Capacity for cars and bikes in zone IV

## 5.6 Total On-Street Parking Capacity of Peshawar Saddar with the application of occupancy factor:

Capacity found does not consider the occupancy factor. Its application is necessary because stall for one car is used by many cars in a single day rather than occupied by a single car for the complete day. Survey was carried out for that purpose and result obtained showed that each stall is occupied six times in a complete working day. Working day is of 12 hours.

### 5.6.1 Total cars

On street Capacity	Cars	Stall use per Day	Cap. After Occupancy Factor
Zone 1	654	4	2616
Zone 2	305	4	1220
Zone 3	278	4	1112
Zone 4	230	4	920
TOTAL		5868	

Table 5.10 On-Street Capacity of cars in term of Vehicles

Similarly, occupancy factor was applied on bikes. However, stalls use per day for bikes came out to be 6 rather than four i.e. time occupied by cars is lesser than bikes

### 5.6.2 Total bikes

On street Capacity	Bikes	Stall use per Day	Cap. After Occupancy Factor
Zone 1	720	6	4320
Zone 2	336	6	2016
Zone 3	312	6	1872
Zone 4	240	6	1440
TOTAL		9648	

Table 5.11 On-Street Capacity of bikes in term of Vehicles

## 5.7 OFF-STREET PARKING:

Offsite Parking space available calculations were done by:

On ground measurement of area with the help of measuring tape.

With the help of GOOGLE EARTH PRO for the measurement.

With the help of GOOGLE AREA CALCULATOR application.

### 5.7.1 Off-Street Parking Calculations:

For the design of parking places a standard procedure was adopted.

Calculated existing areas were located on site for the calculation of on site parking. Its area was calculated by onsite measurements taken and data obtained through survey

International parking standards are adopted.

60 Degree and 45 Degree are used to find the capacity.

#### 5.7.1.1 Off-street Capacity of different locations

On the same lines, off street capacities were determined for different plazas. Because some plazas have underground parking spaces available.

Following table shows off street parking spaces:

OFF-STREET CAPACITY OF SADDAR			
VEHICLE	BIKES	CARS	
	ZONE 1:		
FALAK SEIR PARKING	300		25
JAVED PARKING	450		100
AURANGZEB PARKING	450		80
APWA TOWER PARKING	250		35
TOTAL CAP. ZONE 1	1450		240
	ZONE 2:		
THEKA PARKING	500		300
TIME CENTER PARKING	300		80
TOTAL CAP.ZONE 2	800		380
TOTAL CAP. ZONE 3:	0		0
	ZONE 4:		
DEAN PARKING	3500		2000
TOTAL CAP. ZONE 4:	3500		2000
TOTAL OFF-STREET			
<b>CAPACITY OF SADDAR</b>	<b>5750</b>		<b>2620</b>



Table 5.12 Total Off- street Parking Capacity Of Saddar

The total capacity was determined by On street capacity of cars and bikes obtained after multiplying by occupancy factor. The off Street capacity was determined by locating different areas on map of Peshawar Saddar.

<b>TOTAL CAPACITY OF SADDAR</b>			
<b>VEHICLE</b>	<b>BIKES</b>	<b>CARS</b>	
	<b>ZONE 1:</b>		
<b>TOTAL CAPACITY</b>		2170	834
	<b>ZONE 2:</b>		
<b>TOTAL CAPACITY</b>		1136	657
	<b>ZONE 3:</b>		
<b>TOTAL CAPACITY</b>		312	252
	<b>ZONE 4:</b>		
<b>TOTAL CAPACITY</b>		3740	2210
<b>TOTAL CAPACITY OF SADDAR (2016)</b>	<b>7358</b>	<b>3953</b>	

Table 5.13 Total capacity of saddar

### 5.8 Demand calculation of Peshawar Saddar:

The following method was adopted for the demand calculation. A number of trips to the study area were made and a number of different categories of surveys were conducted. We categorized shops into different categories after analyzing the data.

Categories rely on the purpose they provide for example Category A namely garments and shoes have all shops of garments and shoes both for men and women. Same method was carried out for other categories.

Shops were categorized into following six main categories :

### 5.8.1 Categories and number of shops in different zones

For their distribution shops in Peshawer sadder are mainly divided into six main categories.

Categories are named as A, B, C, D, E, F.

<b>CATEGORIES OF SHOPS IN SADDAR</b>	
<b>CATEGORY A</b>	<b>GARMENTS AND SHOES</b>
<b>CATEGORY B</b>	<b>BANKS</b>
<b>CATEGORY C</b>	<b>RESTAURANTS, HOTELS AND BAKERIES</b>
<b>CATEGORY D</b>	<b>GENERAL STORES / PHARMACY</b>
<b>CATEGORY E</b>	<b>ELECTRONICS AND MOBILE SHOPS</b>
<b>CATEGORY F</b>	<b>MALLS , PLAZA SHOPS &amp; MISC</b>

### 5.8.2 Category results

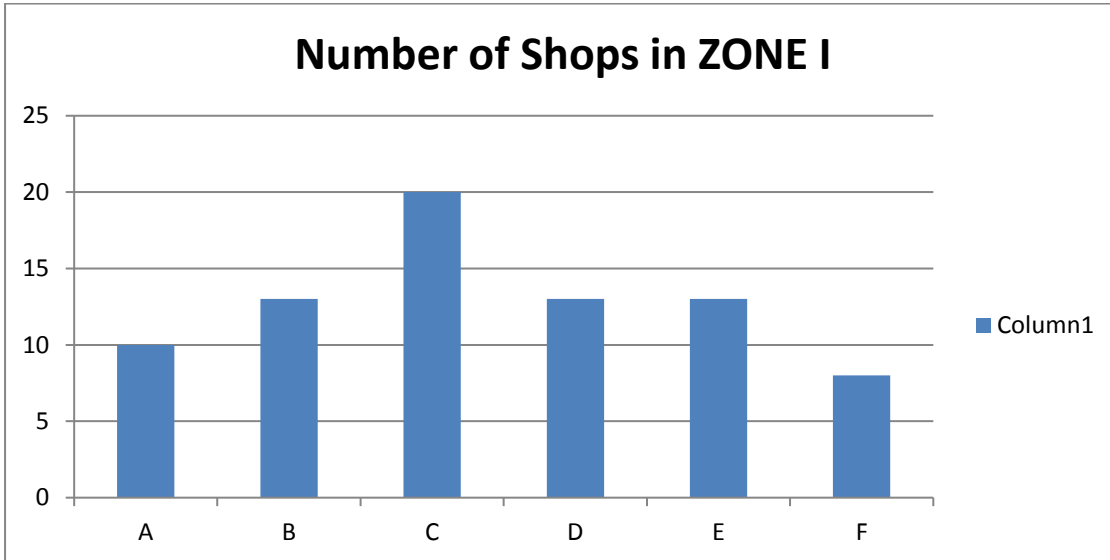
Category	Shop name	ZONE1	ZONE2	ZONE3	ZONE4
<b>A</b>	Clothing	25	10	19	8
	Shoes				
	Carpets				
	Foams				
<b>B</b>	Banks	13	13	9	2
<b>C</b>	Restaurant	35	16	17	18
	Hotels				
	Bakeries				
	Tea Shops				
<b>D</b>	Pharmacy	10	15	12	25
	Photo state				
	General Stores				
<b>E</b>	Electronics	15	13	16	3
	Mobiles				
	Watches				
	Currency exchange				
	Property dealer				
<b>F</b>	Cinema	10	9	4	7
	Malls				
	Handicrafts				
	Showrooms				
<b>Total</b>		108	76	202	63

Table 5.14 Total Number of Shops in each category

### 5.8.3 Distribution of categories in each zone

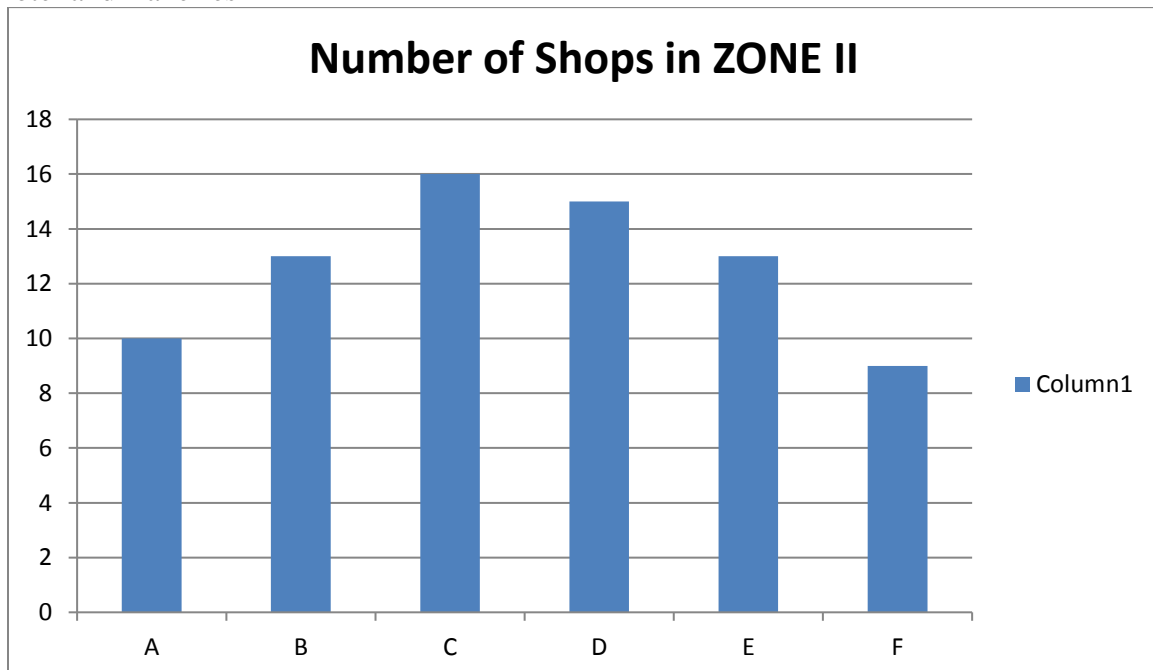
#### Zone I

From graph it can be seen that zone I has majority of C category shops i.e. Restaurants, Hotel and Bakeries



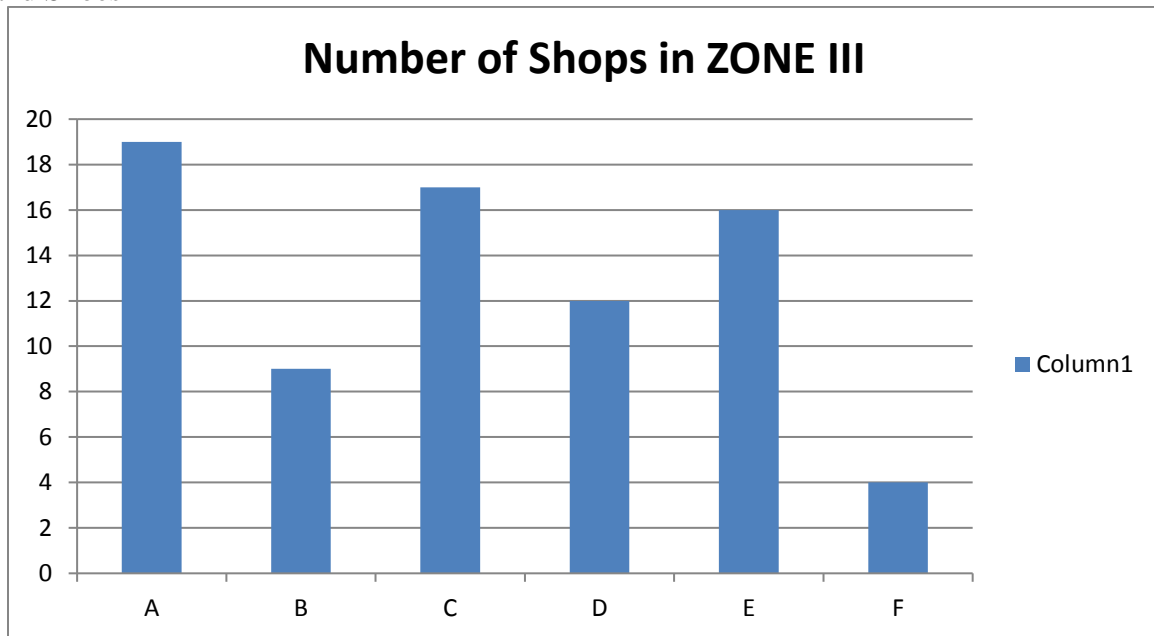
#### Zone II

From graph it can be seen that zone II has majority of C category shops i.e. Restaurants, Hotel and Bakeries



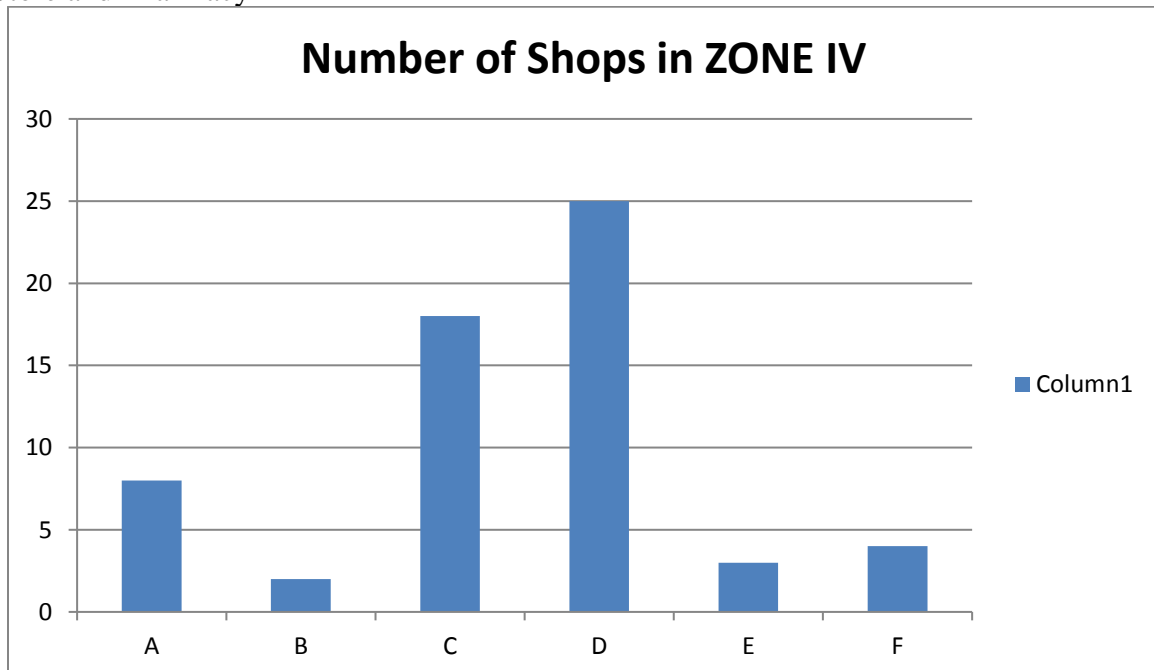
### Zone III

From graph it can be seen that zone III has majority of A category shops i.e. Garments and Shoes



### Zone IV

From graph it can be seen that zone IV has majority of D category shops i.e. General Store and Pharmacy



## 5.9 Surveys

Following two main type of surveys were carried out after the classification of shops into different catagories.

General Public

Business Owner

Surveys were carried out in all zones. General public survey was carried out with the general public randomly interviewed. Business owner survey was carried out by getting information from the business owners.

Questions asked are as follows:

### 5.9.1 General Public Survey:

The different questions asked in the General Public Survey were:

Q1: What is your mode of travelling?

Q2: Which area in Sadder do you come most often?

Q3: How often you come to Saddar?

Q4: Do you find proper place to park your vehicle?

Q5: What category of shop do you visit the most?

Q6: What time do you usually visit sadar?

Q7: What is your parking duration?

A scanned copy of General Public Survey is attached in appendix.

### **5.9.2 Business Owner Survey:**

The different type of questions in the Business Owner Survey were:

Q1: What is your (Business Owner) mode of travelling?

Q2: How many employees do you have?

Q3: Do you have a parking place?

Q4: How much time a customer spends in shop?

Q5: How many employees have their vehicle to come to work and park here?

Q6: What is your peak sale time period?

Q7: Number of customers in average day?

Q8: Number of customers in one peak hour?

A scanned copy of BusinessOwner Survey is attached in appendix.

These questions were helpful in finding out the demand. With the help of three different sources demand was calculated.

### **Customer demand**

Employees of the businesses were asked a number of questions regarding the average number of vehicles parked outside the shop or number of CUSTOMERs that visit on a daily basis and the CUSTOMERs in the peak hours etc.

### **Owner demand**

Usually the owner mode was not of any significance as their mode of travel was car or public transport which do not require any parking facility

### **Employees demand**

Number of employees help in finding out the employees demand. Their mode of travel was determined.

### **5.9.3 Business owner results of whole Sadder:**

With the help of the survey conducted and the deductions from the survey reveals that only few employees use public transport as a mode of travel to the sadder.

A large number of customer visit sadder in peak time. A customer spent normally half an hour in a shop.



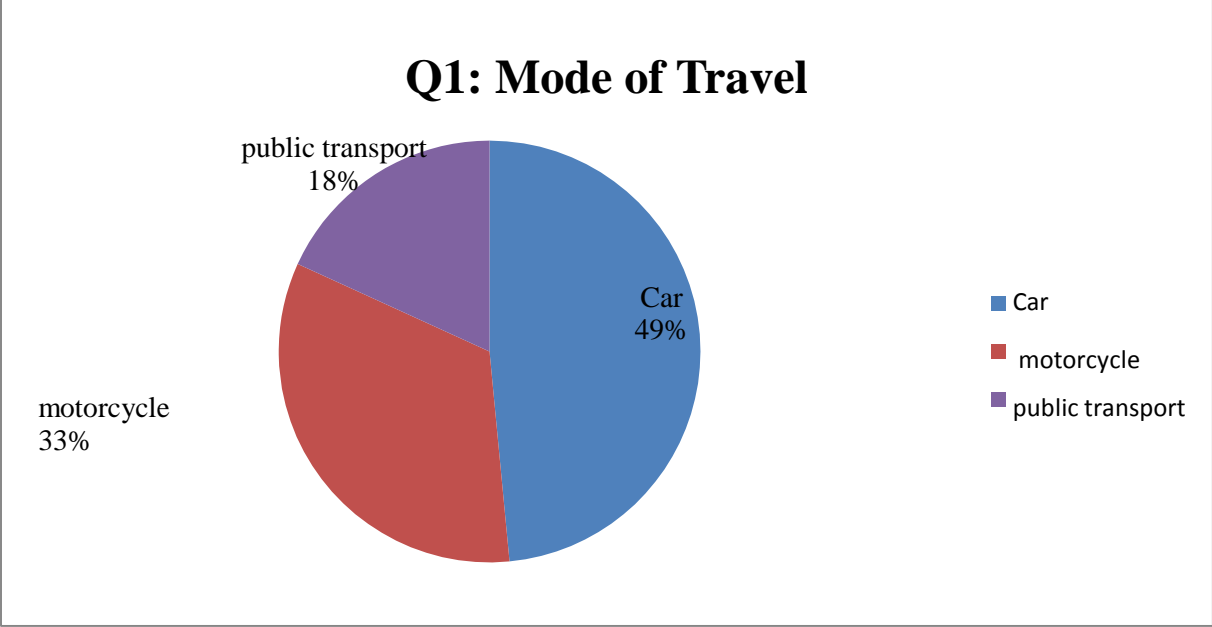


Figure 5.5 Mode of Travel of owners

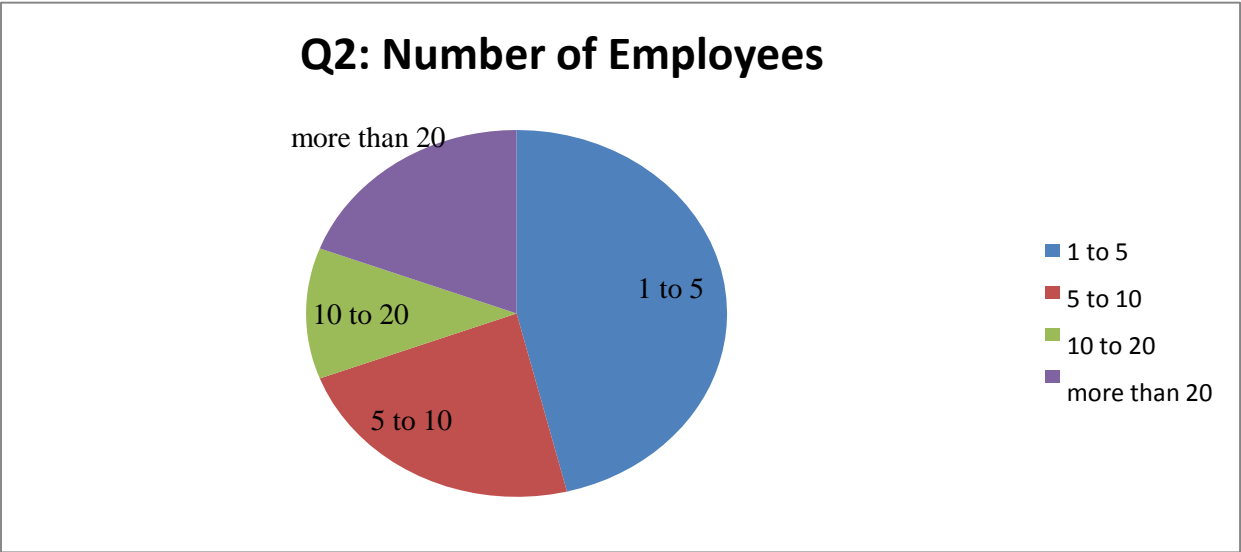


Figure 5.6 no of Employees

### Q3: Number of Shifts Employees Work

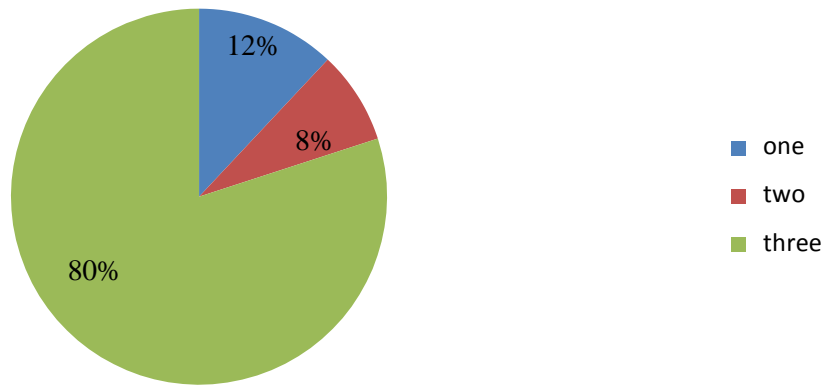


Figure 5.7 No of Shifts Employees work

### Q4: Is parking Space Available?

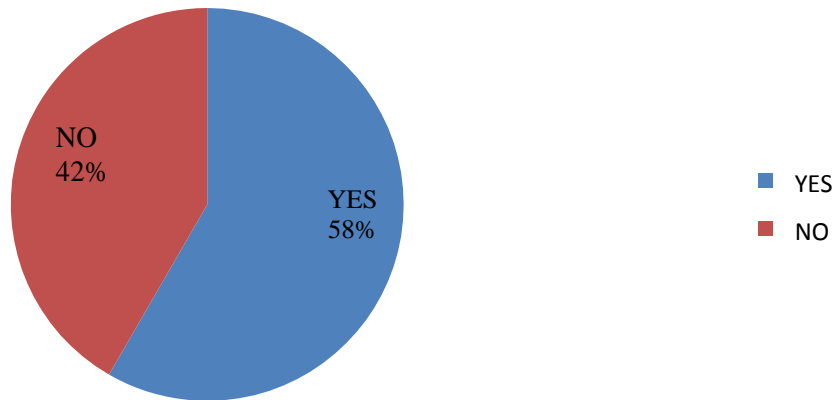


Figure 5.8 is parking Space Available

### Q5: Parking Space Capacity

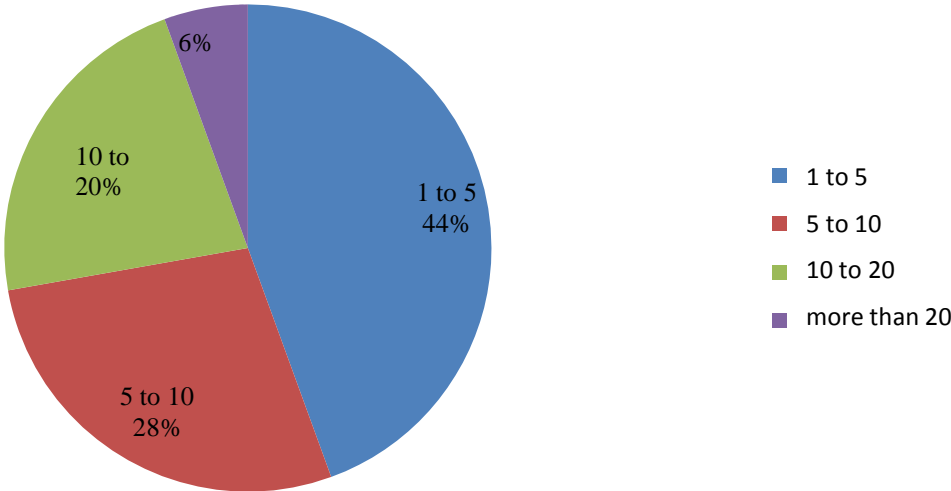


Figure 5.9 Parking Space Capacity

### Q6: Mode of Transport of Employees

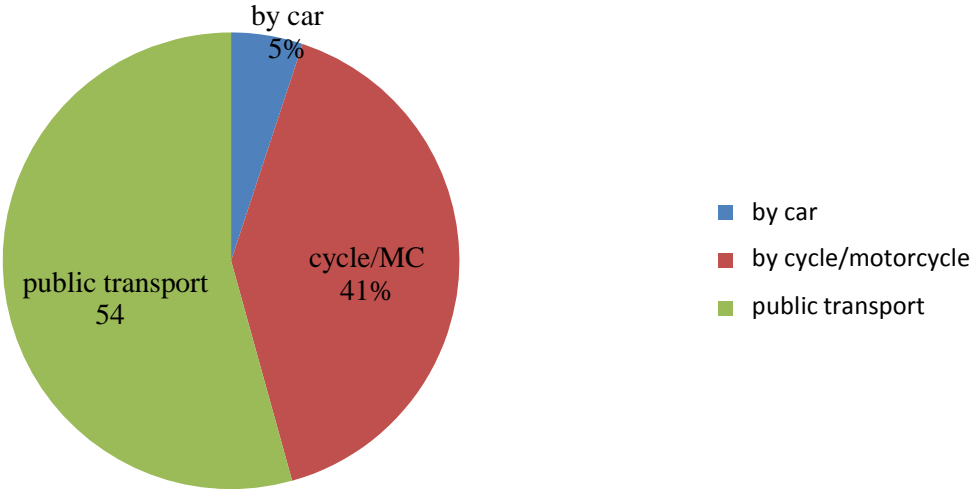


Figure 5.10 Mode of Tpt of Employee

### Q7: Peak Sale Time Period

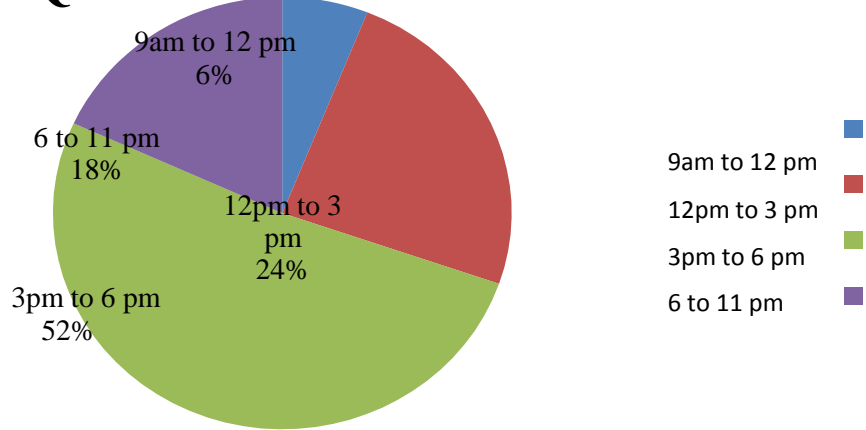


Figure 5.11 Peak Sale time Period

### Q8: Time Spent by Customers in Shop

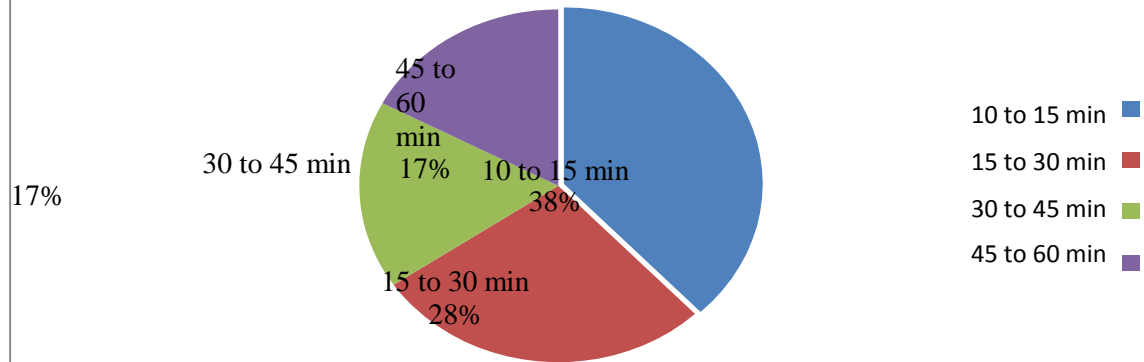


Figure 5.12 Average Time spent by customers in Shop

### Q9: Number of Customers in Average Day

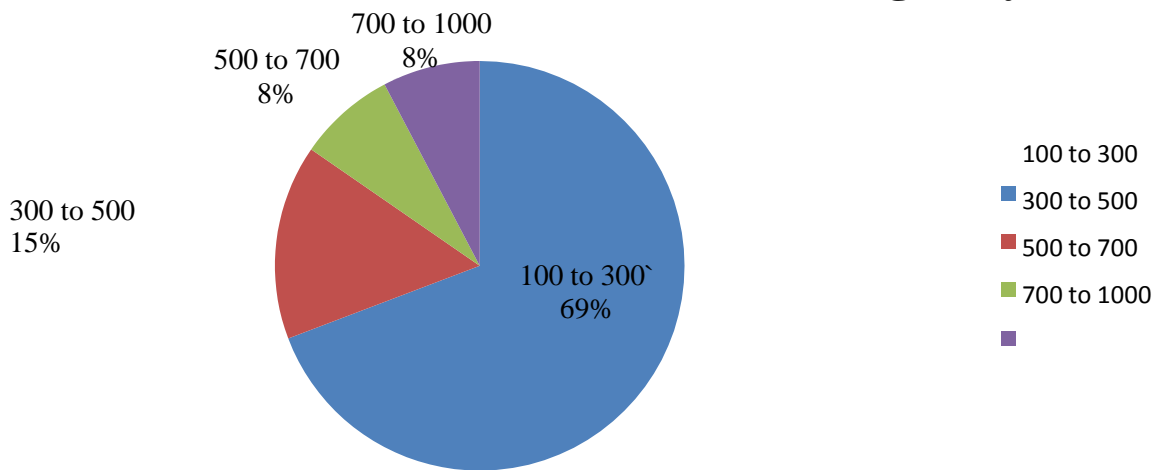


Figure 5.13 No of customers in Average Day

### Q10: Number of Customers in Peak Hour

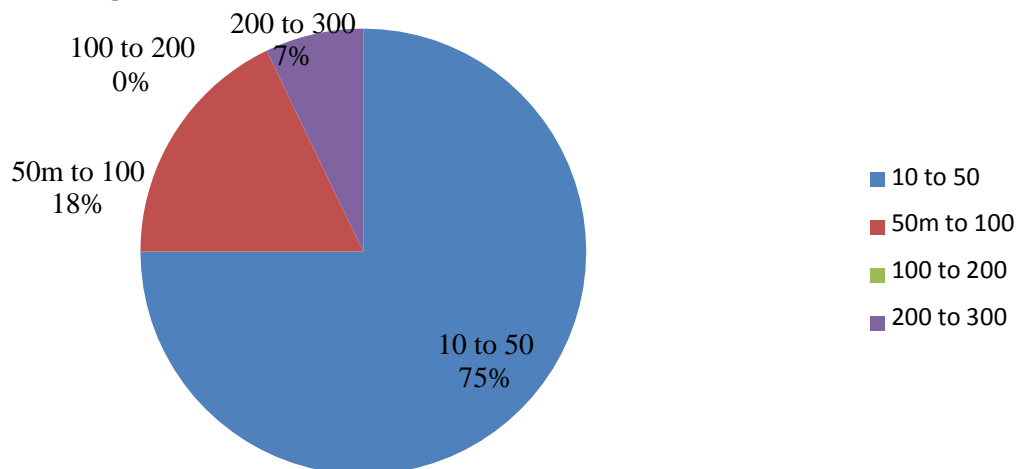


Figure 5.14 No of Customers in Peak Hour

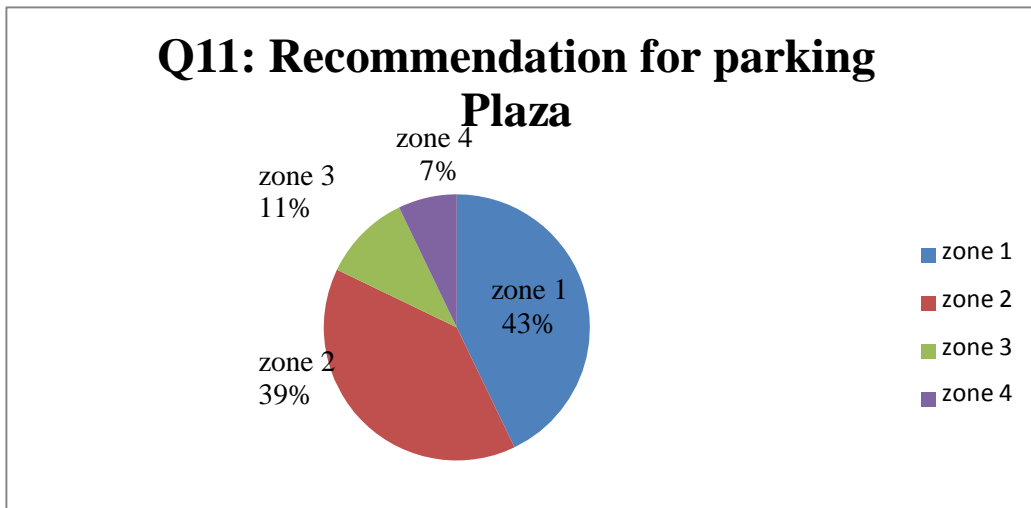


Figure 5.15 Which Place Owners recommend for Parking Plaza

#### 5.9.4 General public survey results of whole Saddar:

After the compilation of the results it was found out that the public use motorcycles after car as their mode of travel and find insufficient space for the parking of their vehicles. Fifteen minutes is the average time for a customer while most of the motorcyclist park instantaneously.

The customers usually visits sadder on weekly and monthly basis rather on daily basis.

Demand is calculated with the help of survey of different zones.

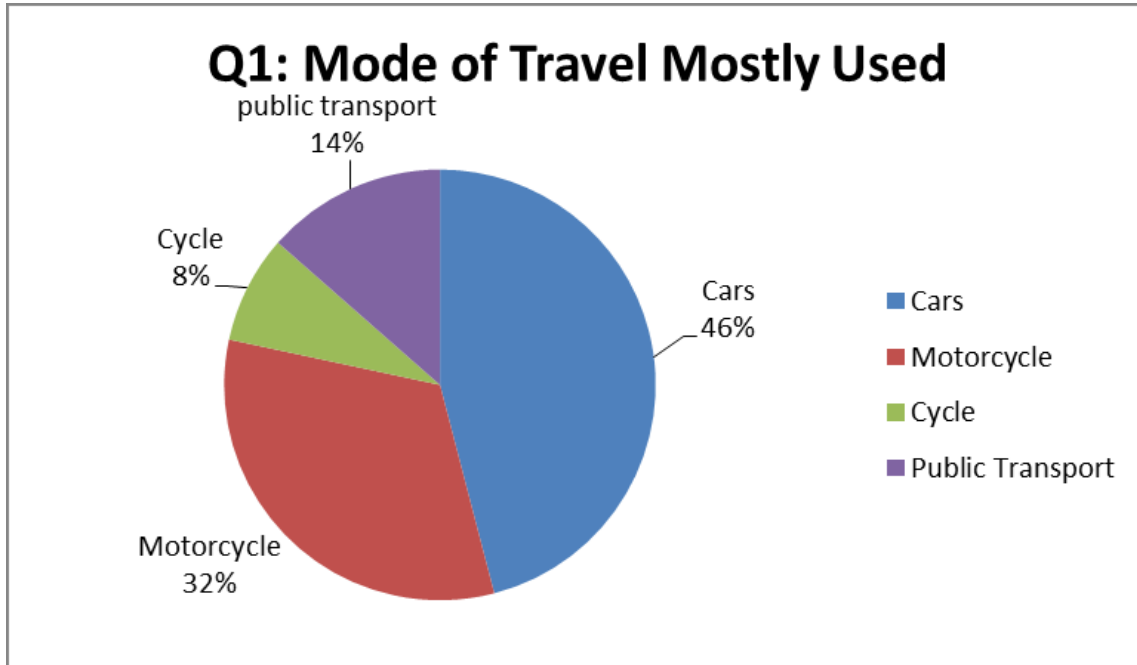


Figure 5.16 Mode of travel used by Customers

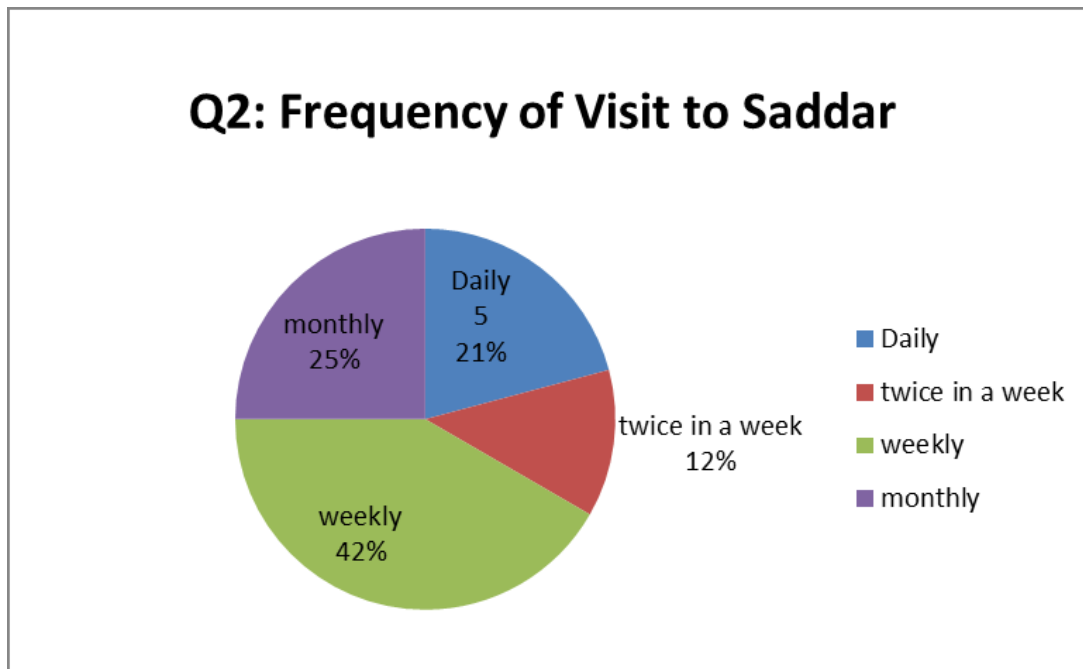


Figure 5.17 Frequency of customers to Visit Saddar

### Q3: Most Visited Portion

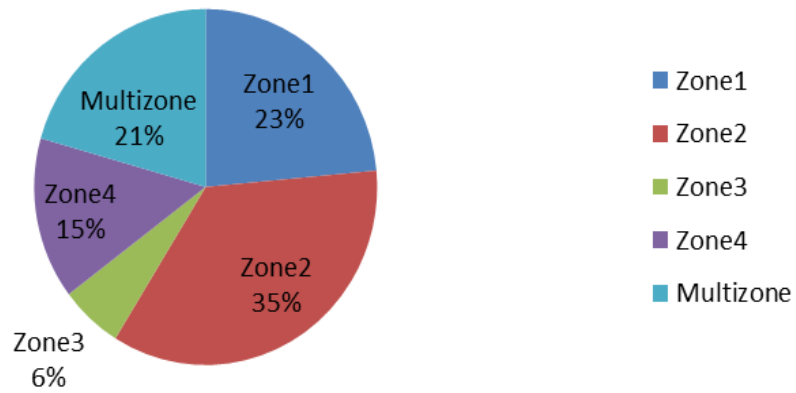


Figure 5.18 Which Portion Customers visit Most

### Q5: Proper Place to Park

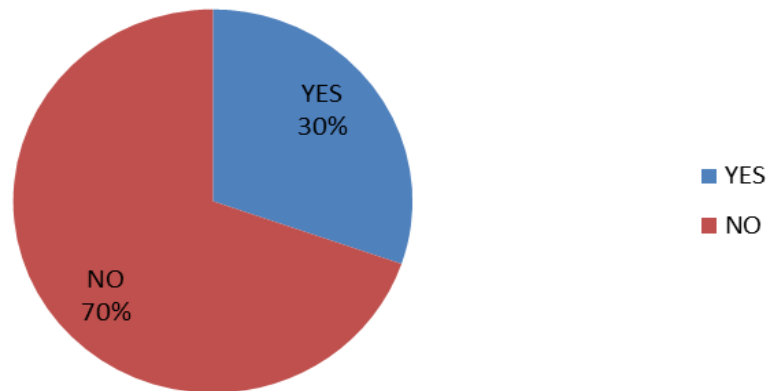


Figure 5.19 Is Proper Place is Available to park



### Q6: Peak Time Visit of Customers to Saddar

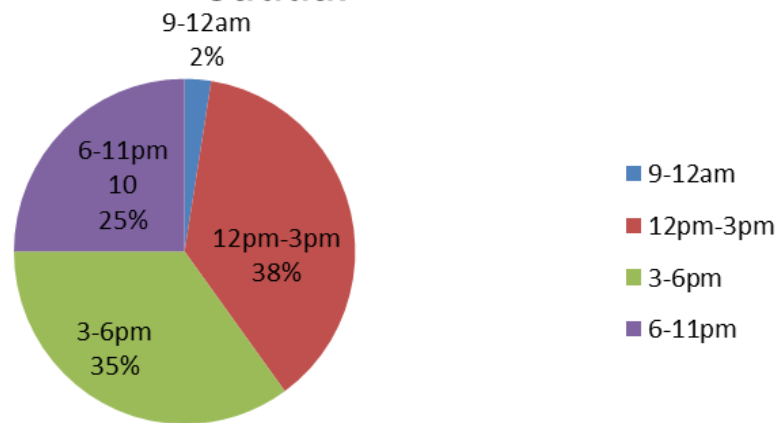


Figure5.20 Peak time visit of customers to Saddar

### Q7: Parking Duration

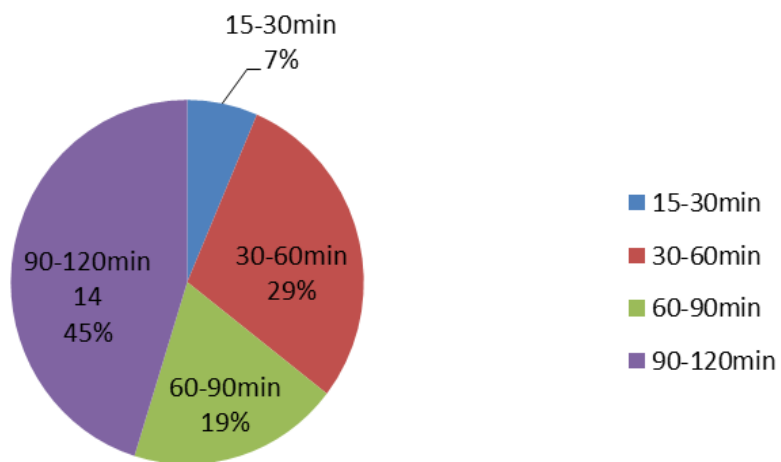


Figure5.21 Parking Duration of Customers

# Q8: Time Taken to Park Vehicle

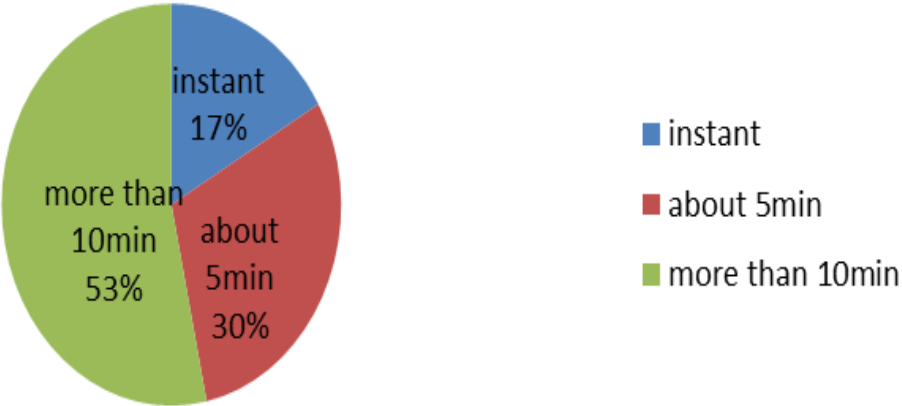


Figure 5.22 Time Taken to Park Vehicle by customers

All the further procedure for demand was carried out in six steps which are as follows

STEP 1: Determination of demand with the help analysis carried out on results of General Public and Business Owner Surveys.

STEP 2: Application of 'Multi category Factor' and 'Passenger Factor' on customers only.

STEP 3: Forecasting the demand for both cars and bikes using a growth factor of 3%. STEP 4:

A comparison of capacity and demand for years 2017, 2022, 2027 and 2032.

STEP 5: Design of parking plaza and calculation of floors required according to the capacity per floor.

STEP 6: Time management of opening and closing of plaza's based on their usage

#### **5.10.1 STEP 1:**

Determination of demand with the help of analysis carried out on results of General Public and Business Owner Surveys.

At the start the sampling was done when the total number of shops were determined of each category. Basing on the most number of customers it serve we selected five to six shops randomly.

Questions asked about the mode of the travel. According to the table above 30% of the customers use their cars to have a visit the category A shop in the zone 1 while the mode of travel motorcycle used is 53%.

## Calculation

Total number of customers for six shops= 825

But we have 25 shops; so to get number of customers in 25 shops proportion formula was used

$$\text{Average number of customers} = \frac{(\text{Number of customers in "X" number of shops}) * (\text{Number of shops Surveyed})}{(\text{Number of shops surveyed in each category})}$$

Total number of customers for 25 shops= 3438

It was divided between cars and motorcycle parking spaces based on the percentage obtained using graphs.

$$\begin{aligned} \text{Total cars parking demand} &= 30\% \text{ times } 3438 \\ &1032 \end{aligned}$$

$$\begin{aligned} \text{Total motorcycle parking demand} &= 53\% \text{ times } 3438 \\ &1823 \end{aligned}$$

Similar procedure was adopted for owners and employers/employee.

$$\text{Average number of employees} = \frac{(\text{Number of employees in "X" number of shops}) * \# \text{ of surveyed shops}}{(\text{Number of shops surveyed in each category})}$$

<b>DEMAND CALCULATION</b>		
<b>ZONE 1</b>		
<b>TYPE A: GARMENTS AND SHOES</b>		
TOTAL NO. OF SHOPS = 25		
<b>CUSTOMERS:</b>		
<u>MODE USE</u>		
BIKES= 53%	PUBLIC TRANSPORT= 17%	CARS= 30%
<u>CALCULATION:</u>		
Total No. of customers for 6 shops=		625
Total No. of customers for 25 shops=		2605
No. of Parking Spaces Required (Bikes)=		1381
No. of Parking Spaces Required (Cars)=		782
<b>OWNERS:</b>		
<u>MODE USE</u>		
BIKES= 10%		CARS= 90%
<u>CALCULATION:</u>		
No. of Parking Spaces Required ( Bike Owners)=		3
No. of Parking Spaces Required (Car Owners)=		22
<b>EMPLOYEES:</b>		
<u>MODE USE</u>		
BIKES= 66%	PUBLIC TRANSPORT= 34%	CARS= 0%
<u>CALCULATION:</u>		
Total No. of Employees using Vehicles for 6 shops=		20
Total No. of Employees using Vehicles for 25 shops=		84
No. of Parking Spaces Required (Bikes)=		56
No. of Parking Spaces Required (Cars)=		0
<b>TOTAL DEMAND FOR CATEGORY A IN ZONE 1:</b>		
<b>CARS=</b>	<b>804</b>	
<b>BIKES=</b>	<b>1440</b>	

Table 5.15 Parking Demand Calculations for category A in zone I

Demand of each category in a zone was calculated and then added together to get the demand of a zone. These zone demands are then added to get the whole demand of Saddar without applying any factors.

DEMAND (CARS)	ZONE 1	ZONE 2	ZONE 3	ZONE 4
<b>OWNERS</b>	59	68	61	58
<b>EMPLOYEES</b>	0	2	43	2
<b>CUSTOMERS</b>	5676	2553	2236	9549
<b>TOTAL</b>	5735	2623	2340	9609

Table 5.16 Parking Demand Calculations for Cars

### 5.10.2 STEP 2:

#### **Application of ‘Multi category Factor’ and ‘Passenger Factor’ on customers only**

Demand obtained by these formulas didn’t considered the occupancy time of each vehicle, number of passengers on car and motorcycle and number of shops/ categories that each passenger visits.

Three type of factors were used for the further reduction of the demand.

Passenger factor

Occupancy time

Multi-category factor

#### **5.10.2.1 Multi-category**

The reason behind using the multi-category factor was that one customer do not visit the only one kind of the shop as they visits a number of shops. The chances of the customer to visit different zones is very less that’s why the multi zone factor is not catered for.

Total demand obtained assumed that customers visit only one zone in Saddar while in real customers visit multi categories due to which demand of parking changes. To correct the applied assumption multi category factor was applied on customers only with the help of surveys to see the frequency of multi zone travel. Questions were asked like how many zone you visit.

### 5.10.2.2 Passenger factor

Passengers for car and motor cycle are obtained using survey and demand is then divided by that factor to obtain the demand after passenger factor. Total number of persons that travel on each vehicle was noted down and in the end average of that was used. Demand was then divided by that average to obtain the modified demand. Similarly demand for zone 2,3 and 4 are calculated. Total demand is obtained by adding all of them.

### 5.10.2.3 Result of Application of multi category factor and passenger factor for cars

	CUSTOMERS DEMAND	MULTICATEGORY FACTOR		DEMAND AFTER PASSENGER FACTOR
		AVG. CATEG. VISITED	DEMAND AFTER MULTICAT. FACTOR	FACTOR USED = 2.0
ZONE 1	5676	1.2	4730	2365
ZONE 2	2553	1.1	2321	1161
ZONE 3	2236	1.15	1945	973
ZONE 4	9549	1	9549	4775

Table 5.17 Application of Factors on Customers Parking Demand

These demands are then added with employer and employee demand to get the total demand of Saddar.

TOTAL DEMAND (CARS)	
ZONE 1	2424
ZONE 2	1231
ZONE 3	1077
ZONE 4	4835
TOTAL	9567

Table 5.18 Total Parking Demand in Term of Vehicles

Similar procedure was adopted for bikes.

**5.10.3 STEP 3:**

**Forecasting the demand for both cars and bikes using a growth factor of 3%**

**5.10.3.1 Growth factor application**

Demand of cars and bikes were then forecasted and solution was proposed by building a plaza whose stories will be increased with the passage of time according to the requirements of parking.

Growth factor of 3 percent was applied to the demand and it was forecasted upto 2032 with a gap of five years.

Growth factor` USED = 3%								
ZO NE	DEMAN D FOR CARS IN 2017	DEMAN D FOR BIKES IN 2017	DEMAN D FOR CARS IN 2022	DEMAN D FOR BIKES IN 2022	DEMAN D FOR CARS IN 2027	DEMAN D FOR BIKES IN 2027	DEMAN D FOR CARS IN 2032	DEMAN D FOR BIKES IN 2032
1	2442	7793	2669	8516	3094	141174	3587	11445
2	1270	1935	1396	2115	1618	2452	1876	2842
3	1097	1684	1199	1841	1390	2134	1611	2474
4	1932	5257	2112	5745	2448	6660	2838	7721

Table 5.19 Forecasted Parking Demand Up to 2030



#### 5.10.4 STEP4

##### Comparison of capacity and demand for years 2017, 2020, 2025 and 2030.

Capacity obtained after application of occupancy factor was then compared with demand. Solution was proposed to build plaza based on the difference between capacity and demand.

It can be seen from the results that demand for zone 4 is less than its existing capacity so no parking plaza is required for zone 4. Similar procedure was adopted for bikes

On street Capacity	Cap. After Occupancy Factor	Demand 2017	Cap. Of plaza to be constructed for 2017	Demand 2020	Cap. Of plaza to be constructed in 2020	Demand 2025	Cap. Of plaza to be constructed in 2025	demand 2030	Cap. Of plaza to be constructed in 2030
Zone 1	2376	2442	66	2669	293	3094	718	3587	1211
Zone 2	1108	1277	169	1396	288	1618	510	1876	768
Zone 3	1008	1097	89	1199	191	1390	382	1611	603
Zone 4	840	1932	NOT REQUIRE	2112	NOT REQUIRED	2448	NOT REQUIRED	2838	NOT REQUIRED

Table 5.20 Capacity of Plaza to be constructed

### 5.10.5 STEP 5:

#### **Design of parking plaza and calculation of floors required according to the capacity per floor.**

In order to design the plaza and its floors its capacity was calculated. Capacity of parking plaza's proposed at different locations was calculated based on parking standards using angle of 60 degrees and 90 degrees.

Then occupancy factor was applied i.e. 4 stalls per day will be used if constructed. Capacity was expanded onto the whole day. To find floors required for plaza's capacity per day was divided by the difference between capacity and demand.

It was then forecasted too to see the number of floors required with the passage of time.

Results are as follows

For Cars

<b>PARKING PLAZAS</b>	<b>TOTAL PARKING CAPACITY PER FLOOR</b>	<b>OCCUPANCY PER STALL</b>	<b>TOTAL PARKING CAPACITY PER FLOOR</b>	<b>NO OF FLOORS</b>
<b>ZONE I JAVED (Behind Imperial Store)</b>	172	4	688	1
<b>ZONE II THEKA (Adjacent Shell)</b>	358	4	1432	1
<b>ZONE III AURANGZEB (Behind J's Emporium)</b>	162	4	648	1

Table 5.21 Number of Floors of Parking Plaza required in 2017

ZONES	NO OF FLOORS		
	2020	2025	2030
<b>ZONE I AURANGJEB (Behind Imperial Store)</b>	1	2	2
<b>ZONE II THEKA (Adjacent Shell)</b>	1	2	2
<b>ZONE III JAVED (Behind J's Emporium)</b>	1	1	1

Table 5.22 Number of Floors of Parking Plaza required up to 2030

Similar procedure was adopted for bikes results of which are attached in annexure.

#### 5.10.6 STEP 6:

##### Time management of opening and closing of plaza's based on their usage

Questions were asked in survey forms about the time during which most of the customers visit Saddar. Percentages were obtained and capacity and demand was calculated accordingly.

It was seen from the results that during 9 am to 12 pm parking plaza is not required because demand is less than capacity. This procedure was done both for cars and bikes in different zones.

Result of cars for zone 1 is shown below. Result of the other zones is given in annexure.

#### FOR CARS

TIMING	PERCENTAGE	DEMAND	CAPACITY	IS PLAZA REQUIRED?
9AM - 12PM	8%	213	336	NOT REQUIRED
12PM - 3PM	18%	479	336	REQUIRED
3PM - 6PM	34%	904	336	REQUIRED
6PM - 9PM	40%	1064	336	REQUIRED

Table 5.23 Time Management of Parking Plaza for zone 1



**RESULTS OF PARKING STUDY**

**6.1 Existing ON-Street Capacity**

With the help of the parking standards the on street capacity of Peshawar Saddar was calculated. Diverse Angles are used for parking i.e 45 degrees and 60 degree basing on ease, existing road width and number of vehicles that can be accommodated and the amount of space available. Occupancy factor was also applied after the conduct of rotation survey, which was found to be 4 stalls per working day for cars and 6 stalls per working day for bikes.

The capacity of different zones calculated was.

**6.1.1 For Cars**

On street Capacity	Cars	Stall use per Day	Cap. After Occupancy Factor
Zone 1	594	4	2376
Zone 2	277	4	1108
Zone 3	252	4	1008
Zone 4	210	4	840

Table 6.1 On-street Capacity of cars

**6.1.2 For Bikes**

On street Capacity	Bikes	Stall use per Day	Cap. After Occupancy Factor
Zone 1	720	6	4320
Zone 2	336	6	2016
Zone 3	312	6	1872
Zone 4	240	6	1440

Table 6.2 On street capacity of bikes

## 6.2 Existing Off-Street Capacity:

A number of on site surveys were conducted for determining existing Off-Street Parking capacity of Saddar and capacity of plazas was also determined. Capacity of the available open spaces was also found along with the capacity of plazas. Capacities of different zones calculated are shown in table on following page;

<b>OFF-STREET CAPACITY OF SADDAR</b>		
<b>VEHICLE</b>	<b>BIKES</b>	<b>CARS</b>
	<b>ZONE 1:</b>	
<b>FALAK SEIR PARKING</b>	<b>300</b>	<b>25</b>
<b>JAVED PARKING</b>	<b>450</b>	<b>100</b>
<b>AURANGZEB PARKING</b>	<b>450</b>	<b>80</b>
<b>APWA TOWER PARKING</b>	<b>250</b>	<b>35</b>
<b>TOTAL CAP. ZONE 1</b>	<b>1450</b>	<b>240</b>
	<b>ZONE 2:</b>	
<b>THEKA PARKING</b>	<b>500</b>	<b>300</b>
<b>TIME CENTER PARKING</b>	<b>300</b>	<b>80</b>
<b>TOTAL CAP. ZONE 2</b>	<b>800</b>	<b>380</b>
<b>TOTAL CAP. ZONE 3:</b>	<b>0</b>	<b>0</b>
	<b>ZONE 4:</b>	
<b>DEAN PARKING</b>	<b>3500</b>	<b>2000</b>
<b>TOTAL CAP. ZONE 4:</b>	<b>3500</b>	<b>2000</b>
<b>TOTAL OFF-STREET CAPACITY OF SADDAR</b>	<b>5750</b>	<b>2620</b>

Table 6.3 Existing Off-Street capacity

### 6.3 Combined Off and On street capacity:

The complete On-Street and Off-Street Parking Capacity of Saddar was then added according to the zones to find out the total capacity of different zones.

Total Capacity of Zone X= (Total On-Street Capacity of Zone X+ Total Off-Street Capacity of Zone X)

<b>TOTAL CAPACITY OF SADDAR</b>		
<b>VEHICLE</b>	<b>BIKES</b>	<b>CARS</b>
	<b>ZONE 1:</b>	
<b>TOTAL CAPACITY</b>		
		2170
		834
	<b>ZONE 2:</b>	
<b>TOTAL CAPACITY</b>		
		1136
		657
	<b>ZONE 3:</b>	
<b>TOTAL CAPACITY</b>		
		312
		252
	<b>ZONE 4:</b>	
<b>TOTAL CAPACITY</b>		
		3740
		2210
<b>TOTAL CAPACITY OF SADDAR (2016)</b>	<b>7358</b>	<b>3953</b>

Table 6.4 Combine On-Street and Off-Street Capacity

#### 6.4 Demand Calculation of Vehicles in Saddar:

DEMAND (CARS)	ZONE 1	ZONE 2	ZONE 3	ZONE 4
OWNERS	59	68	61	58
EMPLOYEES	0	2	43	2
CUSTOMERS	5676	2553	2236	9549
TOTAL	5735	2623	2340	9609

Table 6.5 Demand in terms of vehicles

With the help of the General public survey and Business owner surveys as shown in Appendix, the calculations for the demand were carried out. Results of all the questions asked were used to find out the demand and plot particular graphs. Demand was calculated individually for owners, employees and customers

#### 6.5 Factor application on Demand:

Some of the demand calculations were further adjusted with the help of a factor as the customers generally visit multiple category of shops. There is more than one person per car. Keeping in view these things, two factors were applied on customers i.e passenger factor and multi category factor.



## 6.6 Total Demand of Cars:

With the application of the multi category factor and passenger factor, Demand of car is calculated.

	CUSTOMERS DEMAND	MULTICATEGORY FACTOR		DEMAND AFTER PASSENGER FACTOR
		AVG. CATEG. VISITED	DEMAND AFTER MULTICAT. FACTOR	FACTOR USED = 2.0
ZONE 1	5676	1.2	4730	2365
ZONE 2	2553	1.1	2321	1161
ZONE 3	2236	1.15	1945	973
ZONE 4	9549	1	9549	4775

Table 6.6 Application of factors on customers' demand

Next step involved adding the demand from the table shown above to demand of owners and employees from table 5.4. Results are shown below;

TOTAL DEMAND (CARS)	
ZONE 1	2424
ZONE 2	1231
ZONE 3	1077
ZONE 4	4835
TOTAL	9567

Table 6.7 Total demand for cars in Saddar

### 6.7 Total Demand of Bikes:

Similar procedure was applied on bikes and their demand was calculated. Zone wise calculations of bike demand are shown below.

<b>DEMAND (BIKES)</b>	<b>ZONE 1</b>	<b>ZONE 2</b>	<b>ZONE 3</b>	<b>ZONE 4</b>
<b>OWNERS</b>	95	71	324	75
<b>EMPLOYEES</b>	524	400	1454	1562
<b>CUSTOMERS</b>	8113	3280	3149	13155
<b>TOTAL</b>	8732	3751	4927	14792

Table 6.8 Total demand of bikes as per zones

### 6.8.1 Multi-category factor:

Same as before, Multi-category factor and Passenger factor was applied to the demand of bikes for customers in each zone. So the demand of bikes of the different zones was reduced.

	CUSTOMERS DEMAND	MULTICATEGORY FACTOR		DEMAND AFTER PASSENGER FACTOR FACTOR USED = 1.5
		AVG. CATEG. VISITED	DEMAND AFTER MULTICAT. FACTOR	
ZONE 1	8113	1	8113	5409
ZONE 2	3280	1	3280	2187
ZONE 3	3149	1.8	1750	1167
ZONE 4	13155	1	13155	8770

Table 6.9 Application of factors on customers' demand

### 6.8.2 Total demand of bikes for Saddar:

	TOTAL DEMAND (BIKES)		
ZONE 1		6028	
ZONE 2		2658	
ZONE 3		2945	
ZONE 4		10407	
<b>TOTAL</b>		<b>22038</b>	

Table 6.10 Total demand for bikes in Saddar

## 6.9 Comparison of Total Existing Capacity and Total Demand:

There is considerable difference between the capacity and demand of each zone. These differences will increase each year with the increase in the demand of Saddar. This difference shows that there is a major need of parking accommodation in the Central Business district of Peshawar.

TOTAL CAPACITY OF SADDAR				TOTAL DEMAND OF SADDAR			
VEHICLE	BIKES		CARS	VEHICLE	BIKES		CARS
<b>ZONE 1:</b>				<b>ZONE 1:</b>			
TOTAL CAPACITY		2170	834	TOTAL DEMAND		7793	2442
<b>ZONE 2:</b>				<b>ZONE 2:</b>			
TOTAL CAPACITY		1136	657	TOTAL DEMAND		1935	1277
<b>ZONE 3:</b>				<b>ZONE 3:</b>			
TOTAL CAPACITY		312	252	TOTAL DEMAND		1684	1097
<b>ZONE 4:</b>				<b>ZONE 4:</b>			
TOTAL CAPACITY		3740	2210	TOTAL DEMAND		5257	1932
<b>TOTAL CAPACITY OF SADDAR (2016)</b>				<b>TOTAL DEMAND OF SADDAR (2016)</b>			
		<b>7358</b>	<b>3953</b>			<b>16669</b>	<b>6748</b>

Table 6.11 Comparison of Capacity and Demand of Saddar

### 6.10 Forecasting of Demand of Peshawar Saddar:

Basing on the data analysis and calculations and with the help of the standard formula as per parking the demand of each zone was determined. For forecasting the future demand a growth factor of 4 % was used and calculations of next 15 years were made. The formula which is used for the projection of the demand is:

$$\text{Projected Demand After "X" Years} = \text{Present Demand} \times (1.03)^X$$

ZONE	DEMAND FOR CARS IN 2017	DEMAND FOR BIKES IN 2017	DEMAND FOR CARS IN 2022	DEMAND FOR BIKES IN 2022	DEMAND FOR CARS IN 2027	DEMAND FOR BIKES IN 2027	DEMAND FOR CARS IN 2032	DEMAND FOR BIKES IN 2032
1	2442	7793	2669	8516	3094	141174	3587	11445
2	1270	1935	1396	2115	1618	2452	1876	2842
3	1097	1684	1199	1841	1390	2134	1611	2474
4	1932	5257	2112	5745	2448	6660	2838	7721

Table 6.12 Projection of demand till the year 2032

### **6.11 Planning Parameters for Parking Plazas:**

After completing all the calculations it was found out that there is a large difference between the capacity and demand of Peshawer Saddar. The future demand that was forecasted was a way ahead of the capacity determined of that zone.

In order to minimize the difference, construction of the parking plaza for each zone to be carried out as early as possible to accommodate the maximum number of vehicles visiting the zone.

The following standard parameters used were;

Parking was done at 90 degrees.

Dimensions of each parking bay were 9' x 18'.

Aisle width for 90 degrees was 24'.

Ceiling height was kept 10'.

### **6.12 Requirement of Capacity of Plazas according to the forecasted demand**

Capacity of each plaza to be constructed was determined after forecasting the demand up to the year 2030. It is quite clear that the requirement of parking increased every year. The results for cars and bikes show the difference in parking and demand for each year separately in the table below:

For Cars

On street Capacity	Cap. After Occupancy Factor	Demand 2017	Cap. Of plaza to be constructed for 2017	Demand 2022	Cap. Of plaza to be constructed in 2022	Demand 2027	Cap. Of plaza to be constructed in 2027	demand 2032	Cap. Of plaza to be constructed in 2032
Zone 1	2376	2442	66	2669	293	3094	718	3587	1211
Zone 2	1108	1277	169	1396	288	1618	510	1876	768
Zone 3	1008	1097	89	1199	191	1390	382	1611	603
Zone 4	840	1932	NOT REQUIRE D	2112	NOT REQUIR ED	2448	NOT REQUIR ED	2838	NOT REQUIR ED

Table 6.13 Capacity requirement of plazas up to the year 2032

### 6.13 Requirement of Parking Plaza floors up to the forecasted demand

As shown in the table, raw floor capacities were multiplied by the occupancy factors. Requirement of floors for cars was calculated by dividing the capacity of plaza to be constructed in a year as shown in table 6.11 by total parking capacity per day per floor as shown in table

6.13. The result was rounded up for convenience. Similar procedure was followed for bikes.

ZONES	NO OF FLOORS		
	2020	2025	2030
<b>ZONE I AURANGJEB (Behind Imperial Store)</b>	1	2	2
<b>ZONE II THEKA (Adjacent Shell)</b>	1	2	2
<b>ZONE III JAVED (Behind J's Emporium)</b>	1	1	1

Table 6.14 Floor requirement for Cars

### 6.14 Time Management for Opening of Parking Plazas

After carrying out the design of the parking structure, there comes a need to define the timings upto which the parking plaza should remain open and functional. From the general public survey it was found that the rush hours started with the afternoon so there is no need to open the facility from the early morning. This would generally reduce the power usage, watchman wages and local staff required in the plaza. The results for cars and bikes are as follows:



### ZONE I (AURANGZEB PLAZA)

#### FOR ZONE 1

TIMING	PERCENTAGE	DEMAND	CAPACITY	IS PLAZA REQUIRED?
9AM - 12PM	6%	362	720	NOT REQUIRED
12PM - 3PM	14%	844	720	REQUIRED
3PM - 6PM	29%	1749	720	REQUIRED
6PM - 9PM	51%	3075	720	REQUIRED

### ZONE II (THEKA PLAZA)

#### FOR ZONE 2

TIMING	PERCENTAGE	DEMAND	CAPACITY	IS PLAZA REQUIRED?
9AM - 12PM	8%	213	336	NOT REQUIRED
12PM - 3PM	18%	479	336	REQUIRED
3PM - 6PM	34%	904	336	REQUIRED
6PM - 9PM	40%	1064	336	REQUIRED

### ZONE III ( JAVED PLAZA)

#### FOR ZONE 3

TIMING	PERCENTAGE	DEMAND	CAPACITY	IS PLAZA REQUIRED?
9AM - 12PM	11%	324	312	REQUIRED
12PM - 3PM	17%	501	312	REQUIRED
3PM - 6PM	33%	972	312	REQUIRED
6PM - 9PM	39%	1149	312	REQUIRED

## CHAPTER 7

### CONCLUSION AND RECCOMENDATIONS

#### 7.1 Conclusion:

After analyzing the existing situation and the problems it is causing, we proposed a solution and ended up with the following conclusion.

There is insufficient parking space both on-street and off-street in the CBD under study.

The major reason of the traffic congestion in the CBD under study is illegal and improper on-street and off-street parking.

Furthermore, it was observed that the government policies regarding the construction of multi-story car parks to reduce parking problem has been negligible.

It was observed that there is no strict action for removal of encroachments and on-street double parking. This needs to be removed so that road is utilized to its full potential.

Double parking can be seen on many sites of Saddar due to which delay in traffic flow occurs resulting in congestion problems.

It was identified that there is no restriction from concerned departments in particular on the multistory shopping malls to build their own underground parking.

Projects of same nature have been done before but our project is extensively focused on parking. Approach used for calculating capacity and demand is different and realistic based on standards. The use of different factors such as passenger factor and surveys such as rotation survey has been considered in our study. Design of parking plaza and its location time management have also been worked on.

## **7.2 Recommendations:**

The study of CBD area presented a vast number of problems that feed the prevalent parking issue. For these issues certain recommendations are presented as follows:

Double parking and encroachments needs to be removed so that total width of road is only used for traffic flow rather than parking.

Difference between capacity and demand should be shifted to parking plazas proposed at different feasible locations.

During day time from morning till noon demand doesn't exceed capacity and no plaza is required and cars can be parked at offsite locations. So during day time plaza can be closed. This will help in saving money by having security guards for lesser time and no electricity usage.

Most of the off-street sites are underutilized due to non-presence of delineated markings.

So either markings should be present there or plaza should be constructed on that location.

Furthermore, there is a need for educating people about the traffic and parking rules though flyers, posters, banners, and presentations in schools, colleges and other vocational training institutes.

'No Parking' signs to be increased in number at restricted locations.

It is strongly recommended that provision of parking to be mandatory in building code for any commercial projects to be built in future.

It is also recommended that owners of commercial shops need to contribute towards the construction of plaza.

Congestion pricing survey should be done. Fund generated by it can be used for construction of plaza

PPP (Public Private Partnership) should be done for the construction and operation of parking plaza.

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