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Planning and Designing of Multilevel Parking Facility for GHRCE (Autonomous) Nagpur Using STAAD. Pro

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ABSTRACT

Parking in GHRCE campus has for some time been a troublesome undertaking. Expanding understudy enrolment and the joining of extra workforce and care staff have expanded interest for parking. The campus parking is not sufficient to accommodate this increase, and projected campus population growth will only exacerbate the problem. The current parking problem is analyzed within the campus, and the traffic count of vehicles has been taken and it is been found the inflow of the campus is more than the parking capacity therefore various alternative solutions were taken in consideration and ultimately a solution is brought up to design a MLPS (multi-level parking system). In present proposed problem a multi-level structure of G+4 is design to accommodate the vehicles in the campus conveniently. The complete planning and designing of the Multi-level parking is done on two software's AutoCAD and STAAD. Pro, The provision future expansion to the parking spaces are also taken into consideration while planning and designing of the structure.

Keywords: Parking, Traffic Count , Parking Capacity, MLPS, Planning (AutoCad), Desinging (STAAD.Pro).

I. INTRODUCTION

1.1 Overview

Parking facilities are basic part of the modern community's transportation system. They profoundly influence economic viability, and consequently are a major concern to public administrators, businessmen, shoppers, workers, and in fact to everyone who drives an automobile. Because of its importance, parking has been the subject of numerous papers, monographs, and textbooks, but parking persistently poses problems for every community. In recent years, concern over air pollution and energy conservation has become an added aspect of parking in metro areas. Parking facilities are in constant evolution. As the attitudes, values, and desires of people change, so must policies regarding parking facilities.

Parking facilities actually pre-date the motor vehicle. of the several forms of parking facilities (such as curb spaces, surface parking lots, and parking structures), parking garage technology has changed the most. The first public parking structure was a very stable, whose owner rigged a harness to lift carriages to a second-floor storage area. The advent of automobile usage inspired similar adaptations for storing motorized carriages. Early parking garages were principally service-oriented, with automobile storage a by-product.

1.2 Problem Statement

G. H. Raisoni College of Engineering (GHRCE) run by Ankush Shikshan Sanstha is established in 1996, It's an autonomous engineering college in Digdoh Hill, near CRPF Gate, Hingna Road Nagpur. Since then the

institution has immersed as one of the leading engineering college in central India. With vision to provide quality education to all level of learning processes the group expanded its operations. GHRCE is situated on hilly region of Digdoh Hill campus. The Raisoni Group started Under Graduates, Post Graduates, M.b.a, PhDs, etc., courses and various software courses , Management Seminar to provide quality education. All these courses started in & around same campus. Hence number of students, teaching & non-teaching staff and visitors have increased. Though the campus is large enough to accumulate all of these expansion this left with little open spaces required for parking. Considering the hilly terrain of the campus it makes even more difficult to locate suitable open parking places for the students and commuters. Considering future growth in terms of intake of students for the group of institutions and increase in vehicular traffic of all the people associated with the institutions.

1.3 Aims and Objectives

1. To study the Parking demand, characteristics, statistics, and space inventory.
2. To study the land use for existing parking and need for future consideration.
3. To plan a layout for multilevel parking system.
4. To design for multilevel parking system.

1.4 Scope of The Project

The scope of this project shall be restricted to space planning and management in the design of a multi level parking facility. As a multi-storey complex, it will serve as a commercial building as well as a parking avenue for college.

II. LITERATURE REVIEW

2.1 Overview

This chapter presents a critical appraisal of the previous work published in literature. Some papers are examined investigations on suitability of different types of parking system, accordingly objectives were framed and analysis is carried out.

2.2 Brief literature review

Mrs. Priyanka Kolhar [1]

In this study, WTP survey was conducted to know the willingness of the potential user's appropriate parking fee for the new services. Specific parking management strategies (short term, medium term and long term) and the way they can be implemented are discussed. The cost of proposed parking offices, sparing and changes that can come about because of enhanced administration is figured. Parking request models are created with the assistance of SPSS programming. To take care of parking issue instantly here and now arrangements are prescribed with clog valuing as, activity and upkeep cost is particularly less for on-road parking administration as opposed to off-road and even interior rate of profit is high in for road parking administration.

Hitendra G. Wasnik et al [2]

This paper is displayed, because of the way that present transportation infrastructure and auto parked plaza created can't adapt up to the inundation of vehicles out and about. In India, the situation is made worst by the fact that the roads are significantly narrower compared to the West. Therefore, problem such as traffic congestion and insufficient parking space inevitably crops up. Various measures have been taken in the attempt to overcome the traffic problem. To alleviate the aforementioned problems, the smart car parking system has been developed.

Upendra Singh Dandotia et al [3]

This paper shows, in the limited land source, the construction of multilevel parking is very important as it accommodates large number of vehicles at one place. In this project, multi-level parking or capacity of 600 cars and 550 bikes is designed. Multi-level parking is of G+2+2 Basement having 13 shops on

ground floor and its outline depends on frame structure. In this work, diverse segments of multi-level parking i.e. raft foundation, retaining walls, beams, columns and flat slab utilizing STAAD.-Pro and AUTO-CAD programming for stamping different basic illustrations.

Anumita Roychowdhury [4]

This paper concerns parking strategy as a part of clean air action plan in Delhi. In this paper, parking system is related to the air pollution in Delhi. Key elements for parking system should be considered during design of parking plaza. How much parking should be provided is also explained. This takes into account Sarojini Nagar Parking Plaza and also the need parity between structured and surface parking.

Robert A. Weant [5]

In 1947 The Eno Foundation distributed Traffic Design of Parking Garages, by Edmund R. Ricker, who additionally changed the monograph in 1957. This publication was the first to relate scientifically the geometry of parking structures to driver and vehicle performance in the interest of efficient traffic operations. This study is based on research of some 350 monographs and published papers, augmented by interviews and questionnaires returned by 118 cities in North America that provided information on 274 parking garages. Accentuation is set on current parking plaza rehearse; be that as it may, patterns are noted and parking issues are outlined in national point of view. While this study is based largely on American practice, it is generally applicable around the world. The scope of parking plaza planning, utilitarian design, and activity isn't expected to be a total treatise, yet rather a summary of real focuses and contemplations. An undertaking is made to exhibit how parking garage masterminding, diagram, and action relate to people and the urban condition.

Richard Arnott [6]

This paper takes a gander at ideal parking arrangement in thick urban regions (''downtown''), where spatial rivalry between parking structures is a key component, from the point of view of financial hypothesis. This paper has four sections. The principal takes a gander at the ''parking structure administrator's issue''. The second determines balance in the parking structure showcase when there is no on-road parking, thinks about the harmony to the social ideal, and looks at ideal parking strategy in this unique circumstance. Since parking structure administrators have showcase control, the spatial rivalry balance is for the most part wasteful, and parking arrangement can be utilized to moderate the mutilation. The third includes road parking and considers how its underpricing influences second-best parking approach. The fourth includes mass travel, and thinks about how economies of scale in mass travel cooperate with least and most extreme off-road parking benchmarks.

B VAMSI et al [7]

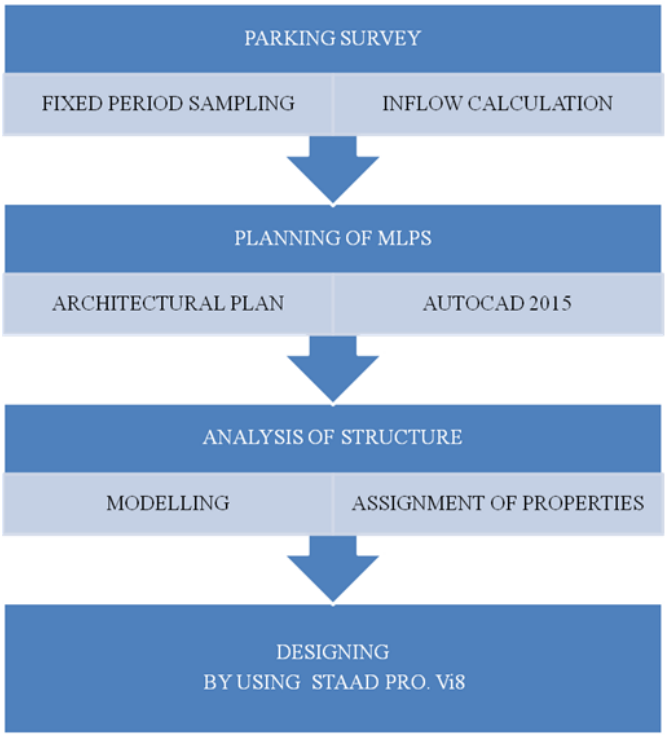
This venture is planned to outline a productive parking framework and limits the parking territory in the city.In the cutting edge world where the parking spot has turned into a noteworthy worry, in the city. The Visakhapatnam city is prescribed for shrewd city, which incorporates every one of the offices like tourism, business edifices, organizations and so on. The movement situation is changing from everyday. Every one of these offices prompts the activity clog and proficient requirement for parking. To maintain a strategic distance from this issue we propose the plan of "Multistory parking" at Dandubazar showcase close Jagadamba focus, which may be a shopping center point in future. To control parking issues we recommend multi story parking framework in this place. Here, we gave parking to in excess of 277 autos as indicated by plan. Keeping in mind the end goal to decide the prerequisites of such parking framework,

we planned the working for G+3 floors.The plan is done in view of the necessities, terms and conditions. The plan of multi-story parking framework is finished by utilizing code IS456-2000, CIVIL programming resembles AUTOCAD, STAAD. Pro and so on. The plan is checked with manual figurings moreover.

III. METHODOLOGY

3.1 Research Methodology :

Research methodology implemented for this project is as follow:



3.2 Extent of The Project

The extent of this project might be confined to space planning and administration in the design of a multi-level parking system . As a multi-story plaza, it will fill in as for college and additionally for commercially use also.

IV. PARKING STUDIES

4.1 Overview

Parking is one of the major problems that is created by the increasing road traffic. It is an impact of transport development. The availability of less space in urban areas has increased the demand for parking space especially in urban areas. This affects the mode choice also. This has a great economic impact.

4.2 Planning for Parking Plaza

1. Calculation of Existing Area

Figure 1: Aerial View Of GHRCE

Existing parking area is calculated by Chain and Tape Method. A 30m long tape is taken and manually all the area is calculated as follows:

Area of first part- 5360 sq. m.
Area of second part- 225 sq. m.
Area of third part- 260 sq. m.

Total Existing Area = 5845 sq.m

Figure 2: Proposed Site for GHRCE MLPS

4.3 Parking Surveys

Parking surveys are conducted to collect the above said parking statistics. The most common parking surveys conducted are in-out survey, fixed period sampling and license plate method of survey.

4.4 Inflow Calculation

Out of the above methods, fixed period sampling was used. By this method we calculated the vehicular inflow at GHRCE. The count was taken during the peak hours. The peak hours were 8 A.M – 9 A.M and 11 P.M – 12 P.M. The peak hours were considered according to the two shifts of the college. The average of these count were considered to be the vehicular count of that day. The survey was carried for six days. Further observations on vehicular count were made.

Table 1: Vehicle Inflow Calculation

Days	Nos. of Two wheelers	Nos. of Four Wheelers
Monday	1903	72
Tuesday	1877	66
Wednesday	1834	64
Thursday	1848	59
Friday	1807	68
Saturday	1785	55

4.2 Calculation of Required Area for Maximum Daily Inflow-

On the basis of above chart the maximum number of two wheelers are 2007 and four wheelers are 72. So the area required for parking using the standards would be as follows:

For two wheeler – 1903 × 3 = 5709 sq. m

For four wheeler – 72 × 18 = 1296 sq. m

Total Area = 5709 + 1296 = 7005 sq. m

4.3 Outcomes of Parking Studies:

Considering the exiting and required parking area we can conclude that there is around 3000 sq. m less area. By considering the above growth provision of Multi-Level Parking Plaza at GHRCE parking will be the best solution.

V. PLANNING

5.1 Introduction of Parking Plaza:

It is a building (or part there in this regard) which is designed particularly to be for Automobile Parking and where there are various floors or levels on which parking happens. Keeping in mind the end goal to oblige the substantial volume of vehicles, little urban areas and towns must build up their infrastructure. One arrangement might be a multi-level parking framework to boost vehicle parking limit by using vertical space, instead of expand on a level plane.

5.2 Solution For The Problem

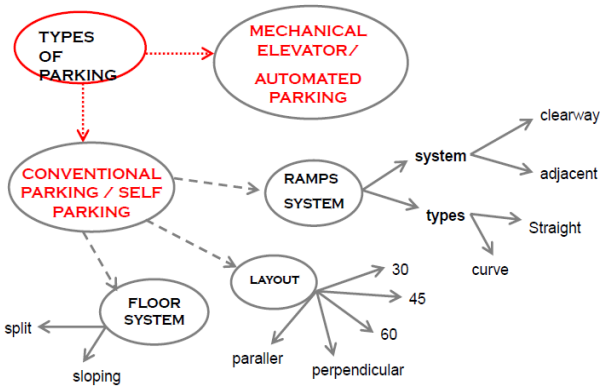


Figure 3: Types Of Parking

5.3 Criteria Considered For The Quality Multi Story Parking Plaza Are:

- ✓ Safety being used
- ✓ Clear perceivability
- ✓ Parking-space stamping to empower drivers to recall the area of their vehicles
- ✓ Integration into the setting of town planning
- ✓ Clear perspectives to the outside
- ✓ Good natural lighting and ventilation

5.4 Description of The Structure

After calculating the parking area the aim was to plan for multi-level parking plaza. Usually parking plaza is of square shape but existing area is of irregular shape. Due to this we planned a rectangular shape of parking plaza. The structure is G+4 in which 88 four wheelers

and 1922 two wheelers can be parked safely. The distribution of floor for two wheeler and four wheeler is as further:

Table 2: Distribution Of Floors For Two Wheelers And Four Wheelers Parking

Floor Plan	Type of Vehicle Parked	No. of Vehicle Parked
Ground Floor	Two Wheeler	480
First Floor	Four Wheeler	44
Second Floor	Four Wheeler	44
Third Floor	Two Wheeler	474
Fourth Floor	Two Wheeler	474
Roof Floor	Two Wheeler	494

5.5 Plan Considerations

Table 3: Standard Dimensions Configuration

Description	Dimension	
	FOUR WHLEER	TWO WHEELER
Plot Area	4410.529 m^2	
Floor to Floor Height	3 meters	
Ramp Width	4 meters	
Type of Parking	Parallel	Perpendicular
Parking block width	3 meters	2 meters
Parking block length	6 meters	3 meters
Driving aisle width (2-way)	6 meters	3 meters

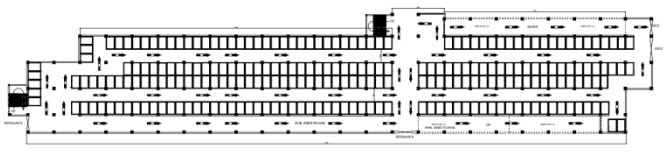


Figure 4: Ground Floor Plan of MLP.

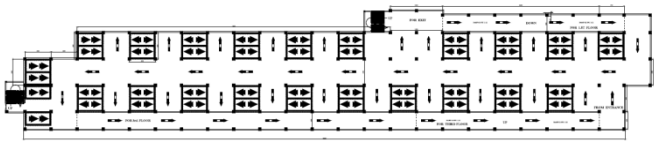


Figure 5: 1st and 2nd Floor Plan of MLP.

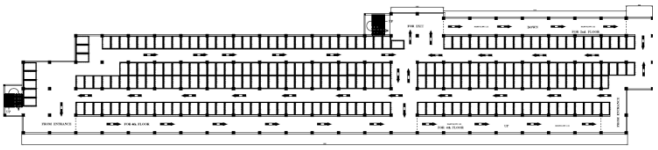


Figure 6: 3rd and 4th Floor Plan of MLP.

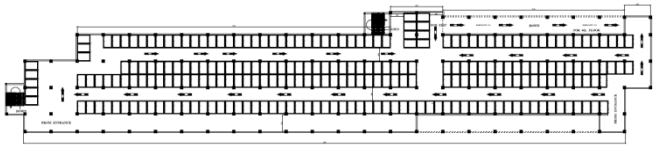


Figure 7: Roof Floor Plan of MLP.

VI. ANALYSIS AND DESIGN USING STAAD. PRO

6.1 Steps Involved In Analysis

The following steps were involved in the process of analysis and design using STAAD. Pro.

1. Frame of the building was created in the software by using the plan created using Auto CAD as reference.
2. Support conditions were assigned.
3. The member properties were assigned for beams and columns.
4. The loading cases were given to slabs and beams.
5. The analysis of the frame was done.
6. The concrete design of beams and columns were done.

6.2 ANALYSIS

After assigning all the member properties and loads, it was checked by using STAAD. Pro. After the analysis the results were obtained. The beam end forces and reactions are found out. The maximum bending moment in beams and maximum axial load in columns was found out.

6.3 DESIGNING

6.3.1 Load Calculations for the Structure:

1) Dead load calculation:-

i. For Slab

Thickness of slab = 0.15 m

Density of concrete = 25 kN/m^3

Grade of concrete = M25

∴ Dead load of slab = 0.15 x 25

3.75 kN/m^2

ii. For Beam

Width of beam = 0.4 m Depth of beam = 0.4 m Density of concrete = 25 kN/m^3

∴ Dead load of beam = 0.4 x 0.4 x 25

= 4 kN/m^2

iii. For Brick

Height of outer wall = 0.6096m Width of wall = 0.23 m Density of brick = 20 kN/m^3

∴ Dead load of brick wall = 0.6096 x 0.23 x 20

2) Live load calculation (as per IS : 875 (Part 2) – 1987):-

i. Live load on slab

The building is designed for maximum live load suggested for Assembly Building, i.e. passages subject to loads greater than from crowds, such as wheeled vehicles, trolleys and the like

= 5 kN/m^2

ii. Live load on staircase

Live load on staircase is taken as per IS : 875 (Part 2) – 1987 for Educational Building = 4 kN/m^2

3) Self weight of structure:-

Self weight of structure is taken on default as per STAAD.Pro for factor of -1.

4) Wind load:-

As per IS : 875 (Part 2) – 1987, wind load is to be calculated for high rise structure and depending on the zone in which the structure is to be constructed. This building is not coming under wind load force but for future perspective,we have provided the wind load of 0 kN/m^2 to 1 kN/m^2 in the range of 14m to 21m, i.e. the top floor of the structure.

6.3 STAAD. Pro Analysis of Structure:

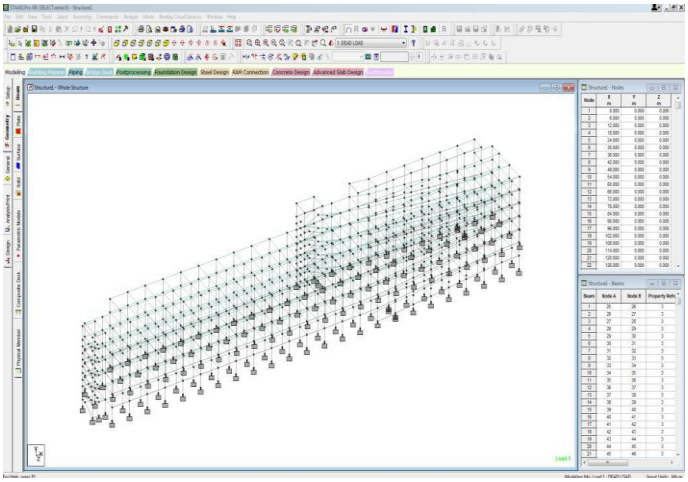


Figure 8 : Modelling in STAAD. Pro.

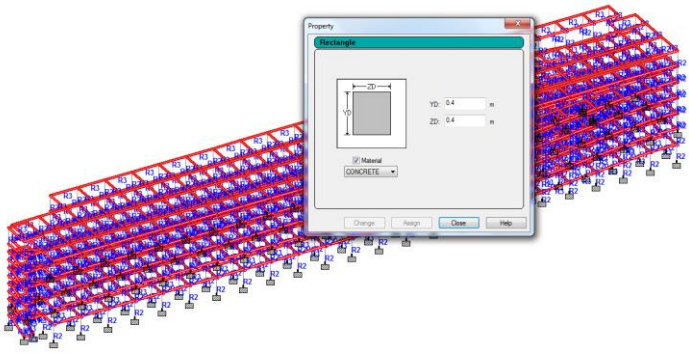


Figure 9 : Properties Assignment for Beam.

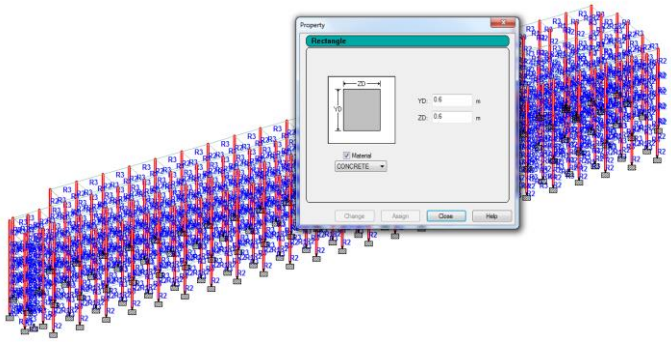


Figure 10 : Properties Assignment for Column.

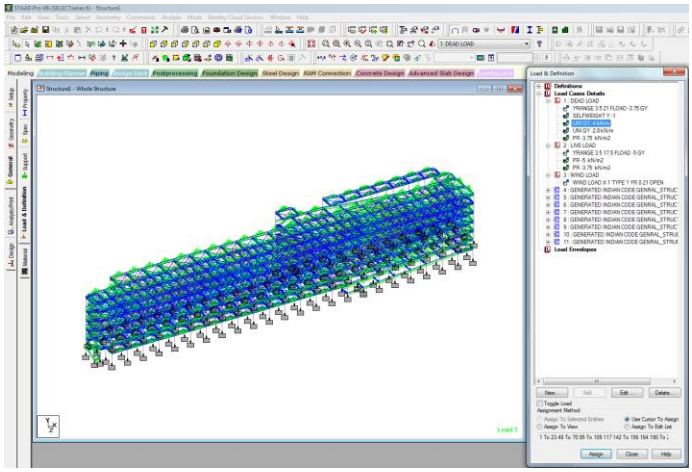


Figure 11 : Different Load Assignment in STAAD. Pro.

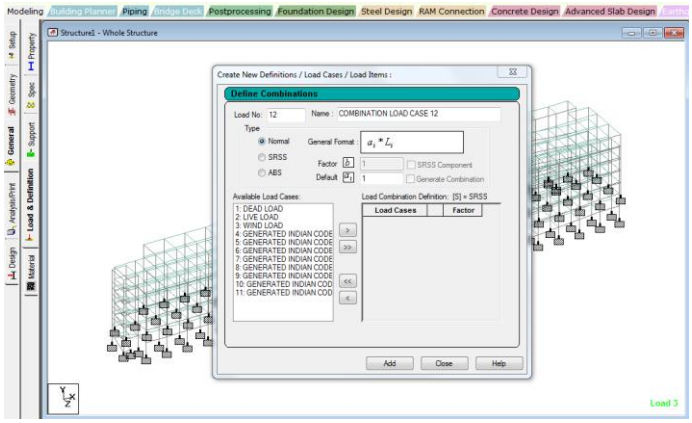


Figure 12 : Different Load Combinations for STAAD. Pro.

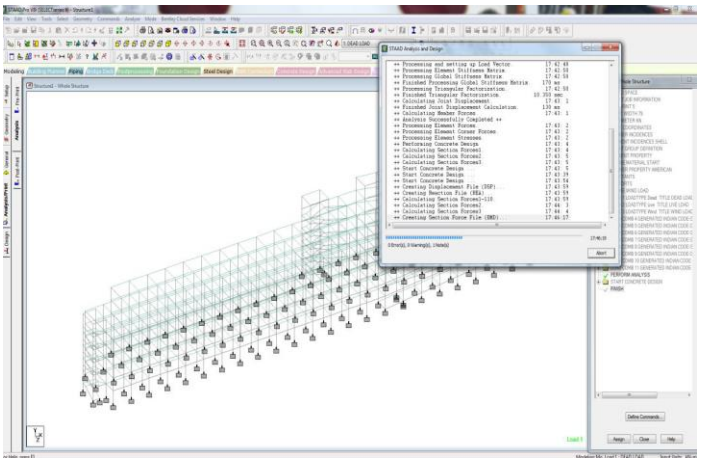


Figure 13: Analysis and Design processing in STAAD. Pro.

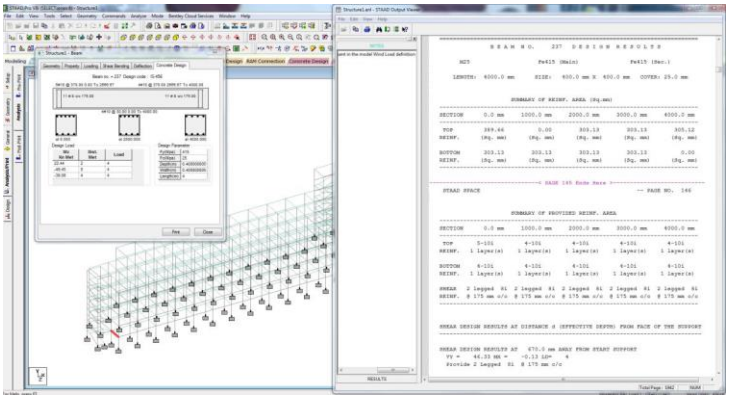


Figure 14 : Beam 237 Design Result.

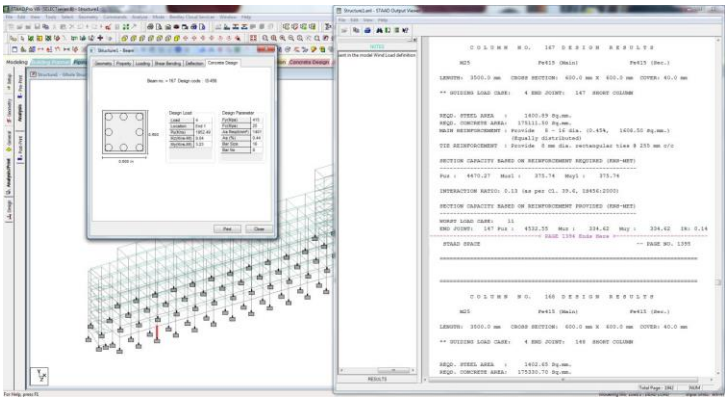


Figure 15 : Column 167 Design Result.

VII. RESULTS

7.1 STAAD. Pro output Beam End Forces

Beam	Node	L/C	Axial	Shear		Torsion	Bending	
			Fx (kN)	Fy (kN)	Fz (kN)	Mx (kN.m)	My (kN.m)	Mz (kN.m)

1	25	5:GENERATED	-2.658	83.634	-0.025	-0.491	0.082	90.914
	26	5:GENERATED	2.658	86.969	0.025	0.491	0.070	-100.916
2	26	5:GENERATED	2.815	84.283	-0.033	0.772	0.084	94.721
	27	5:GENERATED	-2.815	86.320	0.033	-0.772	0.116	-100.831
3	27	5:GENERATED	0.682	121.255	-0.009	0.398	0.031	142.015
	28	5:GENERATED	-0.682	123.688	0.009	-0.398	0.024	-149.314
4	28	5:GENERATED	-0.418	121.251	-0.004	-0.030	0.011	142.610
	29	5:GENERATED	0.418	123.692	0.004	0.030	0.011	-149.934
5	29	5:GENERATED	-0.629	121.250	0.002	-0.030	-0.005	142.615
	30	5:GENERATED	0.629	123.693	-0.002	0.030	-0.004	-149.942
6	30	5:GENERATED	-0.542	121.252	0.006	-0.027	-0.019	142.61
	31	5:GENERATED	0.542	123.691	-0.006	0.027	-0.018	-149.939
7	31	5:GENERATED	-0.425	121.252	0.010	-0.025	-0.030	142.620
	32	5:GENERATED	0.425	123.691	-0.010	0.025	-0.029	-149.937
8	32	5:GENERATED	-0.323	121.253	0.013	-0.023	-0.039	142.62
	33	5:GENERATED	0.323	123.690	-0.013	0.023	-0.039	-149.935
9	33	5:GENERATED	-0.236	121.253	0.016	-0.021	-0.049	142.62
	34	5:GENERATED	0.236	123.690	-0.016	0.021	-0.049	-149.935
10	34	5:GENERATED	-0.176	121.253	0.020	-0.019	-0.058	142.62
	35	5:GENERATED	0.176	123.690	-0.020	0.019	-0.060	-149.935
11	35	5:GENERATED	-0.258	121.251	0.024	-0.017	-0.070	142.619
	36	5:GENERATED	0.258	123.692	-0.024	0.017	-0.072	-149.623
12	36	5:GENERATED	-0.823	121.251	0.028	-0.016	-0.085	142.618
	37	5:GENERATED	0.823	123.692	-0.028	0.016	-0.086	-149.943
13	37	5:GENERATED	-0.328	121.254	0.064	-0.016	-0.165	142.62
	38	5:GENERATED	0.328	123.689	-0.064	0.016	-0.219	-149.936

14	38	5:GENERATED	-1.124	121.245	0.014	-0.030	-0.057	142.60
	39	5:GENERATED	1.124	123.698	-0.014	0.030	-0.030	-149.960

Table 4 : Result STAAD. Pro output Beam End Forces

VIII. CONCLUSION AND FUTURE SCOPE

Considering the problem related to work, we tried to solve the problem at planning and design level. Most of the work has been done to reduce congestion. Following conclusion is made considering planning and design of multilevel parking plaza:

1. The parking plaza regulates parking system in college campus.
2. Congestion problem would be resolved using multilevel parking plaza.
3. Provision of parking plaza would minimise the accident probability.
4. The structure is analysed by STAAD. Pro and therefore minimum sizes are considered. The structure considers dead load, live load and wind pressure load, hence the structure is safe.
5. The parking plaza provides easy access to entry and exit of vehicles. Both the ramps are used as entry and exit ramps.

IX. FUTURE SCOPE

The parking plaza is so designed that it can be extended vertically considering the increase in intake. Multilevel parking plaza can be used at any other required places where there are congestion problems. The parking plaza can be used for all the institutions in the campus and accordingly the plaza can be extended vertically. The structure is designed considering all the requirements of further expansion of the MLPS.

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