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## IMPROVEMENT OF PARKING FACILITY FOR SUBURBAN MUMBAI REGION (RAILWAY STATION)

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**Abstract:** The use of vehicles is increasing unprecedentedly, thereby increasing the need for parking spaces. The current scenario of parking facilities has resulted in illegal parking on the road, which ultimately reduces the effective use and efficiency of the road, which further leads to traffic congestion. Considering the relevant problem, detailed investigation is necessary, with requirement of a proper installation. This study selected the Naigaon Local railway station as the case-study area. During the field investigation, Naigaon local-railway station was observed to be one of the stations where the parking area is insufficient, especially for two-wheelers. To overcome the problems mentioned above, multi-level parking is required which would allow the vehicles to be parked floor by floor, therefore reducing space. By using the tiered parking plan, parking congestion can be reduced drastically as we can park more than 3000 bikes at the same time, which is much better than the current parking capacity (<500 bikes). And so, the existing parking system is complemented to ensure maximum use of space.

**Key words:** *Parking area, Railways, Public transport, Multistory parking.*

### 1. INTRODUCTION:

The annual growth rate of the urban population during the last two decades has been an average growth of more than 1%. The urban population constitutes a major part of the population, which means that around 50% - 55% live in metropolitan areas. In metropolitan cities, the proportion of two-wheelers was still 75% decades ago, on average, sales of two-wheelers in April-March 2018 grew 12 percent compared to April-March 2017. Within the two-wheeler segment, scooters and motorcycles grew by 27.06 %, 2.85 percent, & 6.51 percent respectively in April / March 2018 compared to April / March 2017. In general, a vehicle remains in the parking lot for 8,360 hours out of 8,760 hours per year (5% of the time of day).

It is a generally accepted fact that the availability of parking spaces should be guaranteed for at least almost 22 hours a day if only the vehicle is in use for two hours out of 24 hours a day. This means that every time a new vehicle hits the road, there is an additional demand for parking in the city. The availability of parking spaces needs to develop more regularly with urbanization and rapid motorization, which means cities are densifying and planning and implementation removes the bottlenecks that future high-density development may be associated with. high space costs. All cities in India face significant parking problems. Due to the anonymous increase in traffic in India, parking along with pollution and poor roads has become a new problem. The demand for parking spaces is an urgent need. This is particularly since the growth of the infrastructure of Indian cities cannot keep up with the increasing demand for parking spaces.

The first question that encounter while explaining project is “what is the need of multilevel parking system?”. The answer for above question would be parking more no vehicles in limited available room and space constraint is the major

objective of this project. Due to lack of parking space accessibility people tend up to park their vehicle on roads or nearby areas of railway station which produce traffic congestion. The lack of dedicated space in urban areas has increased the demand for parking space especially in areas like railway stations because it is the only hub for peoples to migrate from one place to another which provides easy and flexibility for connectivity of various works to carry out.

The MSRDC has provided parking lots at 17 different locations, like JV link road, Sion, Chheda Nagar, Elphinstone Road and Vikhroli, mainly below flyovers. There is a need to build multi-storey parking near railway station as its lifeline for Mumbai to help citizens.

### 1.1 OBJECTIVES:

The objectives of this study are as follows:

- To study existing parking conditions,
- To analyse parking demand of our study area.
- To formulate strategies for better management for parking.

### 1.2 PROFILE OF STUDY AREA:

Various suburban station was assessed to find a particular site which faces a severe congestion of traffic and parking issues for 2-wheelers specially. The major railway stations of Mumbai-megacity and its suburban areas including Vasai, Borivali, Thane, Bhayander, Naigaon, Kandivali and many other sites were visited to investigate the most appropriate site for parking development. Thereafter, Naigaon station was selected as site for parking development.



Fig.1 Satellite view of site (Naigaon railway station)

The field study was carried out at Naigaon railway station parking lot and 250 meters radius around the parking. As per parking studies norms Naigaon railway station is a busy station along the western line on the Mumbai suburban railway. The VVMC bus stop located just in front of the parking station on the eastern side of the suburb which is the point of origin for localities of Naigaon East like Juchandra, Chandrapada, Bapane. Bus services also hand out distant destinations like Vasai and Nallasopara.

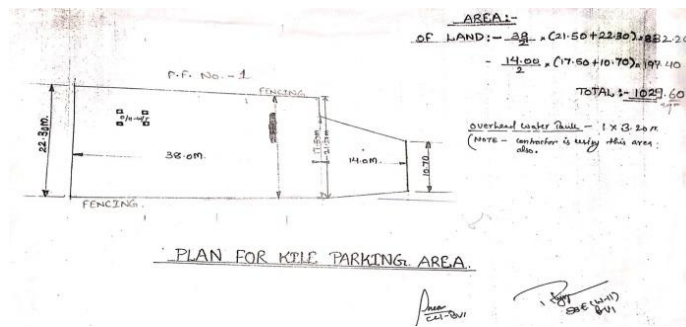


Fig.2 Plot area of site

Fig.2 shows that plot area of the site for which the survey is conducted. It has area of 1029.60 sq.m. with an Floor Space Index (FSI) of 2 which is under railway authority.

### 1.3 Scope of study:

Naigaon station is a developing hub in the context of its major commercial and residential activity, so parking is an important factor to ensure the safe and comfortable movement of the inhabitants of this area. If the actual demand and the existing & actual scenario of the parking system are determined, it can help to ensure an effective parking & sustainable management system for the inhabitants. By this way the Naigaon area can be converted to a well parking facilitated as well as a well transportation management system.

## 2. SURVEY PROCEDURE

The survey was conducted in two stages i.e., Site Reconnaissance Survey and actual survey.

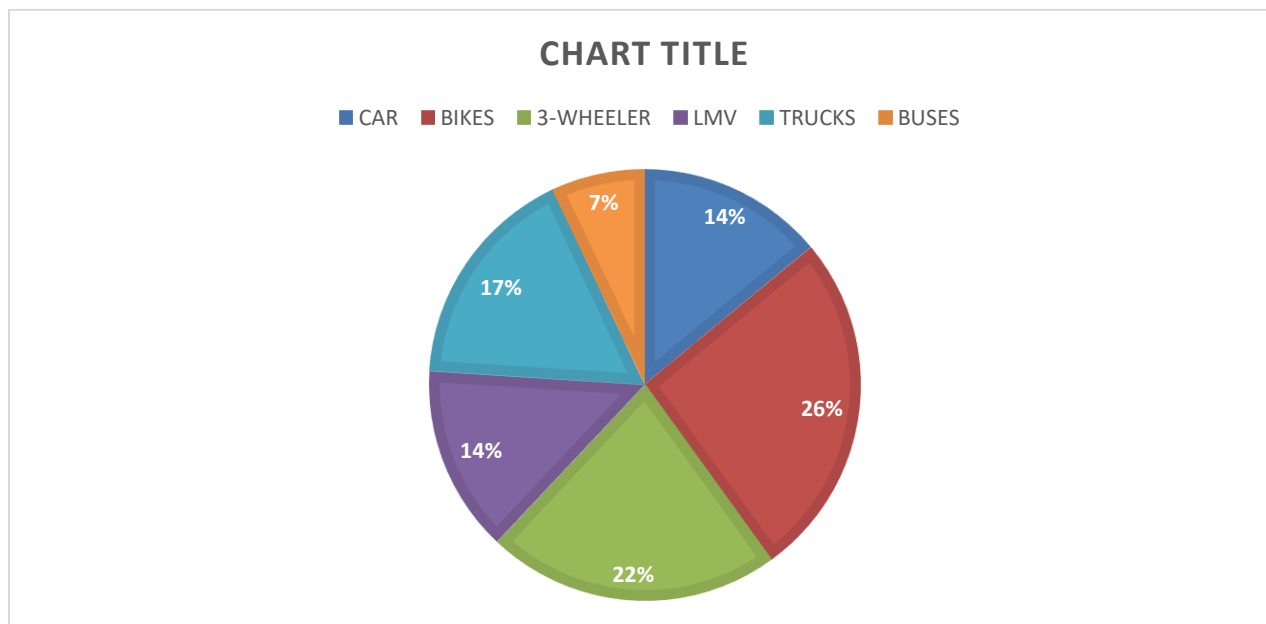
The Site Reconnaissance Survey as shown in fig.2 indicated that the current scenario of the site was observed and the capacity of the site was noted, over loading of the vehicles which are without parking and trying to find the solution for parking maximum vehicles. Further the site was surveyed for 250m radius and found that parking area was separated approx. 1 half by railway section. It was observed that the different lanes which are arriving at the site, were noticed that some lanes were full of parking which were leading to congestion in road system and this problem can be easily solved by giving parking place. Then the lanes were combined into several combinations like 1-7, 2-8, etc as per the requirements of survey.

The actual survey was done by parking usage survey by patrol. Under actual survey parking area count, lanes count, and classified vehicles count, these three counts were successfully completed with the help of local students and few labours. They were divided into three batches. Survey conducted was of 15 hours according to the norms including peak hours. The day selected for survey was a midday which was unaffected from any public holidays, or any other factors. The survey was conducted on 18th Dec 2019 from 7.00 am to 9.00pm.

Each group was asked to perform the parking survey on street as well as off street. For records. The license plate numbers were also recorded. The survey volunteers were allotted in each lane, on every half an hour group of people were allotted to take a round of entire lane and taking record of each 2-wheeled vehicle parked in lane. For every next half an hour again another group of volunteers were allowed to take readings of the whether a particular vehicle is present at same location or not. Thus, finding particular vehicles parked for number of hours at a particular lane.

### 3. Data Analysis / Output

#### 3.1 CLASSIFIED VOLUME COUNT:



**Fig.3 Classified vehicle count.**

Classified volume count was carried out for the full duration to know the traffic composition. It was carried out manually by group of 3 students on the main road opposite to the parking lot for interval of 5 minutes. It was simultaneously carried at all the students to understand the loss of vehicle in between if any. It was seen that maximum 3-wheelers and 2-wheelers were seen.

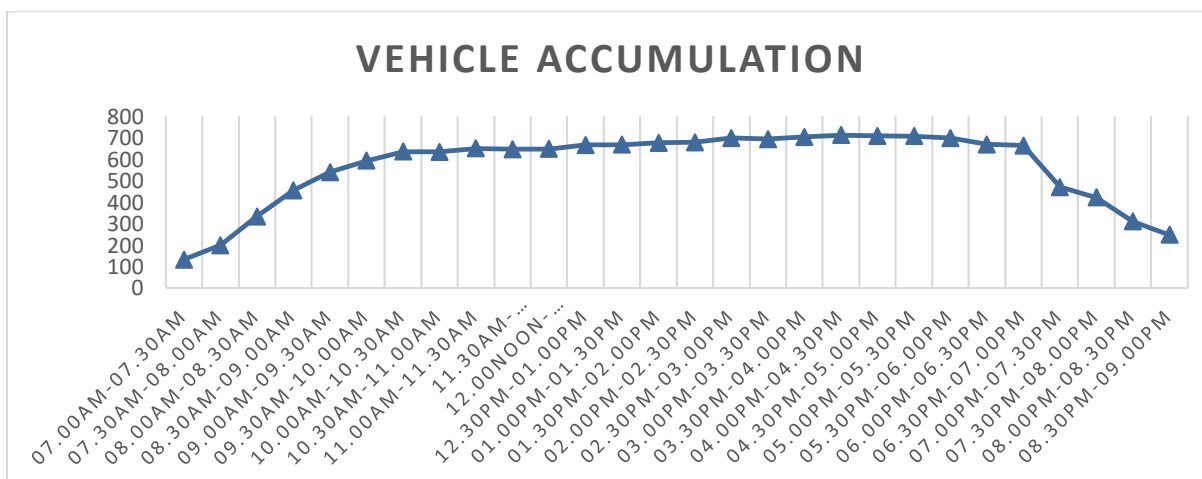
### 3.2 PARKING CHARACTERISTIC:

After surveying for 15 hours data was analysed and number of vehicles requiring spaces for parking was counted. Accordingly, pie chart for classified vehicle count, time v/s no of vehicles accommodation was made.

**Table 1. Vehicles Accumulation.**

TIME DURATION	VEHICLE IN	VEHICLE OUT	VEHICLE ACCUMULATION
07.00am-07.30am	143	21	132
07.30am-08.00am	214	8	206
08.00am-08.30am	345	11	334
08.30am-09.00am	465	9	456
09.00am-09.30am	542	1	541
09.30am-10.00am	596	2	594
10.00am-10.30am	637	1	636
10.30am-11.00am	639	4	635
11.00am-11.30am	652	1	651
11.30am-12.00noon	650	2	648
12.00noon-12.30pm	655	6	649
12.30pm-01.00pm	669	2	667
01.00pm-01.30pm	674	5	669
01.30pm-02.00pm	681	3	678
02.00pm-02.30pm	689	4	685
02.30pm-03.00pm	698	2	696
03.00pm-03.30pm	697	7	690
03.30pm-04.00pm	702	1	701
04.00pm-04.30pm	712	1	711
04.30pm-05.00pm	714	7	707
05.00pm-05.30pm	712	3	709
05.30pm-06.00pm	707	7	700
06.00pm-06.30pm	695	15	670
06.30pm-07.00pm	685	16	669
07.00pm-07.30pm	584	115	469
07.30pm-08.00pm	506	86	420
08.00pm-08.30pm	413	109	304
08.30pm-09.00pm	327	92	235

Following is the data calculated and from this table the maximum capacity of the existing parking lot can know which comes nearby to 700 vehicles at optimum capacity.



**Fig.4 Vehicle accumulation.**

Above figure shows the number of a vehicle which are entering, and which comes out of the parking area which results in the accumulation of number of vehicles which are being parked for number of hours. Thus, resulting in the highest number of vehicles i.e., 713 from 4.00pm to 4.30 pm and the lowest count of the area resulted to be 132 from 7.00am to 7.30am. It was assumed that more than 150 vehicles were send back as there was no space for parking in parking lot.

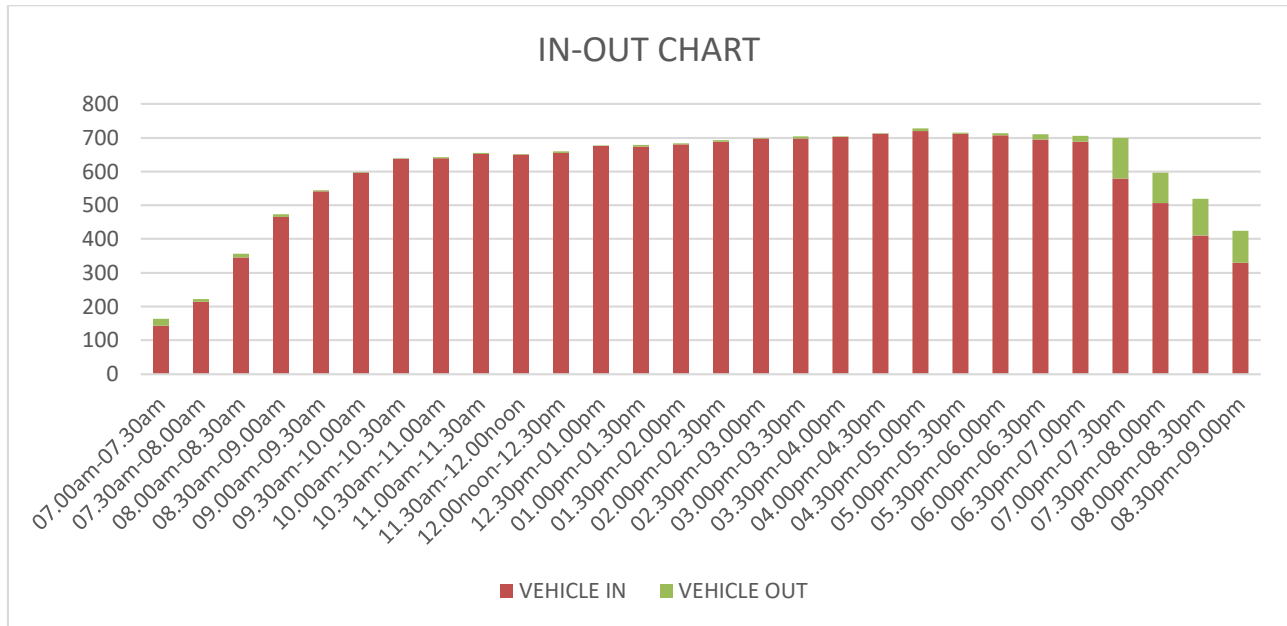


Fig.5 Time duration v/s in-out number of vehicles.

Fig.4 shows the number of vehicles entering the parking lot and the number of vehicles coming out of parking lot from every half an hour slot. It shows that that there is maximum intake of vehicles in morning hours and maximum outcome in evening hours i.e., from 7.00 am to 8.00am and 6.30pm to 8.00pm respectively. Its shows that already more than 100 vehicles are parked before the survey were started.

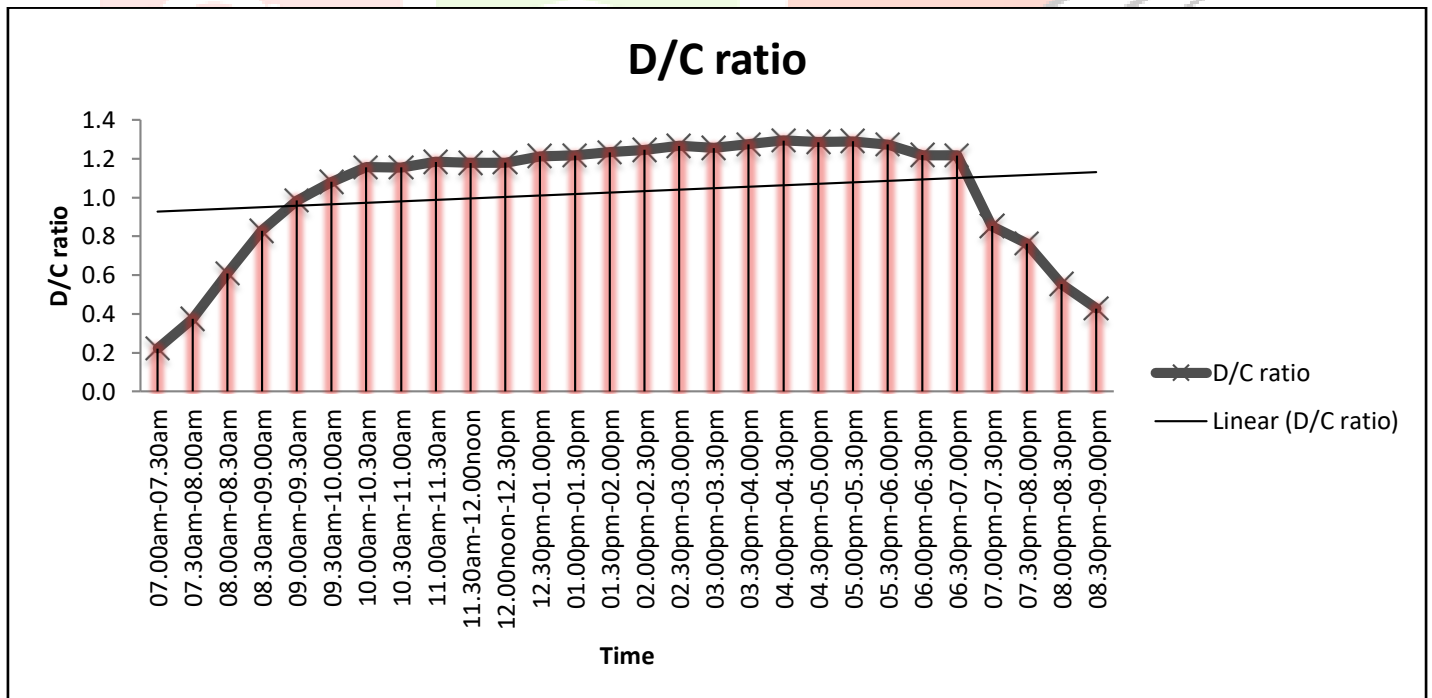
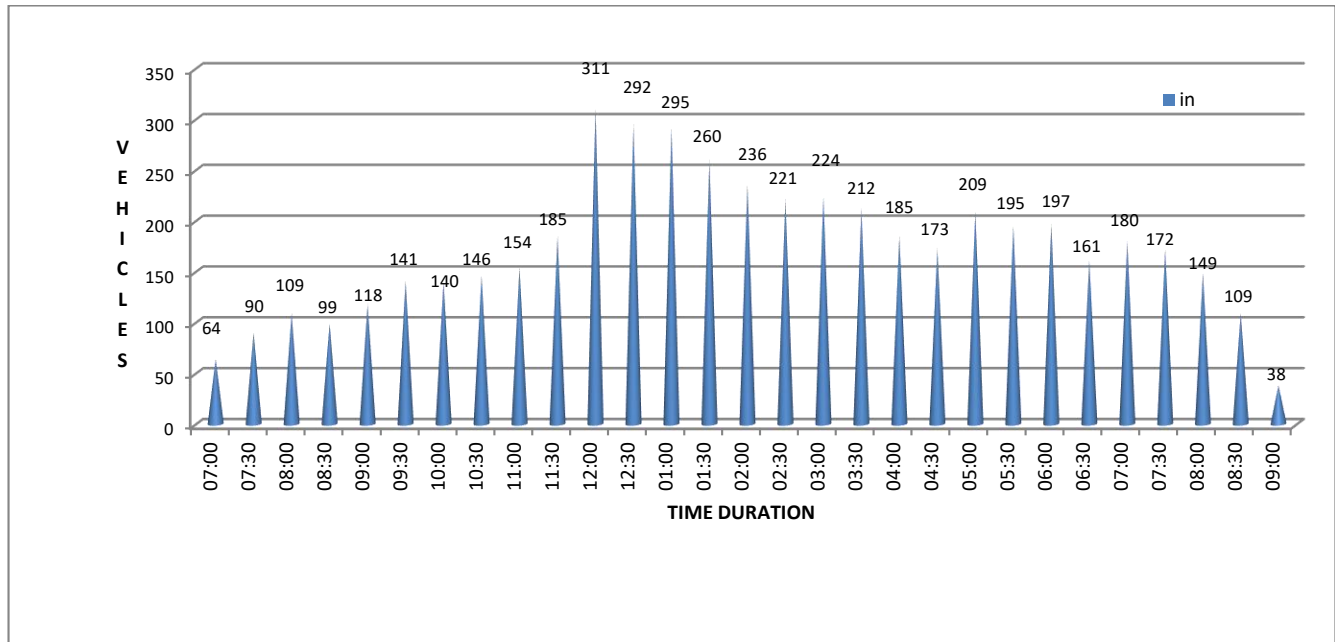


Fig 6. Demand to Capacity Ratio

The above graph states the existing parking system after 9.30 am the demand is beyond the capacity or the inventory available to fulfil the demand up to 7.30 pm in the evening. The field survey showed that the average demand of parking is more than the actual supply with a demand-supply ratio of 1.42 during peak hour, therefore indicating the lack

of parking facilities in existing setup of Naigaon station area. Therefore people are forced to park their vehicles on the street either willingly or in absence of enough parking facilities.



**Fig.7 Vehicle accumulation in lanes.**

The above figure shows the total count of the vehicles parked in the area each lane. This bar chart shows that from 12.00 noon to 1.00 pm there is maximum peak of 311 vehicles parked in all lanes, indicating congestion and thereafter disrupting the government public transport system.

The on-streetcar parking causes traffic due lack of pavement width available for traffic movement and also causes hindrance to the flow during parking manoeuvre.

**3.3 PARKING DEMAND:**

As it has been analysed from the survey data that in parking lot area even on having only capacity of 550 vehicles per day, the present scenario shows that around 711 vehicles are parked at peak hour and on an average more than 150 vehicles are not allowed to park because of insufficient place of parking in addition to 311 number of vehicles parked in lanes which leads to congestion. For proposing any facility to the above demand, we need to analyse the futuristic growth of traffic in that area. As Naigaon comes under Vasai-Virar Administration we have derived the futuristic growth rate of traffic for Palghar District which will assure us with the increasing demand of parking facilities in such areas. A simple linear regression model was performed considering traffic growth as independent variable and per capita income as dependent variable to estimate the growth rate of 2- wheelers.

Table 2. Regression Analysis

REGRESSION OUTPUT FOR TWO WHEELERS								
<i>Regression Statistics</i>								
Multiple R	0.995							
R Square	0.991							
Adjusted R Square	0.989							
Standard Error	0.021							
Observations	6.000							
<i>ANOVA</i>								
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>			
Regression	1.000	0.194	0.194	438.348	0.000			
Residual	4.000	0.002	0.000					
Total	5.000	0.196						
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	-0.285	0.697	-0.409	0.704	-2.219	1.650	-2.219	1.650
X Variable 1	1.202	0.057	20.937	0.000	1.043	1.361	1.043	1.361

Table 3. Projected Annual Traffic Growth.

Sr. No.	Vehicle Type	Projected Annual Traffic Growth Rates											
		Pessimistic Approach				Normal Approach				Optimistic Approach			
		2019-24	2024-29	2029-34	Beyond 2034	2019-24	2024-29	2029-34	Beyond 2034	2019-24	2024-29	2029-34	Beyond 2034
1	2 Wheeler (PCI)	8.10	7.70	6.60	5.30	11.20	10.60	9.10	7.40	14.80	14.00	12.00	9.70

Since the growth rate of vehicles from 2019 to 2024 is 11.2%, the estimated parking requirement escalates up to 2055 vehicles at peak hours, which turns infeasible with existing 550 vehicles facility.

#### 4. Multi Storey Parking Facility Plans

As per the survey analyses, the G+2 with basement multilevel parking is proposed in order to avoid the existing parking challenge.

Table 4. Area for parking

Type	Length	width
Non gear	1.9	0.7
MC with gear (125cc)	1.9	0.6
MC with gear(150cc)	2	0.7
MC with gear(180cc)	2	0.7
MC with gear(200)	2	0.7
MC with gear(220)	2.1	0.7

In the survey it was found that most of the bikes range from 125-180cc, therefore the parking space was considered as 2m x 0.75m.



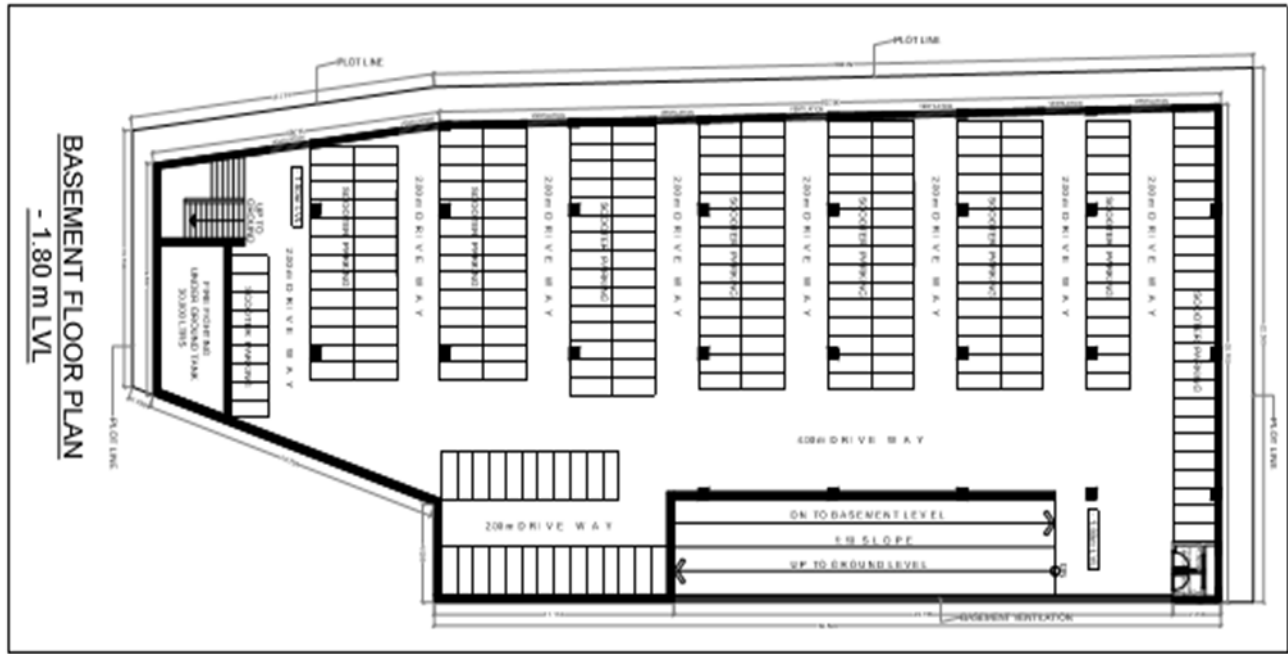


Fig.8 Basement floor plan

Considering the available plot area of 1029.6 sq.m area, planning was executed. With reference to above parking space standard, the capacity of basement floor is planned for 300 bikes with driveway of 2m.

From ground floor to basement, the ramp is provided with slope of 1:10, 2 ramps are provided of 2m width. Staircase is provided connecting basement with ground floor.

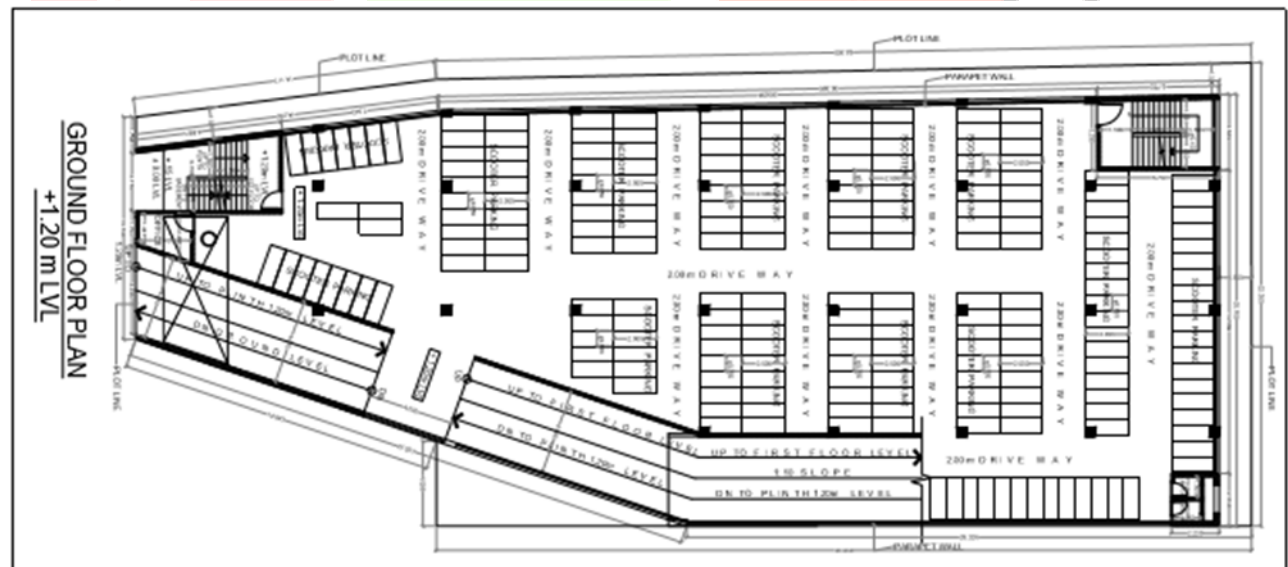


Fig.8 Ground floor plan

As per ground floor planning parking space for 240 bikes is available with 2m driveway. Two staircases are provided i.e., one in front and one in back. Two ramps are provided with slope of 1:10 with 2m width. Office space is provided for official work. Separate toilets are provided.

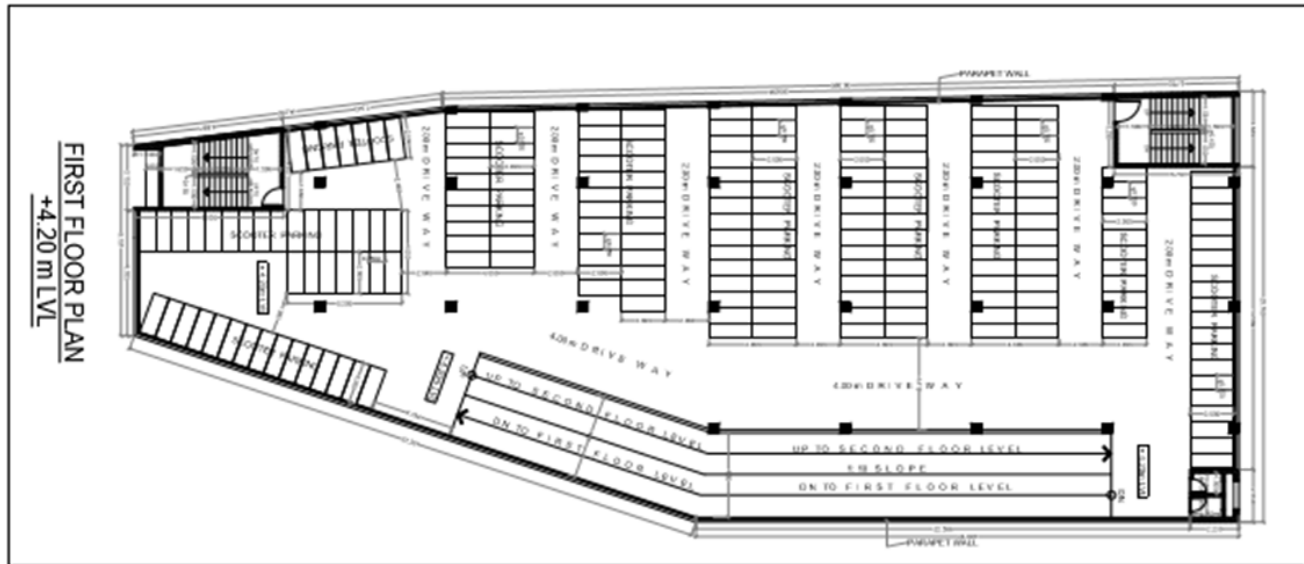


Fig.9 First floor plan & Second Floor plan.

The planning of parking space for 230 bikes is available with 2m driveway. Two staircases are provided i.e., one in front and one in back. Two ramps are provided with slope of 1:10 with 2m width. Separate toilets are provided. Second floor is provided open to sky.

## 5. CONCLUSION

- The average demand of parking is more than the actual supply which get from the field survey.
- The ratio of the demand and supply is 1.42 during peak hours.
- There is no doubt that the lack of parking facilities is already exists in the Naigaon Station area according to the demand of the parking.
- The functionality of the buildings & much intersection of the roads are responsible for which the illegal parking on the roads occurs.
- Based on the analysis it has been concluded that there is huge parking requirement near this station and there is necessity of solution that is multilevel parking.
- The variation of growth of vehicular demand and population multi-storey parking lot is planned which can accommodate minimum of 1000 bikes.
- Also, the cost estimation of the project will be done which will aid government to show interest for investment in parking-related public project. The invested money can be regained by charging vehicle owner for parking on time base.

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