

A STUDY OF PARKING BEHAVIOUR IN CBD AREA OF VADODARA CITY

Panchal Darshan¹, Patel Vivek², Sukhadia Hardik³, Sanjay Dave⁴

¹Civil Engineering Department IJET, Dharmaj, darshanpancrhal.20@gmail.com

²Civil Engineering Department IJET, Dharmaj, vivekpatel6018@gmail.com

³Civil Engineering Department IJET, Dharmaj, hardsukh@gmail.com

⁴Civil Engineering Department M S University of Baroda, smdave@ymail.com

Abstract

Parking is the most challenging problem for Developing Countries like India. The parking problem becomes more difficult to solve within the CBD area of metropolitan cities. Policy making of parking is very essential for the any town planner. For this, behavioral study of vehicles and drivers is necessary to take in mind. We carried out a road side interview survey with three days in a walled city area of Vadodara. We extracted the information and their importance and vision towards parking from the data. From this survey we analyzed that, parking safety is very essential than parking charges for four wheeler owner, but the two wheeler owner having conservative approach towards parking charges. This survey is very helpful for making different policies of parking.

Keywords- Parking Facility, Parking Charges, Drivers Behaviour, Multi-storeyed Parking, CBD Area

I. INTRODUCTION

Parking is an essential component of the transportation system. With the inordinate process of urbanization, parking problems come into prominence. This Passage introduces several parking demand concepts and academic methods domestic and overseas, and also considers these area land exploiting features. Parking behavior analysis in many kinds of commercial activities in central business districts, like the number of parking, the proper relation between parking infrastructure and the building parking attraction, and the coordination between parking scales and the management measure, we get some results on business building and office building parking indexes.

Parking especially 'On-street parking' is the most concerning problem in urban cities, which is created by the increasing traffic and growth of motorized vehicles. Every vehicle trips requires Parking at its destination, so parking facilities are an integrated component of the roadway system. Now a days providing parking facilities are a major problem of society, and parking conflicts are among the most common problems facing designers, operators, planners and other officials. Such problems can be often defined either in terms of supply or in terms of management.

a. Types of Parking

1) *On-Street Parking*: On-street parking means the vehicles are parked on the sides of the street itself. This will be usually controlled by government agencies itself.

2) *Off Street Parking*: Off street parking means vehicles are parked off the street itself. This will be usually controlled by commercial agencies itself.

3) *Parallel Parking*: The vehicles are parked along the length of the road. Here there is no backward movement involved while parking or un-parking the vehicle. Hence, it is the safest parking from the accident perspective. However, it consumes the maximum curb length and therefore only a minimum number of vehicles can be parked for a given kerbed length. This method of parking produces least obstruction to the on-going track on the road since least road width is used.

4) *30 Degree Parking*: In thirty degree parking, the vehicles are parked at 30 with respect to the road alignment. In this case, more vehicles can be parked compared to parallel parking. Also there is better manoeuvre-ability. Delay caused to the track is also minimum in this type of parking.

5) *45 degree parking*: As the angle of parking increases, more number of vehicles can be parked. Hence compared to parallel and thirty degree parking, more number of vehicles can be accommodated in this type of parking.

6) *60 Degree Parking*: The vehicles are parked at 60 to the direction of road. More number of vehicles can be accommodated in this parking type.

7) *Right Angle Parking*: In right angle parking or 90 parking, the vehicles are parked perpendicular to the direction of the road. Although it consumes maximum width kerbed length required is very little. In this type of parking, the vehicles need complex manoeuvring and this may cause severe accident. This arrangement causes obstruction to the particular if the road width is less. However, it can accommodate maximum number of the vehicles for a given kerbed length.

8) *Multiple Level Car Parking*: It is a building (or part there here of) which is designed specifically to be for Automobile Parking and where there are a number of floors or levels on which parking takes place.

Is essentially a Stacked Car Park "Multilevel Car Park" – Term Originated in UK, in US it is called a "Parking Structure" Types:

1) Manually operated (non-mechanized-with ramps)

2) Mechanized

In order to accommodate the large volume of vehicle, small cities and must develop their Infrastructure. One solution may be a multi-level car parking system to maximize car parking capacity by utilizing vertical space, rather than expand horizontally

II. Need of Study

Vadodara is the 20th largest city with a population of 18.22 lacks (2011) in INDIA. Parking is one of the major problems that are created by the increasing vehicle traffic. It has an impact on transport demand management. Public transport system is well planned by VTCOS catering the travel demand of existing population but increasing growth of private two wheeler & four wheeler imposes high parking demand in existing urban infrastructure particularly in CBD area. Hence there is a need to work out the effective parking policy measures to meet demand of existing parking facilities. Attraction in CBD area is for shopping has not decreased in spite of increasing urban sprawl. Use of private owned vehicles using CBD areas aggravate parking problems which needs to be focus for managing the parking demand. Preference in choosing a parking location in the Central Business District area, especially for commuting, business and shopping trips, create a high demand for on street & off street parking which needs to attend by framing appropriate parking policy measures. Free parking policy has resulted into chaotic and illegal parking behaviour particularly of two wheelers which need to be addressed for Traffic Demand Management.

a. Scope of Study

Study is limited to the second order metropolitan city having dominance of two wheeler users where on street parking is free in all CBD area as well as all other arterial and sub arterial roads. Keeping significance in mind, the present analysis investigates the human behaviour to paid parking policy. The analysis criteria's such as travel time, travel cost, parking duration, parking fees, household income, walking distance to parked vehicle, frequency to visit CBD area, purpose of trip are studies. Probability to apply the policy to CBD region can be estimated from the analysis, revenue generated can be calculated for paid parking policy.

III. Objective of Study

1. To study the parking occupancy on the busy street in CBD area and evaluate various Parking parameters.
2. To formulate the scenario of paid on street parking policies as per the guiding principles of National Urban Transport Policy (NUTP) and demand assessment.
3. To develop behaviour models of motorized vehicle users for various formulated parking Policies in CBD area.
4. To estimate the revenue generated on account of paid parking policy.
5. To evaluate response of vehicles users regarding present public transport parameter.

IV. Literature study

a. Parking Pricing and Travel Behaviour

“The price of parking on Great Street” (by Donald shoup, parking today volume 14, February 2009). They suggested contribute making a street great. A city can (1) charge performance based prices for curb parking and (2) return the revenue to the metered districts to pay for added public services. With these two policies, curb parking will help to create great streets, improve transportation, and increase the

All Rights Reserved, @IJAREST-2015

economic vitality of cities. Performance-based prices can balance the varying demand for parking with the fixed supply of curb spaces. We can call this balance between demand and supply the “Goldilocks principle” of parking prices: the price is too high if many spaces are vacant, and too low if no spaces are vacant. When a few vacant spaces are available everywhere, the prices are just right. After the city adjusts prices to yield one or two vacant spaces in every block (about 85 percent occupancy), everyone will see that curb parking is readily available.

“San Francisco park: Pricing Parking by Demand” (Pierce Gregory, Shoup Donald – 2013 fall) In this paper, Drivers see that prices can decline as well as increase, they may appreciate the availability of open curb spaces and learn to use the pricing information to optimize their parking choices for each trip. With performance parking prices, drivers will find places to park their cars just as easily as they find places to buy gasoline. But drivers will also have to think about the price of parking just as they now think about the prices of fuel, tires, insurance, registration, repairs, and car purchases. Parking will become a part of the market economy, and prices will help manage the demand for cars and driving.

“The effects of free parking on commuter mode choice: Evidence from travel diary data” (By-Hess, Daniel Baldwin, University at Buffalo, The Ralph and Goldy Lewis Centre for Regional Policy Studies, JANUARY 2001) they discuss the effect of free parking on mode choice and parking demand. A multinomial log it model is developed to evaluate the probabilities that commuters who do and who do not receive free parking at work will choose to drive alone, ride in a carpool, or use transit for the trip to work in Portland's (Oregon) CBD. The mode choice model predicts that with free parking, 62 percent of commuters will drive alone, 16 percent will commute in carpools and 22 percent will ride transit; with a daily parking charge of \$6, 46 percent will drive alone, 4 percent will ride in carpools and 50 percent will ride transit. The mode choice model predicts that a daily parking charge of \$6 in the Portland CBD would result in 21 fewer cars driven for every 100 commuters. This translates to a daily reduction of 147 VMT per 100 commuters and an annual reduction of 39,000 VMT per 100 commuters. The policy variables that play a part in mode choice decisions for commuters are the parking cost and the travel time by transit, and the results suggest is that raising the cost of parking at work sites and decreasing the transit travel time (by improving service and decreasing headways) will reduce the drive alone mode share.

b. Parking Demand Management Tool

“Effective transportation demand management the results of combining parking pricing, transit incentives, and transportation management in a commercial district of Portland” (By - Oregon bianco, Transportation Research Board – JANUARY 2000) He studied the effects of strategies like parking pricing in the form of meter, limitation of parking supply, maximum parking ratios and car pool metered spaces on mode choice and observed that above strategies have decreased drive alone mode for work trip by 7% and 38% increase in carpool share. The program's strategies that have emerged as the most

significant in effecting this decrease in the installation of the meters and the discounted transit pass program. He find that the majority of the respondents to this survey indicated that their employers participate in Tri- Met's Passport program. For these respondents, results were even more striking: the drive-alone mode decreased by 19 percentage points to only 41 percent of the total commute share. For this group, transit use has risen by 12 percentage points, to over 30 percent of the commute share. Clearly, the presence of a Passport program at these respondents' place of employment is a strong indicator of the hoped-for shifts in mode even if all of the employees at these firms are not using the Passport themselves all of the time. The fact that many of these employees indicate that they have increased their use of parking in non-employer- provided off-street parking suggests that what is valuable for these employees is the flexibility and availability of options. Some days they may use transit; other days, they may drive and pay to park. Those employees who indicated that their employer did not offer a Passport appear to be the most intransigent in terms of hoped-for mode shifts. Not only has this group increased their drive-alone share, but they seem to have adjusted to the installation of the parking meters by parking in either employer- or non-employer-provided off-street parking, rather than by shifting to another mode.

The results show that workers are more likely to change their mode of travel or time of day than to change destination or cancel their activity. Non-workers are likely to make all types of changes and for all policies they are more sensitive than workers. These results suggest that parking measures may be effective in reducing congestion in the business district. However, they may also have a negative effect on the vitality of the business district as shoppers and other visitors are likely to go to other places in response to the change.

c. Multilevel Parking Facility and Parking Response

"Lessons from multi-level parking in sarojini-nagardelhi" (By-Anumita Roy chowdhury, Centre for Science and Environment, April 2012) in this study multi-level parking in commercial area like Sarojini-nagar has been studied in detail. The municipal agencies, New Delhi Municipal Council (NDMC) and the Municipal Corporation of Delhi (MCD), and the Delhi Development Authority (DDA), have drawn up impressive lists of multi-level parking lots to be built in prominent commercial areas of Delhi. The latest tally shows that these agencies together will build nearly 27 multilevel structured parking (NDMC – 3; MCD – 19; DDA – 5). Parking strategy will have to be designed differently and conjoined with other demand management measures to make a difference. In Delhi the Eros parking in Nehru Place remained grossly underutilized for a long time and till the time enforcement in surface parking improved. This is particularly important now as the government policies like the JNNURM are poised to promote these structures. Multi-level parking and local area management also requires a larger planning perspective to achieve decongestion, pollution, and freeing up of common areas for improved walk ability and access. With combined strategy of appropriately priced parking charges, and an area management plan it is possible to reduce parking demand in

the area. Multi-level parking should be leveraged to meet the local need for car park. The on street car parking can be limited to accommodate 56 cars which can be used for immediate and emergency cases Rest of the on street parking can be dedicated to two wheelers and Auto rickshaws.

d. On-street and Off-street Parking Management

"Comparison of On-Street Parking Management in Ermita-Malate Manila and Makati Central Business District" (By - Associate Prof. De La Salle University- Manila Proceedings of the Eastern Asia Society for Transportation Studies, Vol.9, 2013) In this paper, The on-street parking facilities in Ermita-Malate area needs improvement since most of the on-street parkers stay for a very long period and they park in areas where parking is not allowed. The laws and ordinances are not implemented properly, thus, the motorists tend to ignore these. And Recommendations are (1) the area of Ermita-Malate should impose better parking rules and regulations and these should be strictly implemented. (2) The three hour parking rule may also be implemented so that the turnover rate may be increased for the on-street parking. (3) More parking facilities should also be constructed so that the demand will be met by the supply of parking spaces. (4) Off-street parking facilities are harder to increase since some areas are residential areas so off-street parking facilities should be increased instead. (5) The open lot parking facilities should be constructed into a building parking facility so that the number of slots will be increased. Strict implementation should be practiced so that the project will be successful. (6) The enforcers should be alert and should do their assigned tasks properly and they should implement the rules and regulations of the on-street parking.

V. Study Area and Data Collection

1. As the study is focused about Modelling the Response to Paid On-street Parking Policy for Two-wheelers on Busy Urban Street of CBD Area using AHP. It is necessary to define the BUSY STREET first.
2. Busy Street: In this study, busy street term is used to identify the street having following characteristics.
3. Undivided carriage way,
4. Having restricted carriage way width (8-14M),
5. Where on-street parking is allowed for odd-even date on both side,
6. Where land cost is comparatively high and,
7. Where commercial activities are maximum i.e. shops on both the sides.
8. All roads in study have two way traffic flow allow and minimum carriage way 7mt.
9. Where public transport vehicles and Para transit plying on the street.
10. Free on-street parking and Very high parking demand.

Hence streets having all characteristics mentioned above are considered as busy street in this study. Considering about mention criteria follow five roads are selected for the parking study in CBD area. (1) M G Road, (2) Kathy to

Jubelibaug, (3) R C Dutt Road, (4) Palace Road, (5) Around Court & Sursagar Lake

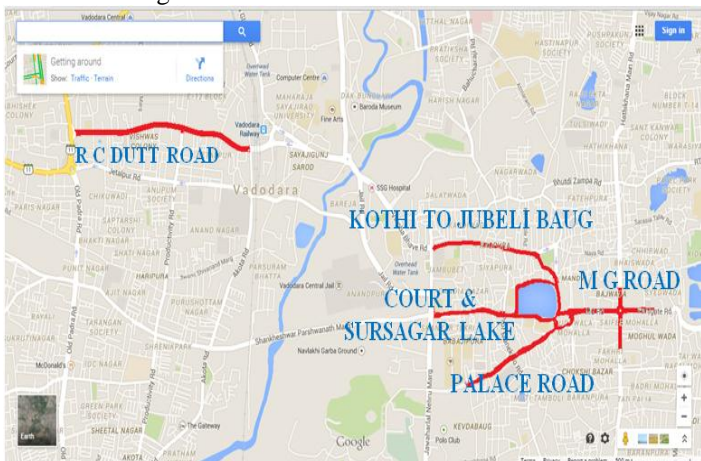
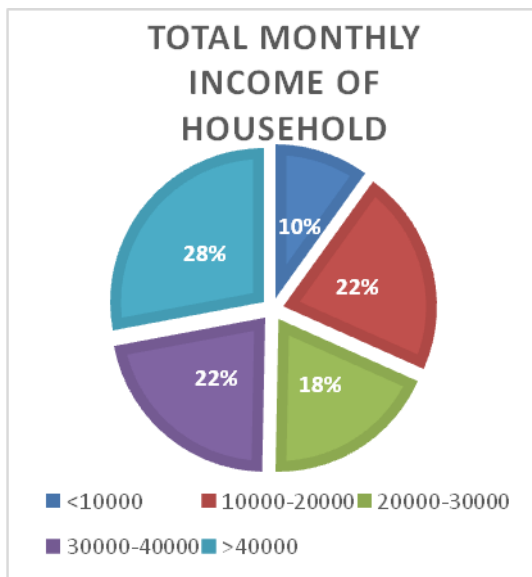


Figure 1 Study area profile

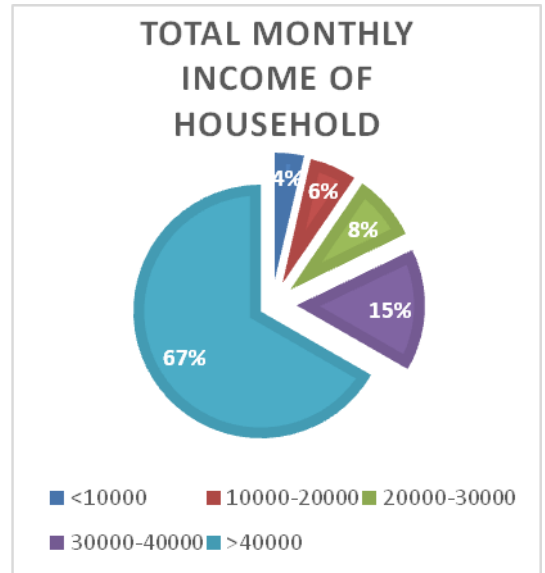
VI. Methodology

The type of parking survey to be conducted for formulating a comprehensive parking plan for an area can be varying detailed in scope. The first step in a parking survey is to collect data on the amount, type and location of space actually or potentially available for parking in area. The area to be surveyed should first be delineated. The central business district is usually the area where parking survey is needed. The area surrounding the central business district where the parking spills over should also be included in the survey. The survey area is then subdivided on a street-by-street basis and sub-divisions marked on a map. For the study “Questionnaire type parking usage survey” was carried out.

VII. Result



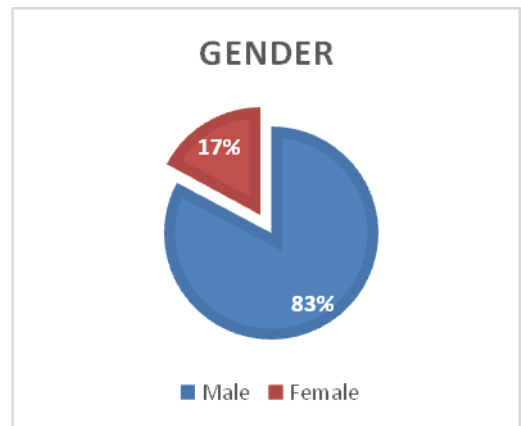
(a)



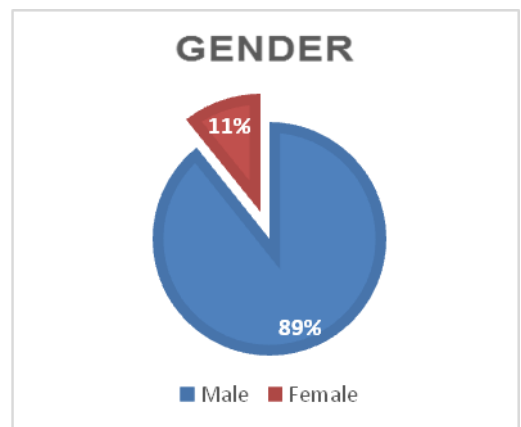
(b)

Figure 2 (a) 2W, (b) 4W: Total monthly income of household

Figure 2 showing the Household income, sample reflect overall economic status resembling the Indian society with more share of higher income group from ≥ 20000 .



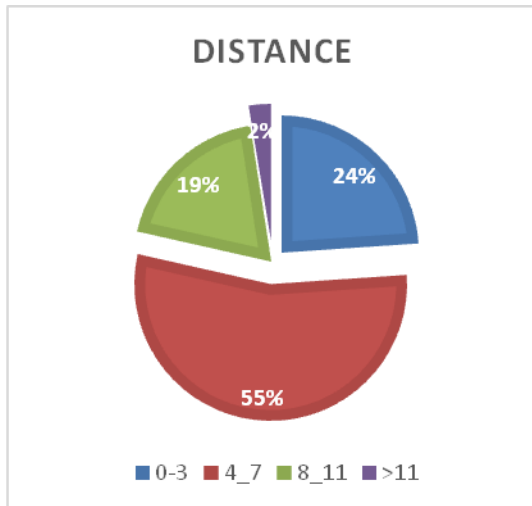
(a)



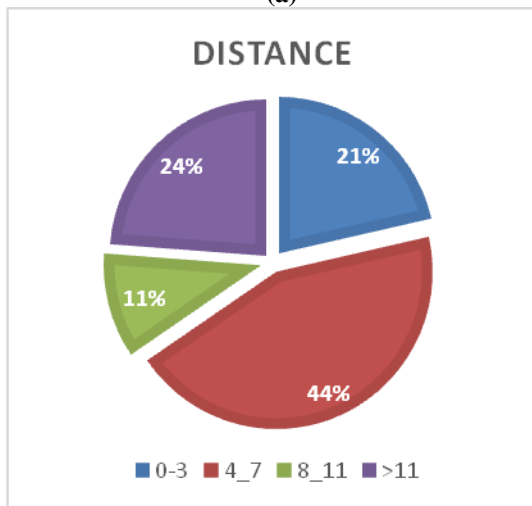
(b)

Figure 3 (a) 2W, (b) 4W: Gender

The above figure 3 indicates most of the visitors in study area were male of composing of 83% and 89% for 2W and 4W respectively.



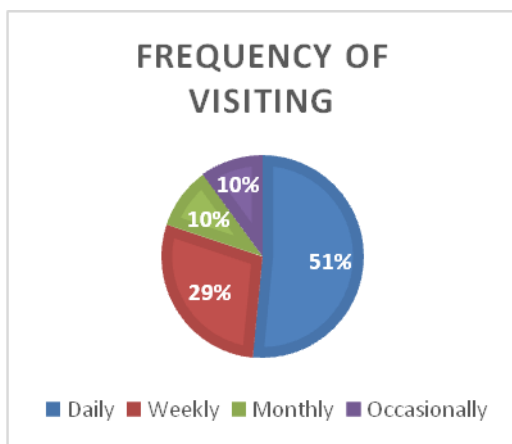
(a)



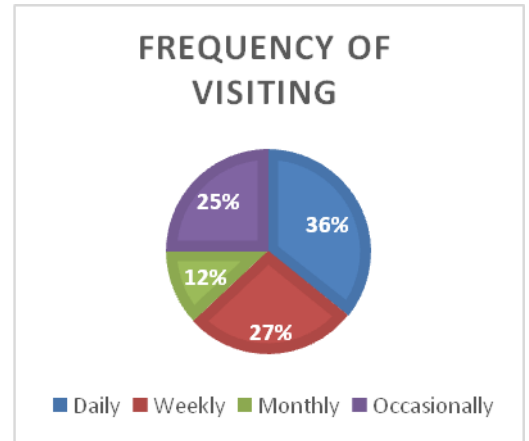
(b)

Figure 4 (a) 2W, (b) 4W: Policy 2

Above figure indicates that most of the commuters have trip length of 4-7 km. The distance commuters are 55%, 44% for 2W, 4W of the total sample respectively.



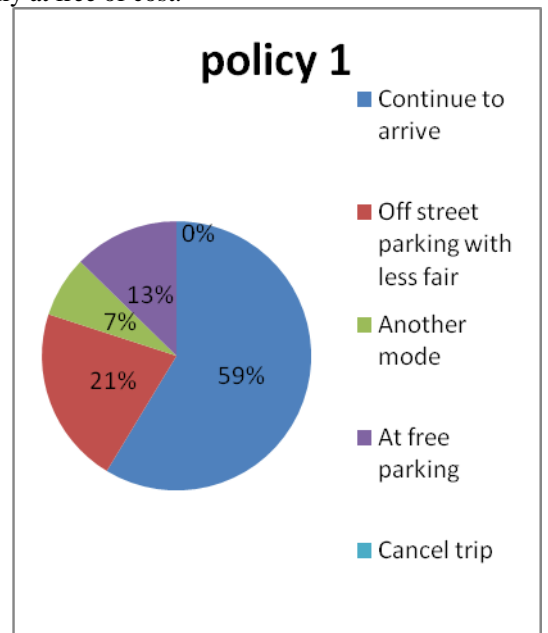
(a)



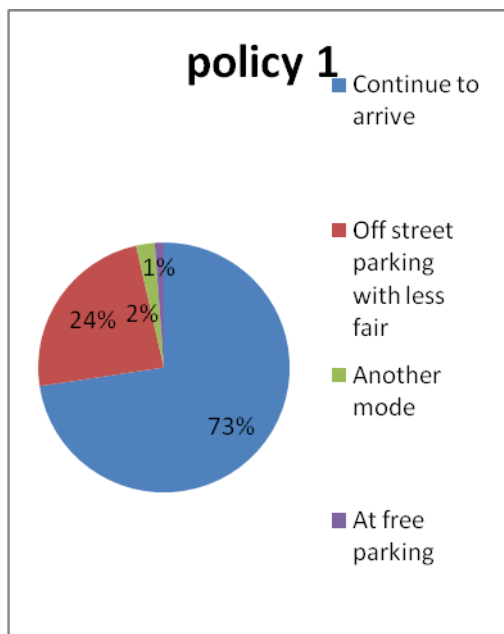
(b)

Figure 5 (a) 2W, (b) 4W: Policy 2

Figure indicates that average 44% (average of 2Wheelers and 4Wheelers) of passengers travel daily, 28 % travel weekly and 11 % travel in a month while 17 % travel occasionally or yearly. It shows that work trip is higher as compact to other trip. Above 44 % commuters are regular visitor of the CBD area which are occupying the parking space daily at free of cost.



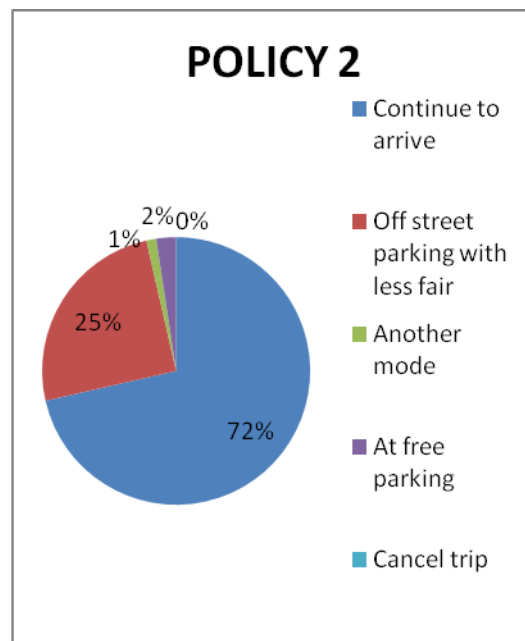
(a)



(b)

Figure 6 (a) 2W, (b) 4W: Policy 2

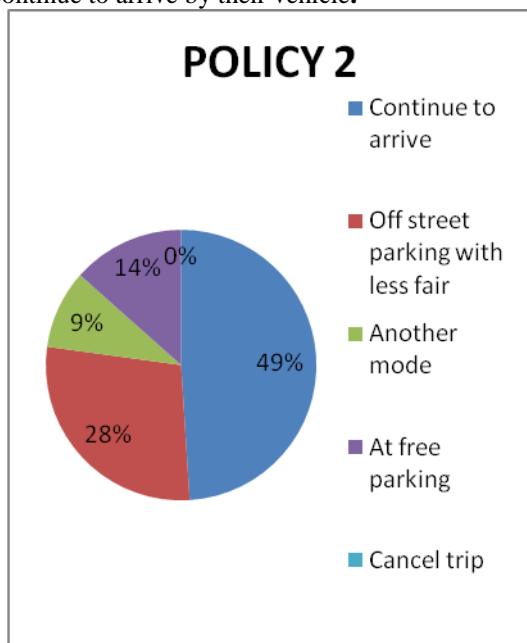
Above chart results shows that most of the vehicle users are ready to pay the parking charges as per shown in above table and will continue to arrive by their vehicle.



(b)

Figure 7 (a) 2W, (b) 4W: Policy 2

Above chart results shows that most of the vehicle users are ready to pay the parking charges as per shown in above table and will continue to arrive by their vehicle.



(a)

VIII. Conclusion

1. People have given positive response to proposed paid parking policy with regard Time Restriction and hence it can be stated that it can be an effective tool for management of parking demand.
2. This policy may be effective for the Vadodara city and it is also effective for the city having a same population growth rate.
3. Government can generate revenue from this policy.
4. Travel parameters like trip length, frequency of trip and walking time from parking to destination have identical significant for response to paid on-street parking policy.

IX. References

1. Daniel B., "The Effect of Free parking on Commuter Mode Choice: Evidence from travel Diary Data", TRB Publication (2000).
2. De La S., "Comparison of On-Street Parking Management in Ermita-Malate Manila and Makati Central Business District", University-Manali, Proceedings of the Eastern Asia Society for Transportation Studies, Vol.9 (2013).
3. Deo C., and Mbakisy O., "Optimization of Short Term "On-Street Park-Pay" License Plate Surveying", Journal of Infrastructure Systems (2011).
4. Dueker K., Strathman j., Bianco M., "Strategies To Attract Auto Users To Public Transportation", Transportation Research Board. National Academy

- Press: Washington, Dc, Transit Cooperative Research Program Report40 (1998).
5. IRC: SP: 12
 6. Michael M. and Shoup D.,” Parking, People, and Cities”, ASCE (2005).
 7. Pierce G., Shoup D.,” San Francisco park: Pricing Parking by Demand.”(2013).
 8. Shoup D.,” The Price of Parking on Great Street”, Parking TodayVolume14. (2009). Weil and Xiuyuan Z., “Analysis of Parking Fee Effect on Travel Behaviour in A Downtown District”, Transportation and Development Innovative Best Practices (2008).
 9. William H., Zhi-Chun L. And Hai-Jun H., “Modelling Time-Dependent Travel Choice Problems in Road Networks with Multiple User Classes and Multiple Parking Facilities”, Transportation Research Part B 40 (2006).
 10. Yoram S. and Rachel B., “Modelling the Response to Parking Policy”, Transport Research Board and In Publication in Transportation Research Record (2000).
 11. www.urbanindia.nic.in
 12. www.googlemaps.com