SSUET Parking Facility, A Case Study; Current Scenario, Future Needs and Proposed Solution

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Abstract— **This paper presents results of a study carried out for planning a parking facility in order to mitigate traffic congestion problem on Sardar Ali Sabri Road near Sir Syed University of Engineering & Technology (SSUET) Chowk in Gulshan-e-Iqbal town of Karachi city. American Association of State Highway and Transportation Officials (AASHTO) guidelines were used in planning of the parking facility. The planned parking facility has capacity to accommodate around 700 cars and 2000 motorcycles. A traffic study has been carried out to estimate the space required by vehicles for parking in the SSUET. Data analysis of traffic growth of Karachi city has been performed to study the co-relation between traffic growth rate of Karachi and number of parking vehicles in SSUET. It is found that no such co-relation exists and the city's traffic has no impact on number of parking vehicles in SSUET. It is found that the parameters, affecting growth of parking traffic in SSUET, are number of departments of the university and number of seats per discipline allowed by HEC/PEC. Finally, construction of a parking plaza in SSUET is proposed for improvement of parking facilities.**

Index Terms **–SSUET chowk, Parking facility, Stall angle, Traffic Growth rate, Traffic Forecasting**

I. INTRODUCTION

Parking lots are essential element of any transportation system as they have an impact on the overall performance of the transportation system [1]. SSUET parking area (sports ground) had served, as an important students' activity space (survey, sports etc.) in past. Currently this space is being utilized for vehicle parking activity with a high volume of pedestrian and motorcycle traffic. The presence of vehicles (whether moving or parked) disrupted the student activities and can jeopardize the safety of pedestrians and motor cyclist. The present parking facility of SSUET cannot hold 100% vehicle volume and the vehicles are parked at different places around the university.

Due to the lack of capacity of parking area in university domain, people had to park their cars under the flyover in front of Aligarh Institute gate and motorcycles are parked on Sardar Ali Sabri road which ultimately resulted in frequent traffic congestion near the SSUET Chowk. Therefore, it was necessary to study the parking issue of vehicles of university staff and students.

The objectives of the study are as follows:

a) To identify the causes of parking problems in SSUET
b) To recommend solutions to overcome the congestion and limited parking space

II. LITERATURE REVIEW

Many Studies have investigated the effect of the parking stall angle on the overall efficiency of a parking lot. In other words, optimal stall angle provides the maximum number of spaces for vehicle parking [1]. Some researchers and investigators have given the idea of manual planning and adjustments for finding the most feasible parking pattern. This was aimed to get the maximum utilization of available space by dividing the lot into appropriate number of rectangles and their separate planning [2]. According to a research, the 90 degree stall angle resulted in the maximum number of spaces in most of the cases [3]. In addition, the 75 degree stall angle is the second most efficient orientation for parking facility. Table I shows the results of a study about space efficiency of different stall angles based on manual design.

Table I
Summary of parking space efficiency [3]

Parking Stall Angle (degrees)	Space Efficiency (%)
90	67
75	23
60	8
45	2
30	0

III. METHODOLOGY

A general survey was conducted to get an idea of parking stakeholders' mindset. The scope of survey included the distance which has to be travelled by staff and student to reach the university and the satisfaction ratio of users in current parking scenario. A data collection form is used to obtain the data of current parking condition [4]. A sample of this form is shown in Section IV.

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IV. DATA COLLECTION AND ANALYSIS

A sample of the sheet which has been used for questionnaire survey is given below:

Day: _____

Time_____

Mode used: Car / motorcycle

1. Are you:
   a) Student
   b) Employee
   c) Visitor
2. From which area you have come here?
3. What distance have you traveled?

_____ Kilometers

4. Are you satisfied with existing parking facility?
   ➤ Yes
   ➤ No
5. What problems do you face in parking your vehicle?
_____

6. How can this problem be sorted out?

_____

7. Presently you have to walk long distances. If a better parking facility is provided, would you like to pay some parking fee for that?
If yes how much amount can you pay?
   a) Yes   Amount _____
   b) No

The results of survey have been compiled to obtain a clear vision of the whole scenario. These results are shown in Figure 1 to Figure 4.
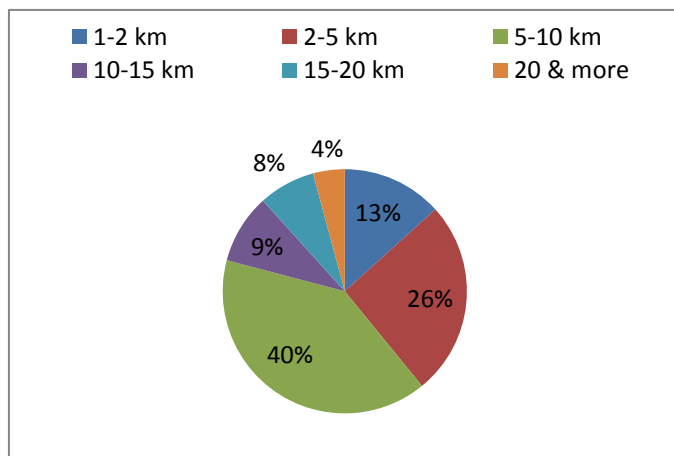

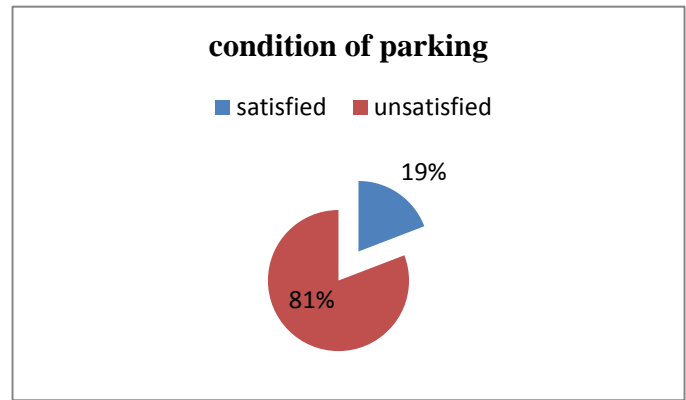Fig. 1. Pie diagram of distance travelled by users to reach the university

Fig. 2. Percentage of user's satisfaction with the existing parking conditions
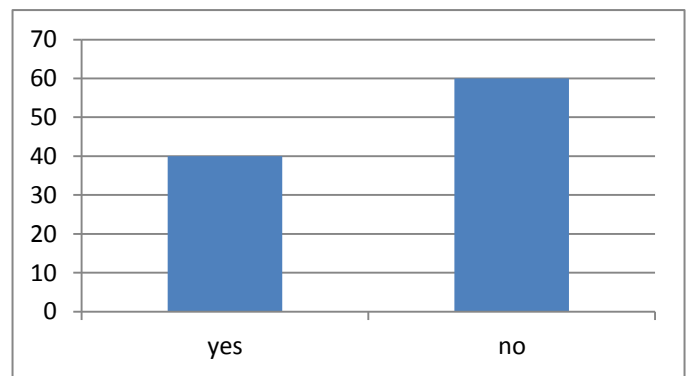

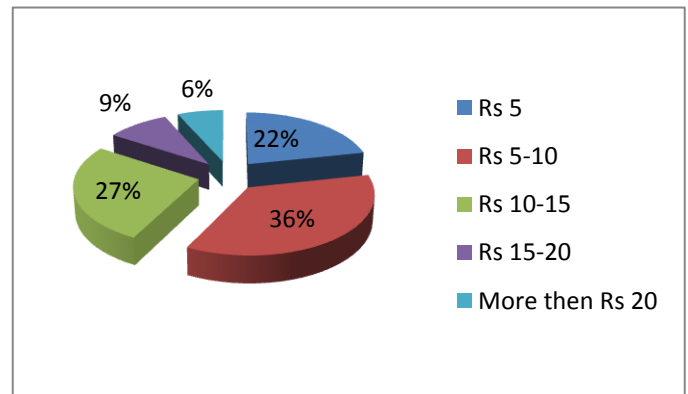Fig. 3. Percentage of user's consent for charged parking

Fig. 4. Parking fee for charged parking as suggested by users

These results have shown that more than 40% users are satisfied if a more convenient parking facility is provided even with a charged parking scheme and 58% users are agreed to pay up to 10 rupees per day as charged parking fee, if available.

V.   PROBLEMS FACED BY USERS

The problems faced by the university staff and students in parking their vehicles as indicated by the survey:
- a)   Long distance from parking to university
- b)   No shades
- c)   No proper sign boards and guidance
- d)   Security problem
- e)   Space Congestion

VI.   SUGGESTIONS GIVEN BY USERS

The suggestions given by the university staff and the students in the survey, to improve the existing parking condition are
- o   Take KHA club on rent for parking
- o   Provision of a parking lot/parking plaza
- o   Provision of shades
- o   Proper marking and guidance for parking

VII.   TRAFFIC COUNT SURVEY

To conduct the traffic count survey, four major locations were selected and total number of bikes and cars were counted as per American Association of State Highway and Technical Officials (AASHTO) traffic count specifications. These four locations include1) SSUET Main Gate 2) Sardar Ali Sabari Road 3) Aligarh ground 4) beneath the fly over opposite to Aligarh Gate. The detailed traffic survey has been conducted twice for three consecutive days (Tuesday, Wednesday and Thursday) and it was conducted in August 2016.

VIII.   PEAK HOUR VOLUME

The peak hour for cars and bikes were recorded as follow
- a)   For cars 12:00 (PM) – 12:15 (PM)
- b)   For bikes 11:45 (AM) – 12:00 (PM)

Maximum accumulation of cars and bikes are shown in Table II showing maximum parking accumulation.

Table II
Maximum number of parked vehicles

Cars	Bikes
420	1252

IX.   TRAFFIC FORECASTING

Table II shows maximum vehicles parked at one time. These numbers of vehicles can be used to estimate the required area of parking facility. But growth rate of traffic should also be studied for forecasting increase in number of parking vehicles [4]. For this reason growth rate of traffic in Karachi and motor vehicle registration record (from Motor Vehicle Registration Department, Sindh Government) of last two years were analyzed. Table III shows the growth rate of registered vehicles in Karachi city for last two years.

Table III
Vehicle registration in Karachi

Months	Volume	Growth Rate (per 6 month)
Dec 2014	3420971	
		0.007930873
July 2015	3610890	
		0.007224313
Dec 2015	3741321	
		0.009118972
July 2016	3980140	
		0.007520087
Aug 2016	4010071	

Table III shows that increase in number of vehicles per annum is on average around 9.3%. On the other hand, the increase in parking vehicles volume in SSUET depends upon the number of registered students and staff members. Furthermore, there is no correlation between the increase in city traffic volume and the university parking volume. To study the demand of vehicle parking of SSUET, the database of university has been studied. Number of employees and students for last five years are considered to estimate the growth rate of vehicle parking in SSUET. Table IV shows the population of university for last five years. From table IV, it is evident that there is no drastic increase occurred in population since 2013 in the university. This is owing to the fact that the number of student has now been limited in each department and batch, in order to comply with the regulations of HEC and PEC. Furthermore, the increase in number of employees is not found noticeable. The average growth rate of the university population is between 1-3%.

Hence, the traffic growth ratio defined by AASHTO, which is 5%, is more reliable in forecasting traffic growth.

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Table IV
Population growth rate of SSUET for the last five years

Year	Batch	Students admitted	Employees	Total	Growth Ratio (%)
2010	2007	1164	1792	7171	-------
	2008	1292			
	2009	1334			
	2010	1589			
2011	2008	1292	1908	7621	6.2
	2009	1334			
	2010	1589			
	2011	1498			
2012	2009	1334	2092	8286	8.7
	2010	1589			
	2011	1498			
	2012	1773			
2013	2010	1589	2187	8338	0.6
	2011	1498			
	2012	1773			
	2013	1291			
2014	2011	1498	2231	8391	0.6
	2012	1773			
	2013	1291			
	2014	1598			
2015	2012	1773	2463	8702	3.7
	2013	1291			
	2014	1598			
	2015	1577			

Forecasting for cars

Table V shows the forecasted results of cars up to the year 2025.

Table V
Forecasting for the cars up to 2025

Forecasting for cars		
Year	Increment per year	Accumulation
2015	-	414
2016	414x0.05=20.7=21	435
2017	435x0.05=21.75=22	457
2018	457x0.05=22.85=23	480
2019	480x0.05=24	504
2020	504x0.05=25.25=25	529
2021	529x0.05=26.45=26	555
2022	555x0.05=27.75=28	583
2023	583x0.05=29.15=29	612
2024	612x0.05=30.6=31	643
2025	643x0.05=32.5=32	675

Forecasting for bikes

Similarly the traffic volume for motorcycles is also forecasted and its results are shown in Table VI.

Table VI
Forecasting for bikes up to 2025

Forecasting for bikes		
Year	Increment per year	Accumulation
2015	-	1244
2016	1244x0.05=62.2=62	1306
2017	1306x0.05=65.3=65	1371
2018	1371x0.05=68.55=69	1440
2019	1440x0.05=72	1512
2020	1512x0.05=75.6=76	1588
2021	1588x0.05=79.4=79	1667
2022	1667x0.05=83.35=83	1750
2023	1750x0.05=87.5=87	1837
2024	1837x0.05=91.8=92	1929
2025	1929x0.05=96.45=96	2025

A detailed accumulated traffic analysis conducted in this study is summarized in Table AI (Appendix-A). This table contains the traffic data for the year 2015 which is further forecasted as described earlier. The traffic is accumulated for the university timing of 8:30 AM to 4:00 PM only.

X.   SOLUTION FOR SSUET TRAFFIC ISSUE

To overcome the traffic issue near SSUET Chowk in front of SSUET main gate, two proposals are suggested based on the findings of this study

A) KHA Ground on Rent

One of the solutions to minimize the traffic problem is to take KHA hockey ground on rental basis. Currently SSUET has taken this step by paying a handsome amount to Karachi Hockey Association (KHA) on annual basis. But this measure is still not providing any safety and parking shade for vehicles. Based on user's opinion from survey results, it is recommended that security measures should be taken, if SSUET is going to continue this arrangement.

B) Construction of Parking Plaza

Another solution for the discussed issue is to provide a proper parking facility within the vicinity of SSUET. It will assure the vehicle security for the stakeholders of university. Based on the results of this study, a ground plus five stories structure is suggested with a basement and roof with parking facility.

The calculations for required parking area are carried out using the standard vehicle sizes as per given in AASHTO Green book 2004. The standard dimensions prescribed by AASHTO for bikes and cars mentioned in Table VII and Figure 5, respectively [5].

Table VII
AASHTO standard dimensions for bikes

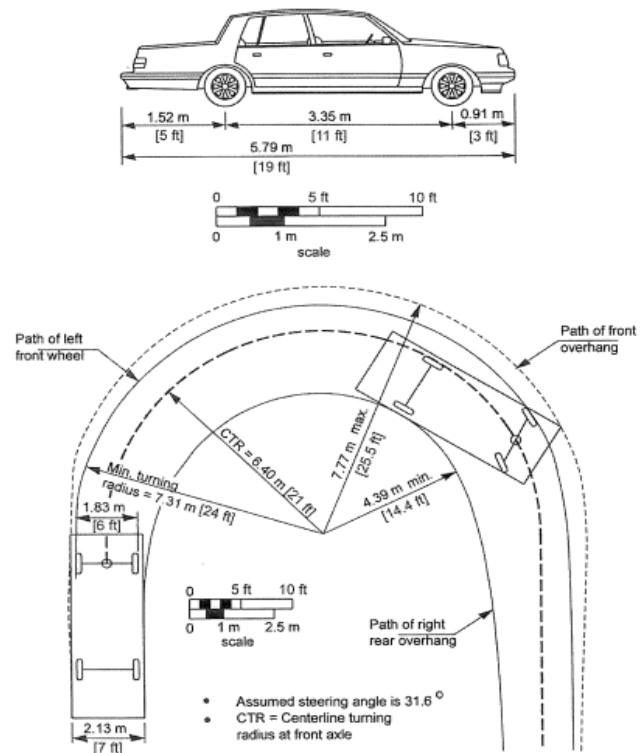| Standard Dimensions (Bikes)	
Length	8'9" or 9'3"
Width	4'8" or 4'10"

Fig. 5. Standard dimensions for a car [5]

The site location of proposed parking plaza is the parking ground of Aligarh Institute (Figure A1). The available area for this ground is 97530 square feet (Figure A2).

No. of floors required
Using the volume forecasted till 2015-2025

Vehicles
Capacity of one floor = 348 vehicles
Total no. of vehicles = 675 vehicles
No. of floors required =675/348=1.93 floors
No. of floors taken = 2 floors

Bikes
Capacity of one floor = 1477 bikes
Total no. of bikes = 2025
No. of floors required =2025/1477=1.37 floors
No. of floors taken = 2 floors

Total floors required
Thus total no of floors required = Ground floor + 3 floors + Roof top as parking, which comes equal to four (4) floors with a parking layout plan having 60 degree stall orientation (Figure A3& A4 in Appendix A) is proposed.

XI. CONCLUSIONS

Traffic growth rate of Karachi is found to be around 9.3% per annum. The increase in number of parking vehicles per annum for SSUET is nearly negligible for the last three years. Volume of parking traffic in SSUET depends on the number of departments of the university and number of seats allowed by HEC/PEC for each department.

The traffic growth of city has no co-relation with the change in volume of parking traffic of the university.

Based on volume of parking traffic, the proposed facility is sufficient till 2025.

It is observed from this study that the access to Sir Syed University is also affected due to the traffic congestion at SSUET Chowk. Hence, it is strongly suggested to construct a parking plaza (basement+ground+5 floors+ roof top parking) with nominal parking fee, as almost 40% users have agreed with this solution.

REFERENCES

[1] Abdelfatah A. S. and Taha M. A., 2014. "Parking capacity optimization using linear programming," Journal of Traffic and Logistics Engineering, Vol 2, no.(3), pp. 176-181

[2] G. Chang and G. Ping. , 2012. "Research on parking space optimal design method inparking lots," Advanced Science Letters, vol. 11, no. (1), pp. 698-701

[3] Chodash I. L., 1986. "Relative efficiencies of various parking angles," ITE Journal, Vol 56, no. (3), pp. 34-37

[4] Project 2004-2005 batch, Khuwaja Sheraz, parking requirement of big hospitals of Karachi, NED University

[5] AASHTO Green Book 2004, Geometric Design for Highways and Streets, Pp. 18-43

APPENDIX-A: ANALYTICAL AND SUGGESTED RESULTS

Table A1
Detailed traffic accumulation for SSUET parking vehicles

| Time	Traffic In		Traffic Out		Parked Vehicles		Vehicle Accumulation	
	Cars	Bikes	Cars	Bikes	Cars	Bikes	Cars	Bikes
8:15 - 8:30	29	145	4	6	25	139	25	139
8:30 - 8:45	67	202	8	12	59	190	84	329
8:45 - 9:00	61	181	2	4	59	177	143	506
9:00 - 9:15	52	144	5	12	47	132	190	638
9:15 - 9:30	48	162	4	13	44	149	234	787
9:30 - 9:45	40	96	9	6	31	90	265	877
9:45 - 10:00	25	81	5	17	20	64	285	941
10:00 - 10:15	34	86	11	29	23	57	308	998
10:15 - 10:30	37	81	5	39	32	42	340	1040
10:30 - 10:45	29	86	8	40	21	46	361	1086
10:45 - 11:00	30	68	6	21	24	47	385	1133
11:00 - 11:15	37	116	15	59	22	57	407	1190
11:15 - 11:30	26	77	11	38	15	39	422	1229
11:30 - 11:45	18	75	21	74	-3	1	419	1230
11:45 - 12:00	13	107	16	85	-3	22	416	1252
12:00 - 12:15	21	70	17	78	4	-8	420	1244
12:15 - 12:30	8	46	16	69	-8	-23	412	1221
12:30 - 12:45	12	45	24	81	-12	-36	400	1185
12:45 - 1:00	13	60	30	104	-17	-44	383	1141
1:00 - 1:15	18	41	34	103	-16	-62	367	1079
1:15 - 1:30	14	33	23	83	-9	-50	358	1029
1:30 - 1:45	17	33	15	91	2	-58	360	971
1:45 - 2:00	13	41	19	76	-6	-35	354	936
2:00 - 2:15	10	42	15	75	-5	-33	349	903
2:15 - 2:30	18	30	23	90	-5	-60	344	843
2:30 - 2:45	20	50	26	90	-6	-40	338	803
2:45 - 3:00	9	26	12	63	-3	-37	335	766
3:00 - 3:15	17	37	22	91	-5	-54	330	712
3:15 - 3:30	10	24	15	98	-5	-74	325	638
3:30 - 3:45	9	17	18	52	-9	-35	316	603
3:45 - 4:00	11	18	34	77	-23	-59	293	544
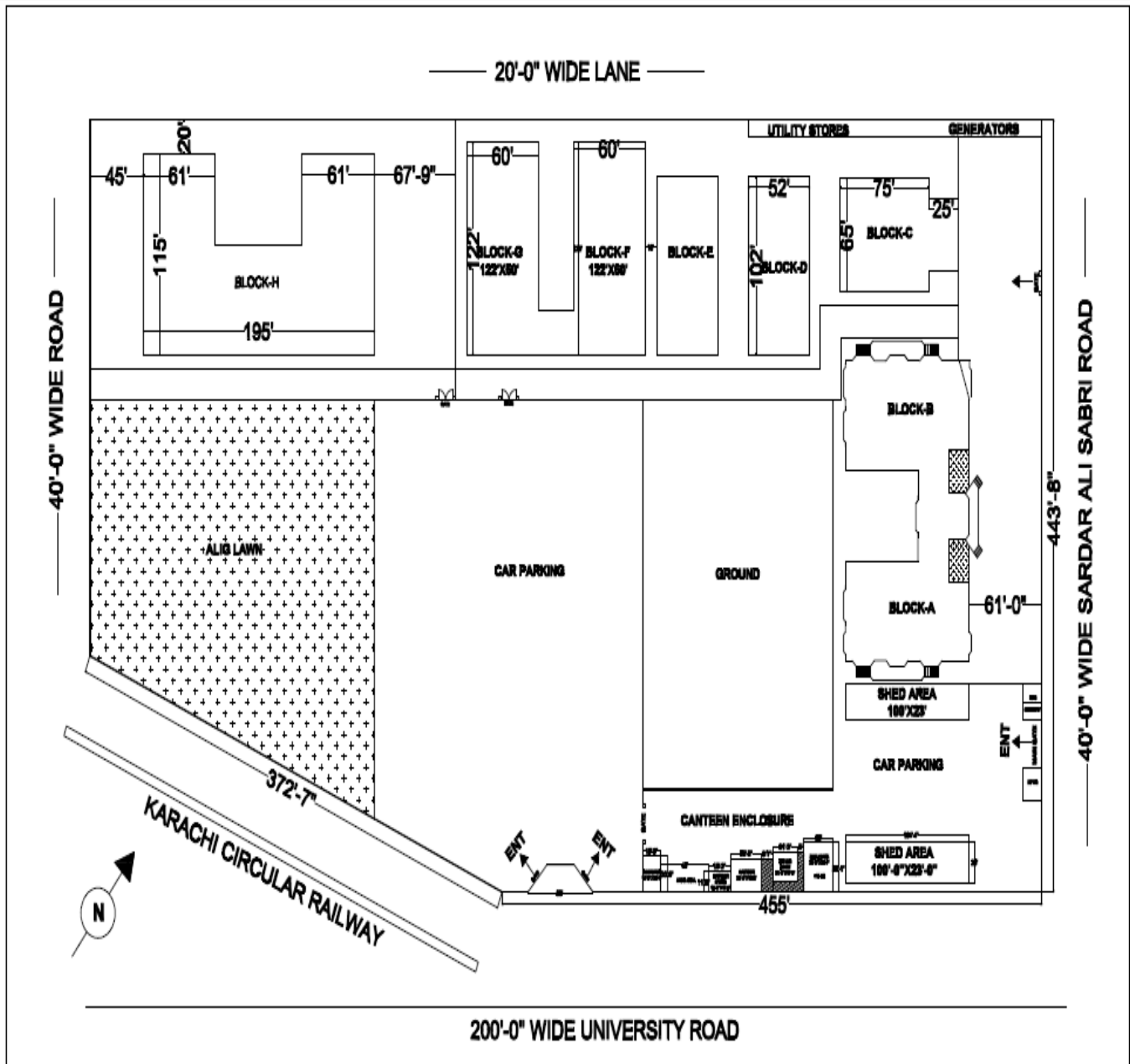
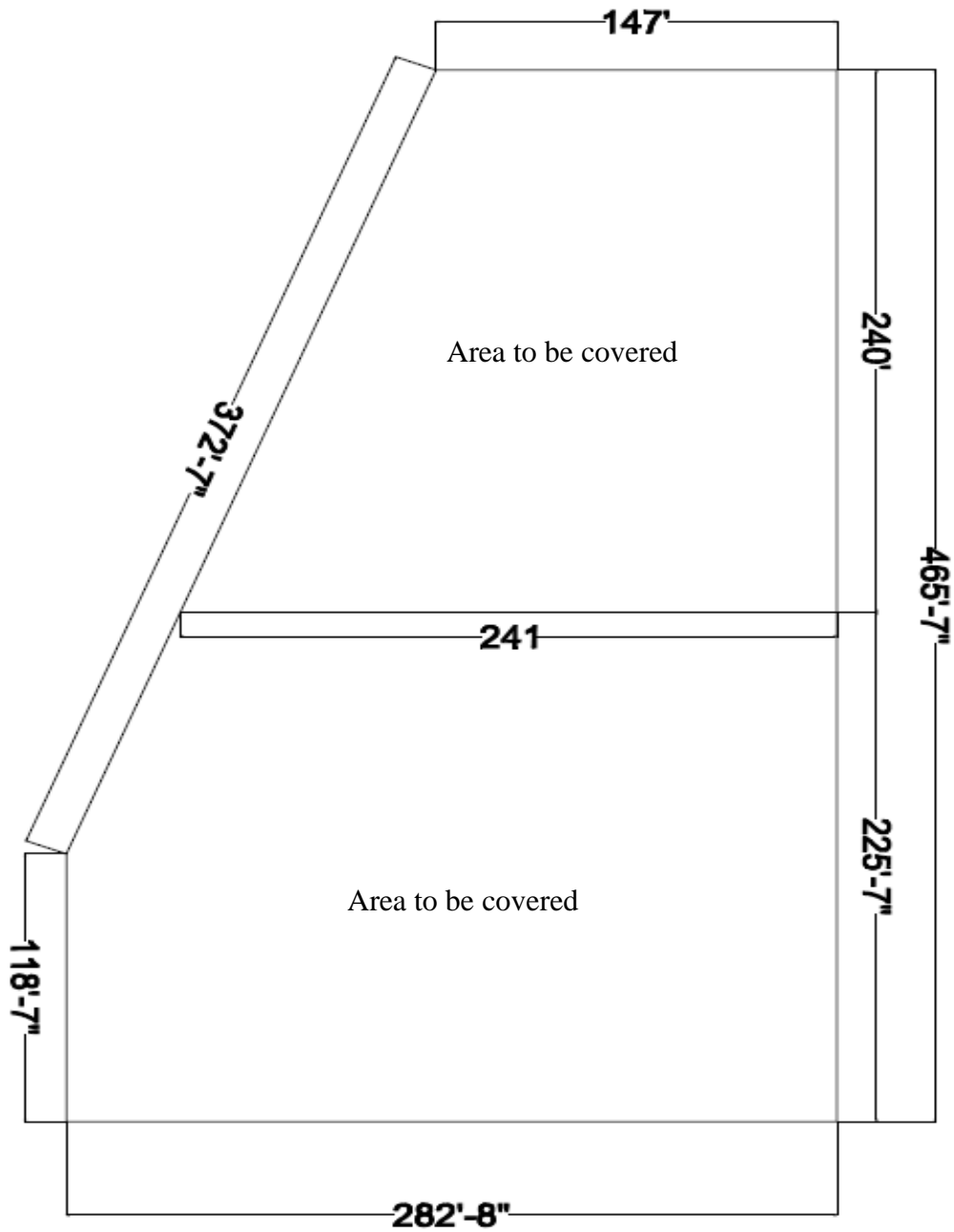Fig. A1. Existing Master plan of SSUET

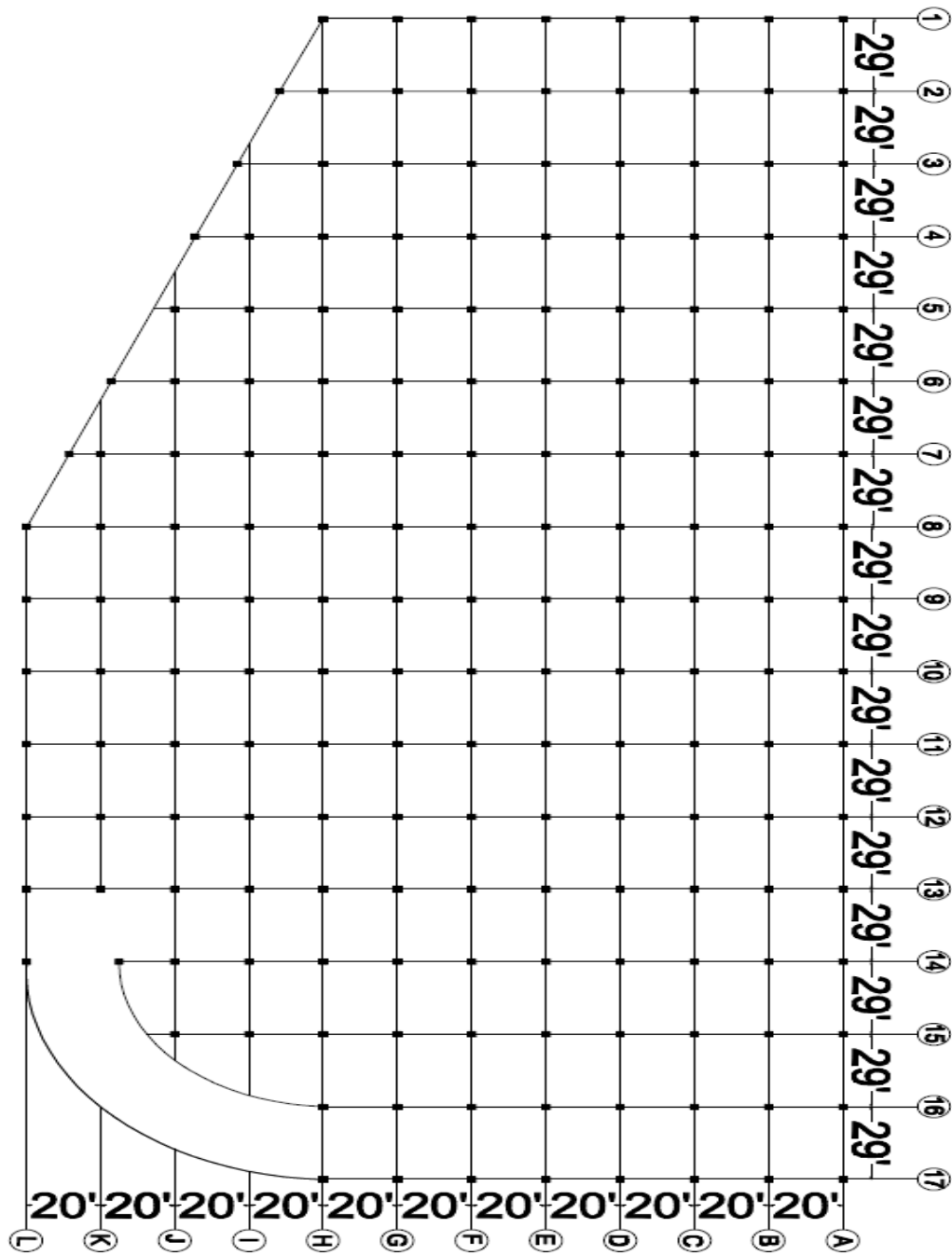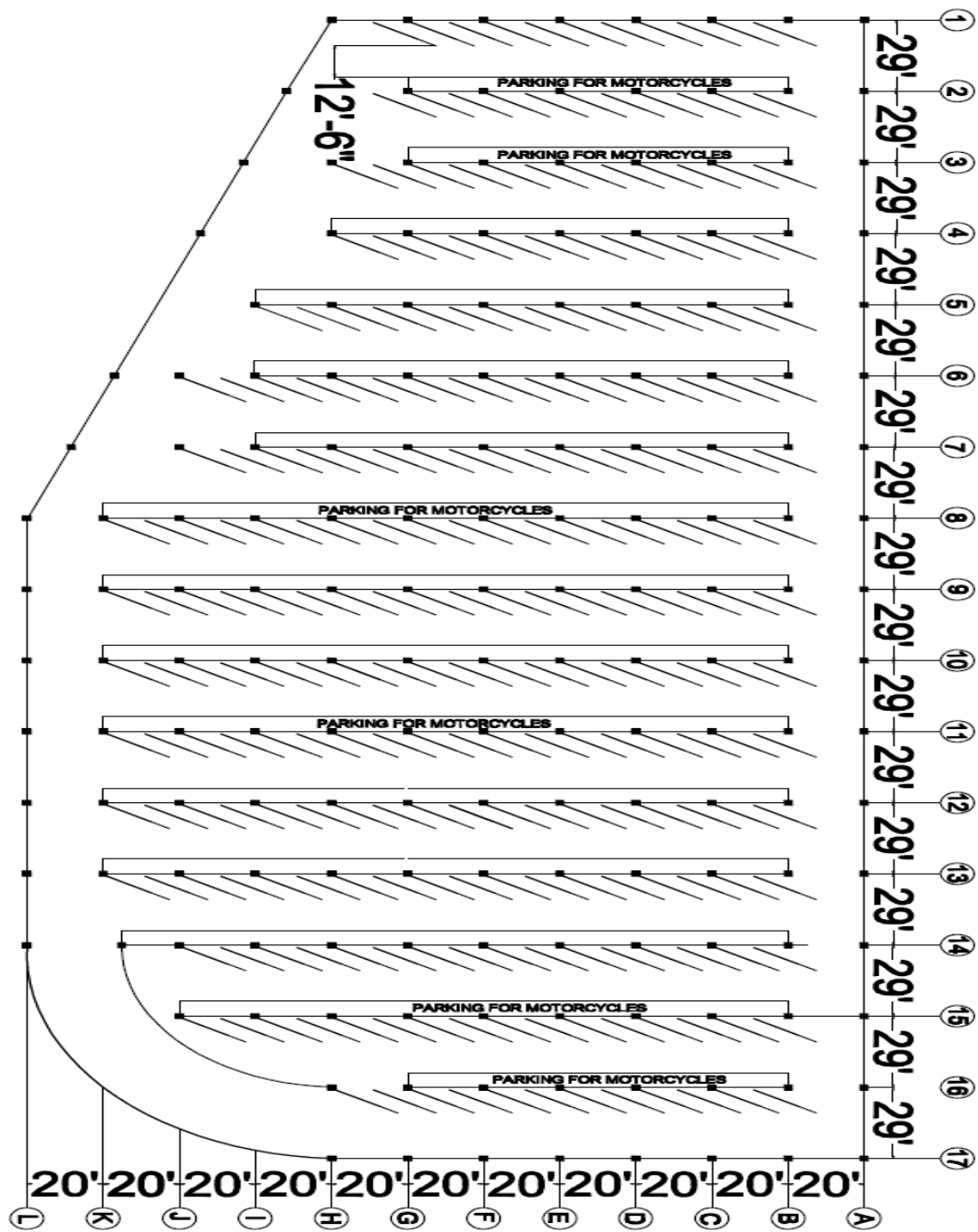Fig. A2. Site plan where parking plaza is to be proposal

Fig. A3. Proposed architectural plan for parking facility

Fig. A4. Proposed parking stall layout plan