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Analysis of Parking Trends and Design of an off-Street Parking System and Implementation of Management Solutions on J.M. Road, Pune

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Abstract- **A sprawling complex of industrial suburbs has developed around the city of Pune. Large factories producing a wide variety of products are distributed along the roads radiating from Pune. The study area of Jangli Maharaj Road in Pune is one of the most commercially active centres of Pune. Many small industries, commercial businesses, restaurants and residential area are found on both sides of the road. This study is mainly focused on the demand & supply of parking system analysis in the area. Existing parking accommodation, parking demand, parking management, parking types are analysed on the base of manual count survey. On-street parking spaces have been surveyed to find out the actual measurement of the demand & supply of parking in the study area. Some specific purposes are determined for which the illegal on-street parking is increasing day by day. The demand - supply ratio is found out in data analysis part.**

I. INTRODUCTION

The old city of Pune is largely residential and commercial. The study area of JM Road in Pune is one of the most commercial active centres of Pune. Many light industries and commercial businesses and residential area are found by the both side of the road.

It starts from the Sancheti Hospital Intersection at Shivajinagar, a suburb of Pune, and stretches up to Deccan Gymkhana where it ends at the Garware Bridge at Shivajinagar. J. M. road has a large number of consumer outlets and showrooms on this road. A large public garden called Sambhaji Park occupies a large section on one side of the road. There are many small businesses as well as large commercial spaces on both sides of the road. JM road is the house to many eateries, mobile shops as well as clothing stores. A statue of Rani Laxmibai of Jhansi in Bal Gandharva Chowk is a landmark on this road J. M. road is one of the busiest places in Pune. Jangli Maharaj road is not only the first 80 feet road but also the first tar road in the city of Pune.

II. STUDY METHOD

The study method for the project is a mixed method. The research is conducted by both manual count survey and public questionnaire survey. The manual count survey accounted for a total of 9 days (6 weekdays and 3 weekends). The survey was conducted from 8am to 10 pm on all the days. Primary data was collected from this survey.

The public questionnaire survey consisted of questions designed to understand the view of the public. Questions were related to current parking situation as well as future scope of off-street parking system. A total of 100 people were accounted for the public questionnaire survey. The collected data was input in the form of excel sheets and was analysed. Analysed data was represented in the Pie charts and Curve graphs.

III. PARKING SITUATION OF STUDY AREA

Pune, formerly Poona, is the second largest city in the state of Maharashtra and eighth largest metropolis. The city extends up to the limits of Pimpri-Chinchwad. The population of Pune is 3.5 million. The vehicular population is greater standing at 3.62 million vehicles (Source: The Economic Times). As per the RTO of Pune and Pimpri Chinchwad daily registration of vehicles in Pune amounts to 700-750. The above number includes all the various types of vehicles permitted.

This increased vehicular population results in traffic congestion on the streets Pune. Also due to restriction of parking spaces it gives rise to illegal parking, haphazard parking, and parking on footpaths. These problems are growing in the CBDs of Pune such as JM Road. JM road is host to many small scale businesses such as road side eateries, hotels, mobile shops etc. Being a commercial area the parking demand on the street is higher than the supply for most of the time.

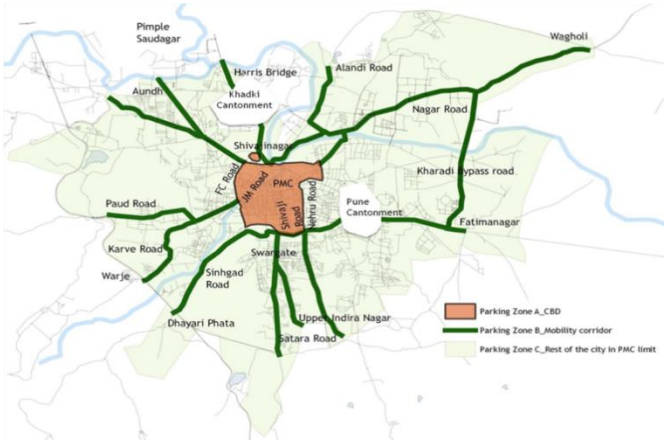

Fig. 2. CBD Area Of J.M. Road Pune

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IV. CONCEPTUAL FRAMEWORK

Parking facilities are a major part of traffic engineering. Most of the public accesses public areas, commercial centres and urban areas via vehicles; mainly cars and bikes. The feasibility of these areas depends on the parking facility in the area.

A. On - Street Parking

The word actually explains itself, On-street parking means parking your vehicle on the street, anywhere on or along the kerb of streets, in contrast to parking it in a parking garage.

B. Off-Street Parking

Off-street parking means parking your vehicle anywhere but on the streets. This includes parking on drive-ways, basements, garages etc.

C. On-Street Parking Capacity

The number of parking spaces available shows the accommodation parking behaviour of the area. Parking capacity = planning capacity + actual parking capacity.
Planning capacity: Total parking spaces in the study area.
Actual Parking Spaces: Number of parking spaces which can be actually accommodated in actual parking and management.

Parking Demand and Supply Analysis
In the parking survey study, the on-street parking capacity or the supply of the study area was found out to be as follows:
For Cars: 139 units
For Bikes: 317 units
The above number was determined by counting the number of legal vehicles on JM road. The vehicles are parked in a parallel manner with equidistant spaces between all the vehicles parked.

TABLE I. Parking Supply and Demand for Cars

Demand/Supply for Cars			Day - Monday
Date	Allowed cars	Total cars	D/S for cars
8-9 am	139	56	0.4
9-10 am	139	89	0.64
10-11 am	139	112	0.8
11-12 pm	139	141	1
12-1 pm	139	142	1.02
1-2 pm	139	160	1.15
2-3 pm	139	174	1.25
3-4 pm	139	155	1.55
4-5 pm	139	133	0.95
5-6 pm	139	155	1.11
6-7 pm	139	154	1.1
7-8 pm	139	167	1.2
8-9 pm	139	194	1.39
9-10 pm	139	203	1.46

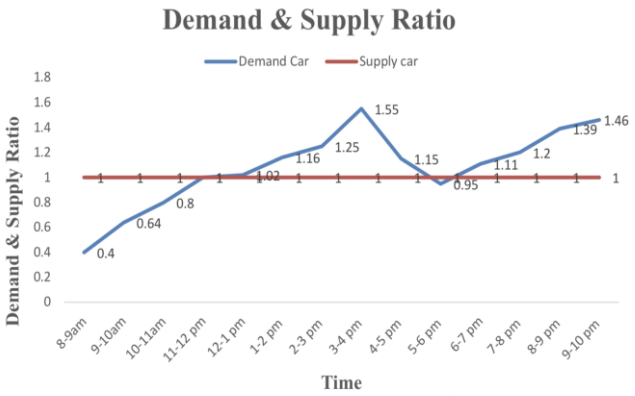

Fig. 2. Parking Supply and Demand for Cars

TABLE II. Parking Supply and Demand for Bikes

Demand/Supply for Bikes			Day- Monday
Date	Allowed bikes	Total bikes	D/S for bikes
8-9 am	317	187	0.59
9-10 am	317	376	1.18
10-11 am	317	401	1.26
11-12 pm	317	424	1.33
12-1 pm	317	429	1.35
1-2 pm	317	456	1.43
2-3 pm	317	498	1.57
3-4 pm	317	490	1.54
4-5 pm	317	489	1.54
5-6 pm	317	476	1.5
6-7 pm	317	499	1.57
7-8 pm	317	494	1.55
8-9 pm	317	372	1.17
9-10 pm	317	364	1.14

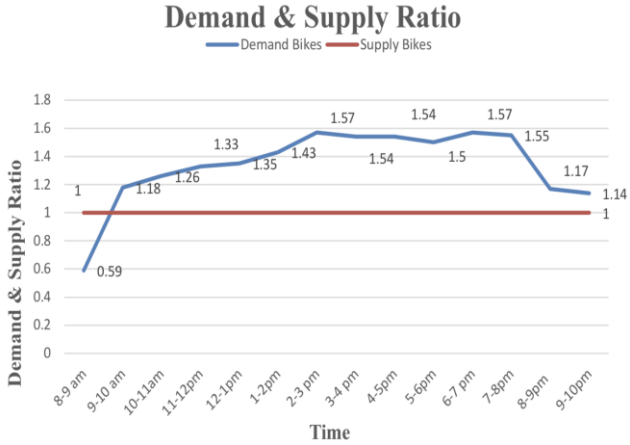

Fig. 3. Parking Supply and Demand for Bikes

V. ANALYSIS OF PUBLIC QUESTIONNAIRE SURVEY

The public survey questionnaire consisted of 8 questions related to parking issues on JM road. The results are displayed in the form of pie charts are follows.
Q1) How frequently you use the public parking system?

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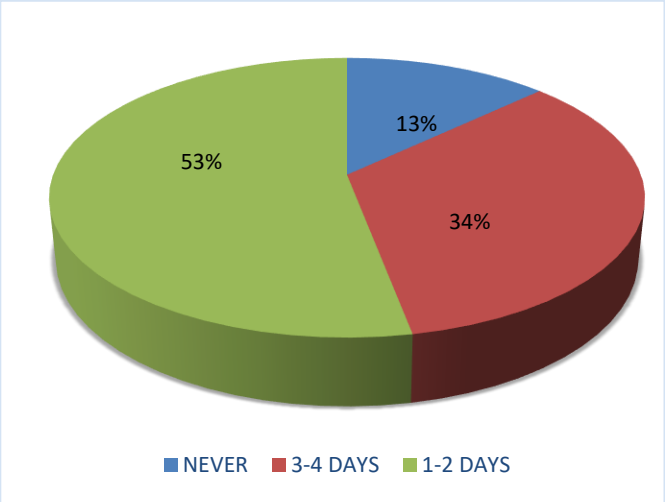

Fig. 4. Pie Chart for use of public parking system

Q2) For how long do you park your vehicle?

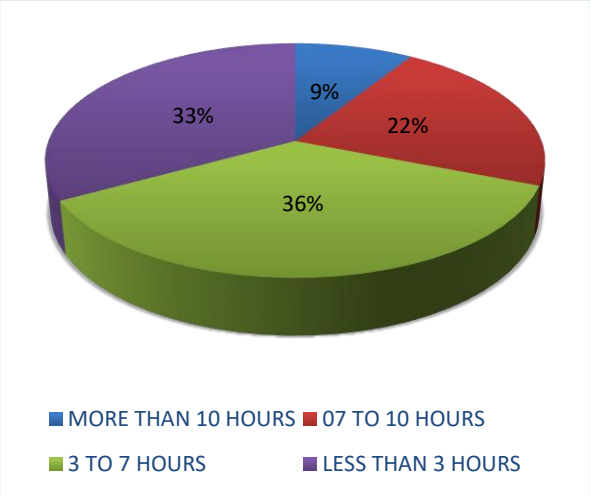

Fig. 5. Pie Chart for parking of vehicles as per hours

Q3) Rank according to your importance.

A) Quality of an Off-Street Parking System.
   1st Rank – 30%
   2nd Rank – 25%
   3rd Rank – 17%
   4th Rank – 28%

B) Convenience of the Off-Street Parking system
   1st Rank – 23%
   2nd Rank – 30%
   3rd Rank – 39%
   4th Rank – 8%

C) Cost of an Off-Street Parking System.
   1st Rank – 9%
   2nd Rank – 20%
   3rd Rank – 22%
   4th Rank – 49%

D) Safety of Off-Street Parking system
   1st Rank – 38%
   2nd Rank – 25%
   3rd Rank – 22%
   4th Rank – 38%

Q4) What is the severity of the traffic congestion if any, when vehicles slow down to search parking spaces.

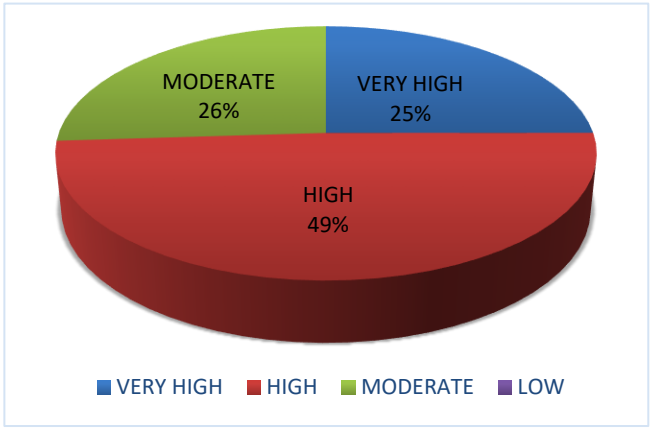

Fig. 6. Pie Chart for severity of traffic.

Q5) Availability of on-street parking space in the study area.

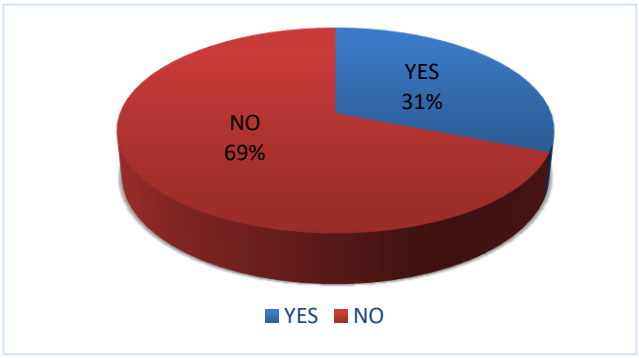

Fig. 7. Pie Chart for availability of parking space

Q7) If an Off-Street Parking system available in your vicinity would you prefer to use it?

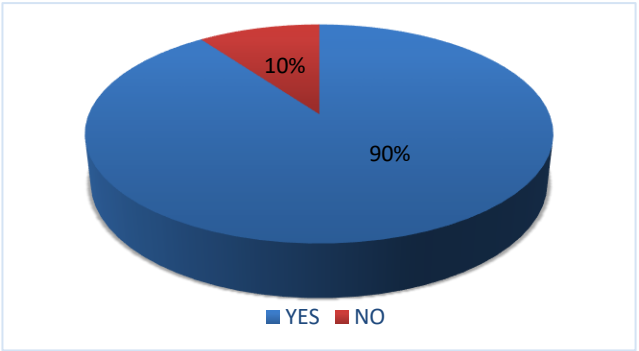

Fig.8. Pie Chart for the preference for the use of off-street parking

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Q8) Are you willing to pay parking charges for Off-Street Parking if any?

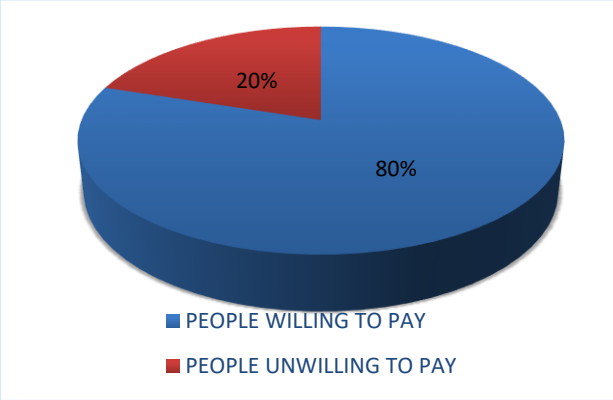

Fig. 9. Pie Chart for payment of parking charges.

VI. RESULTS AND FINDINGS FROM THE SURVEY DATA

After the analysis of data, it was seen that there is a need for off-street parking at JM road. As the demand/supply ratio showed that the demand was always greater than the supply. For this the area which was surveyed was given a trial of different design and possibilities. As the area was compact, considering all the parameters the design is choose.

The analysis of survey showed that there is need of more parking not only for cars but also for the bikes. Keeping in mind the number of excess cars and bikes and the laws the parking levels was decided.

Accounting to the peak hours and demand supply it was observed that at particular peak hours there will be a great need of this parking. It is expected that it will fulfil the particular need. The use of the off-street parking will be partly depended on the strict enforcement. It is mainly important for on-street parking, particularly at bus routes and main road. It may lead to public dissatisfaction at strict imposition of parking regulations at beginning, but once it is made clear through public education campaigns that parking illegal is not right and strict actions are taken by the police, overtime it may bring a change in perception of people. This in return requires that these regulations remain fair, uniform and public friendly.

VII. SELECTION OF TYPE OF OFF-STREET PARKING SYSTEM

1. The parking system optimum for the plot area is Semi-automatic parking system
2. The reason behind it was that out of the three parking systems ramp systems require more space though it has less cost.
3. So the only options that are left are automatic or semi-automatic parking system
4. From this automatic system requires more cost as compared to semi-automatic parking system.
5. So semi-automatic parking system is the best option.

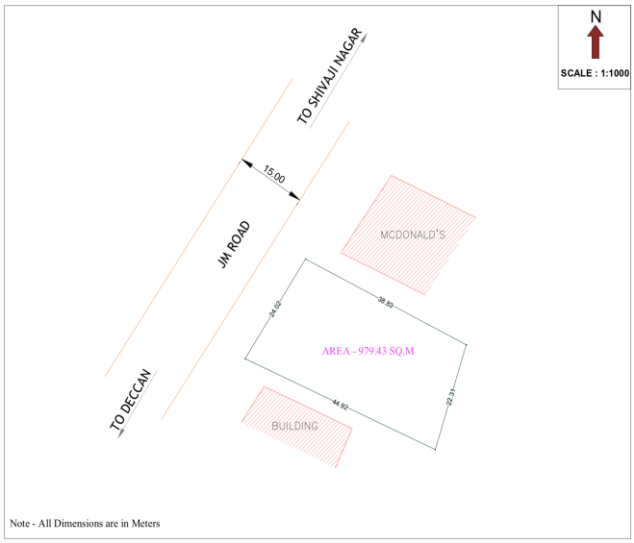

Fig.10. Location Area Survey

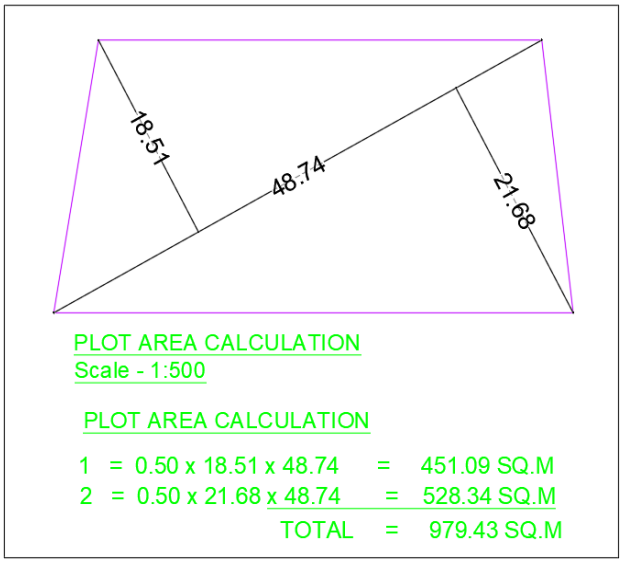

Fig. 11. Area Calculation

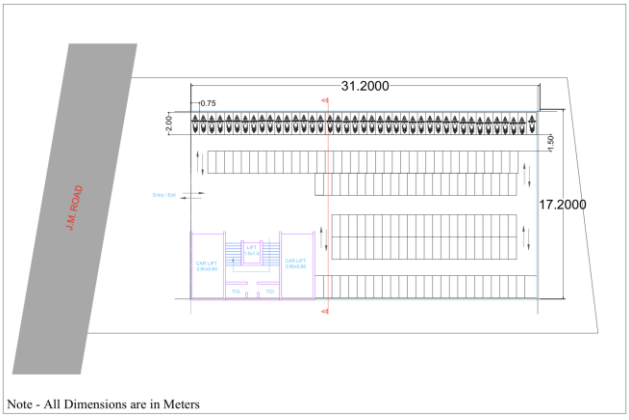

Fig. 12. Ground Floor Parking For Two Wheelers

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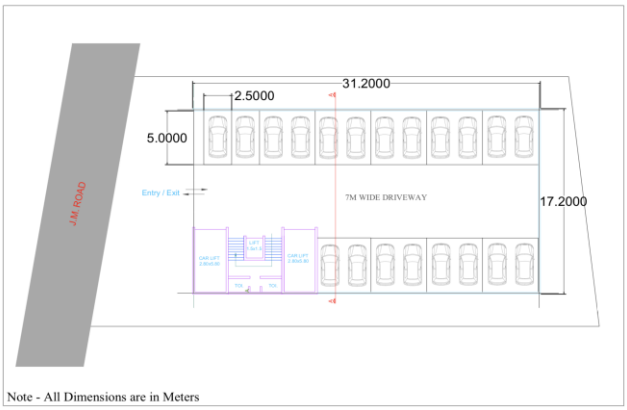

Fig. 13. Remaining Floors and Terrace For Four Wheeler Parking

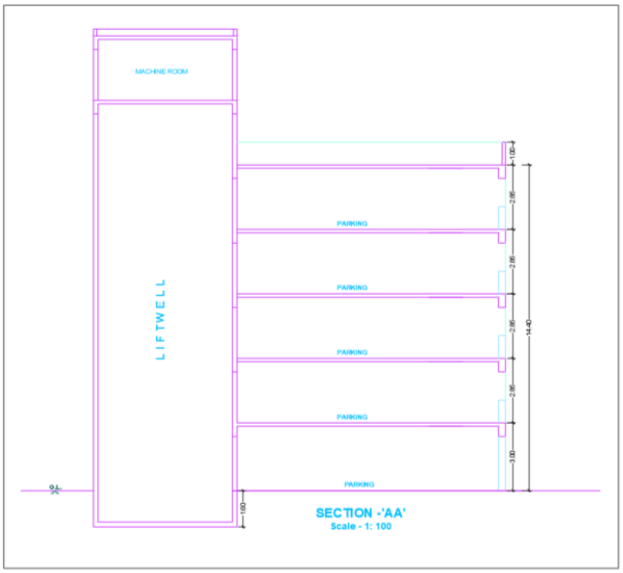

Fig. 14. Elevation of the Off-street Parking System

VIII. FEARTURES OF THE PROPOSED OFF-STREET PARKING SYSTEM

1. Area can be constructed – 3920 sq.m
2. Area use for construction – 2132 sq.m
3. No. of Floors – G+4 and terrace.
4. Four-wheeler parking – 80
5. Two-wheeler parking – 175
6. Lifts – 3
7. Bay size for four-wheeler – 2.5M X 5M
8. Bay size for two-wheeler – 0.75M X 2M
9. Size of Car Lift – 2.80M X 5.80M
10. Size of passenger lift – 1.5M X 1.5M

The second major part of the solution to the parking problem on J.M. road is management solution. Here we have provided solutions that should encourage the people to shift to and off-street parking system or curb the use of personal vehicles. The management solutions are as follows.

PENALTY LEVELS			
ENFORCEMENT INTENSITY		LOW	HIGH
	LOW	UNACCEPTABLY LOW COMPLIANCE	FINES BECOME UNFAIR LOTTERY
	HIGH	FINES TREATED AS PRICE OF PARKING	OVERKILL

SWEET SPOT

Fig. 15. Matrix for Parking Management

A big part of management solutions is to have stricter law enforcement and increase of parking penalties. It is one of the most common and efficient solution if we want to curb on-street parking. The above matrix considers the two most important parameters i.e. enforcement intensity and penalty charges.

The most perfect solution to the matrix is to obtain the perfect match between the whole matrix.

The matrix comprises of 4 main combinations.

A) Low Enforcement, Low penalty:
This might be the current situation on JM road. As a result there is huge excessive parking taking place on JM road.

B) Low Enforcement, High penalty:
This scenario would result in an unfair lottery system. Here the few people who are caught violating traffic rules would have to pay a huge sum of money as fine. In contrast people who are lucky would slip past the law enforcement evading the penalty.

C) High Enforcement, Low penalty:
This situation might create a casual attitude towards penalties. The people who are being penalized might consider the penalties as a parking fee and may not feel any problem to pay the low penalties.

D) High Enforcement, High penalty:
This is a highly compliant situation but it'll result in excessive cost to city.

IX. THE MOST OPTIMUM SOLUTION TO THE MATRIX

The matrix is a system to set the parking fares for on-street parking. As per Paul Barter any parking facility should have a 15% of free board for various purposes. Hence the maximum capacity of a parking facility it at its 85%. From the above data we can see that at its peak the D/S ratio reaches at 1.55. It means there a need for 70% of excess parking. As for bikes there is 72% of excess parking. Some of this excess parking can be diverted to the off-street parking system which is being designed. The remaining percentage of vehicles users can be encouraged to use public transport system and non-motorized transport by imposing

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regulations/management solutions with the help of the parking management matrix.
The optimum solution to the matrix will be bridging the gap in between the 4 categories. The solution is likely to be when there is high enforcement of law and the penalty for illegal parking is not too high but just above average. The penalty should be charged such that people would think twice or hesitate to park their vehicles illegally.

1) Proper parking of vehicles:
   A simple habit of parking the vehicles in a proper manner can help curb the traffic congestion and also may create space for more vehicles to fit in the spaces.
2) Fixed space for loading and unloading docks:
   Presently on JM road there no fixed zone for loading/unloading docks. The goods carrier trucks/tempos stop according to their convenience and use the space occupied for an undetermined period of time. This not only reduces the available parking, but also causes hindrance to the traffic flow on the road. Fixed zones for carrier vehicles will ensure availability of open parking spaces as well as smooth traffic flow.
3) Improve information for motorists:
   Create sign boards, indicators and other information resources indicating parking availability and price.
4) Reduce automobile dependency and encourage public transportation alternatives:
   This can be achieved by improving the availability, accessibility and condition of our public transportation system such as convenient bus routes, metro routes etc. Also discounted rates of public transit system will further add to the encouragement.
5) Create time-oriented parking zones:
   The on-street parking system should be divided in zones of time such as a parking space can be used only for specific hours of the day otherwise the vehicle maybe towed or fined. It discourages “sleeper parking”. Sleeper parking is the phenomena where employees in the area may constantly shuffle their vehicles and take up the free parking spaces which can be used by visitors.
6) “Cashing out” the value of parking:
   Encourage the employers to participate in this program, where he/she would get fully or partially subsidized parking offer in return to give up their parking space for exchange of its monetary value.

7) Time limit for load/unload zones:
   For businesses with quick turnarounds (ATMs, Drycleaners, Passenger Cabs and Delivery vehicles) a certain time limit should be imposed. This will discourage use of on-street parking for excessive hours.

X. CONCLUSION

1) There should be reduction in parking on-street and the vehicles to be parked should be diverted towards the off-street parking being designed.
2) Imposing of stricter norms will definitely curb excessive parking to an unknown extent.
3) It will reduce average vehicle kilometres. Time of travel will also be reduced.
4) Off-Street parking will generate revenue for local governing body.
5) There will be increase in on-street parking space which may be used for various purposes, this would help in reducing congestion and the problem in finding the parking space.
6) This will also promote public transport system and non-motorized transport.
7) All of this will be beneficial towards the city financially as well as environmentally, creating a smart city.

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