Mitigation of Parking Hurdle by providing Multilevel Parking facility at Bapat Galli, Belagavi-A Case Study

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***Abstract*—An attempt has been made to improve the car parking facility at Bapat Galli, Belagavi. A suggestive alternate solution has been discussed in regards with the current parking congestion problems and horizontal land spread restrictions for car parking. As alternative for the problem, A Composite Multilevel car parking is been proposed. The effect of wind on the structure is studied. The Structure is modeled using STAAD PRO V8i. Various parameters of the structure are analyzed. Analysis is carried out using IS 456:2000, IS 800:2007, IS 875: Part I, IS 875: Part II, IS 875: Part III & IS 875: Part V.**

Keywords—MLCP, Composite Structure, Steel Roof Truss, Wind analysis, STAAD Pro V8i

I. INTRODUCTION

In the Congested commercial areas of the city using the area only for one ground floor for parking is not a feasible and acceptable idea. Multilevel parking has become common in metropolitan cities but it is the need of the hour even in the non-metropolitan cities like Belagavi. The idea of multilevel car parking system (MLCP) is justifiable, as the city is chosen for development as smart city. Here number of vehicles parked on limited ground area get multiplied according to the number of floors that we can provide. Recently, the vehicle populations of the city has shot up drastically. The parked vehicles on the road side is a nuisance. Hence RTO is taking stringent action on the vehicles parked in non-specified areas.

Of course RCC floor is essential to take the load of the vehicles but on the terrace floor the trussed steel roofing reduces the load on the foundation, hence, the structure becomes composite. Considering the average number of vehicles to be parked in the area and the area available for parking the multilevel car parking becomes the best choice.

II. METHODOLOGY

A. Case Study

The major issue of car parking in Belagavi city is in the market areas like Ramdev Galli, Samadevi Galli and Khade Bazar. To accommodate more vehicles, a suitable and efficient parking is necessary in this area. Hence a Mutlilevel car parking is being proposed in Bapat Galli, Belagavi. A case study is carried out for the improvement of existing condition of car parking in Bapat Galli, Belagavi. This is centrally located in the market. In this paper a study has been made for improving the car parking facility in Bapat Galli. A Multilevel car parking structure suitable for the requirement is considered for analysis. The analysis of the structure is carried out using Indian Standard Codes in STAAD Pro V8i software.

B. Structural Overview

The multistory car parking is the structure which helps for the vehicle parking in discipline manner. As a case study the multilevel car parking (MLCP) structure is considered with ramp type of parking for way in & way out to have effective movement of vehicles in parking area.

This structure consists of basement, ground floor and three floors. The third floor of the structure is composite which is covered with steel roof truss. The structure is having three entry and exits with three connectivity roads.

The proposed multistoried level car parking (MLCP) for parking improves public convenience. The structure is a combination of RCC at base and steel on top floor. The parametric analysis is carried out for the safety of structures under wind loads.

III. DETAILS O F THE STRUCTURE

Table 1: Details of the Structure

Structure Details	
Type of structure	Multi-storey Composite frame structure.
Occupancy	Multi-Level Car Parking Building.
Number of stories	5 (B+G+3)
Basement storey height	2.75m
Intermediate storey height	3m
Type of soil	Hard soil
Site Location	Bapat Galli ,Belagavi

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 9 Issue 07, July-2020

Table 2: Properties of Structural Members

Properties of Frame members	
Beam Size	230 mm × 500 mm
Secondary Beam Size	230 mm × 300 mm
Grid Slab Beam Size	100 mm × 450 mm
Column Size	600mm diameter (circular)
Slab Thickness	100mm
Wall Thickness	230mm

Table 3: Properties of Materials

Properties of Concrete	
Grade of Concrete	M30
Density of Concrete	25000N/m^3
Modulus of Elasticity of concrete	27386N/mm^2
Properties of Steel	
Grade of Steel	Fe 415
Unit Mass of steel	7850 kg/m^3
Modulus of elasticity, E	2.0 x 105 N/mm^2
Poisson ratio	0.3

A. *Plan of the Structure*

The Figure 1 shows the Basement plan of the multilevel car parking. A plan is showing the details of the ramp rising from the basement level to the ground level. The entry ramp and exit ramp is planned separate for effective movement of the vehicles in the basement floor.

The Figure 2 shows the Floor plan for the ground floor and the consecutive three floors. The entry and exit is made separate for the parking area. The exit is at the central perpendicular level, which connects to one of the main way near the area.

B. *Plan of the Structure*

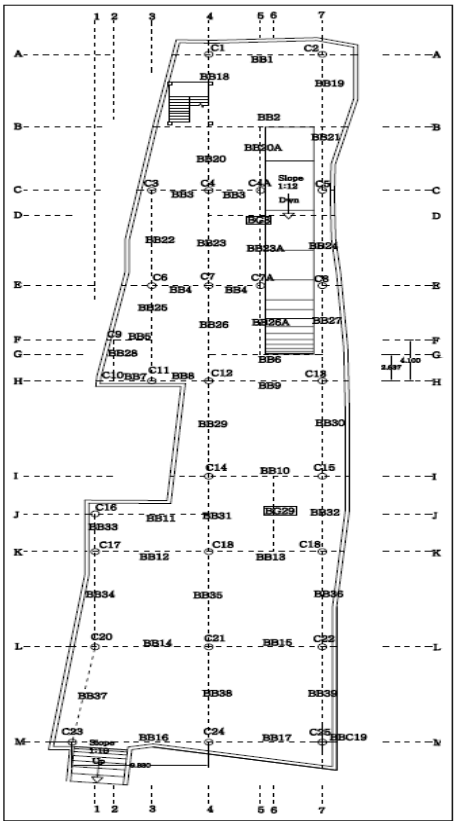

Figure 1: Basement Floor Plan

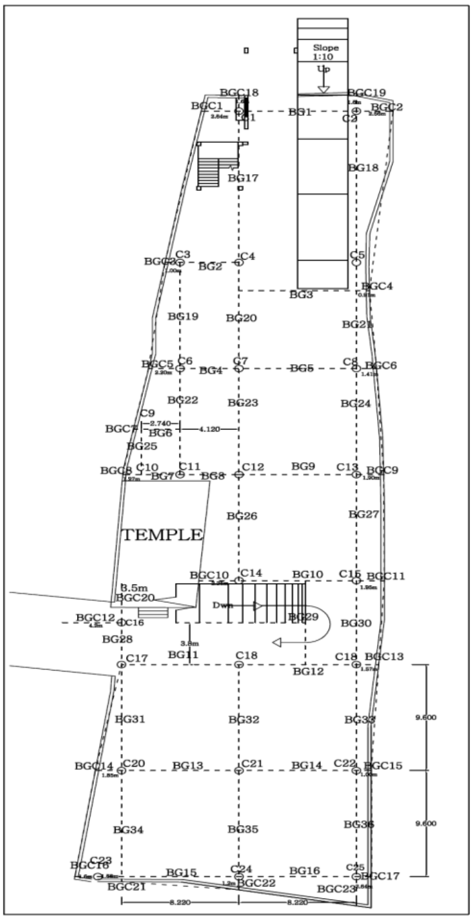

Figure 2: Floor Plan for G + 3

IV. MODELING AND ANALYSIS

The multilevel car parking is modeled into STAAD Pro V8i for the analysis. The 3D model is prepared for the effective identifying of the analysis of the parameter.

Table 4: Structure Details

Physical Parameters	
Length of Structure	7 bays at 9.5m
Width of Structure	3 bays at 8.22m
Height of Structure	12m
Live Load on Structure	5 kN/m^3
Floor finish	1.0 kN/m^3
External wall	6.55 kN/m

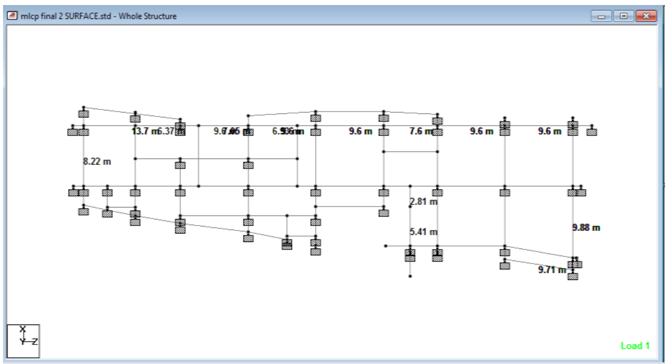

Figure 3: Plan of MLCP in STAAD Pro V8i

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 9 Issue 07, July-2020

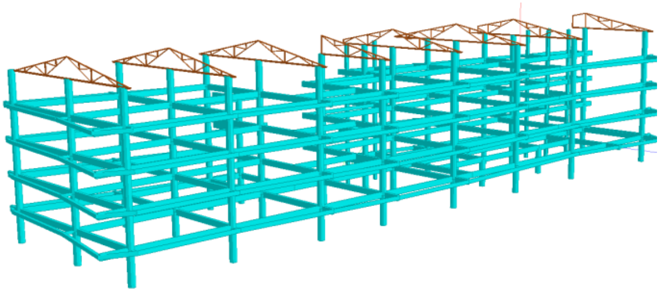

Figure 4: 3D model of MLCP in STAAD Pro V8i

The Figure 3 shows the modeled line diagram plan of the structure showing the support conditions, the supports are of fixed type.

The Figure 4 shows the 3D model with the steel roof truss, this 3D model shows the composite structure. The pinned support conditions are considered at the steel to concrete structure.

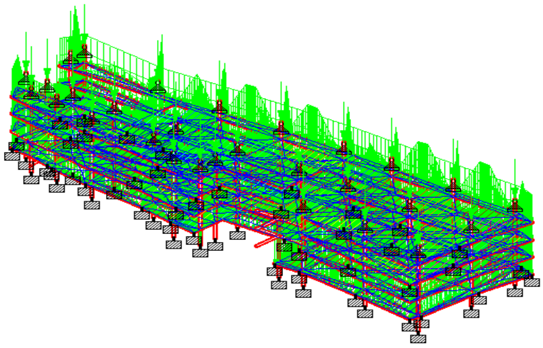

Figure 5: Dead Load effect on MLCP Structure

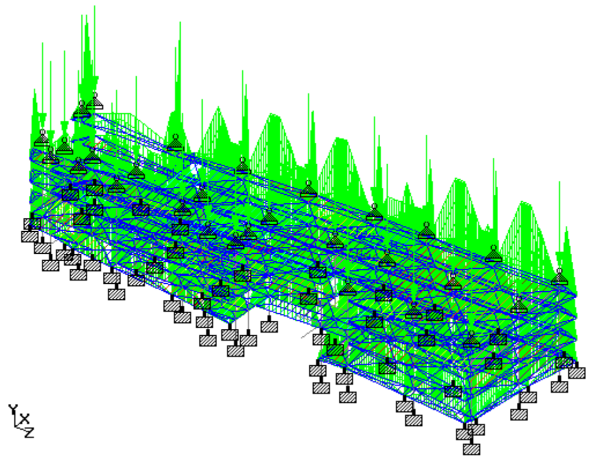

Figure 6: Live Load effect on MLCP Structure

The loads on the structure are placed as per IS 875 Part 1, Part 2, and Part 3 for dead load, live load and wind load. The effect of structure under deal load and live load is shown in the Figure 5 & Figure 6.

ANALYSIS OF ROOF TRUSS

The steel roof truss is analyzed and designed manually using IS 800:2007 and IS 875 Part 3

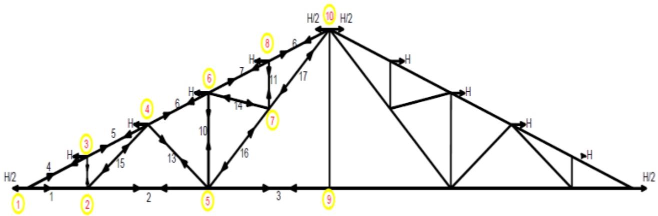

Figure 7: C/s of Steel Roof Truss

Table 5: Steel roof truss details

Physical Parameters	
Span of truss	16m
Spacing	9.6m
Height of eve	12m
Pitch angle	18^0
Basic wind speed	39m/second

V. RESULTS AND DISCUSSIONS

1. *The maximum shear force and bending moment on the column are*

Table 6: Result force the forces on column

Result on Column no. 197	
Puz	4490.53kN
Muz1	187.31kNm
Muy1	187.31kNm

The maximum bending moment and shear force is obtained from Table 6. Which are 4490.53kN and 187.31kNm. The results can be used for designing the column.

2. *The maximum shear force and bending moment on the beam are*

Table 7: Result force the forces on beam

Result on Beam no. 90	
Shear Force Fy	174.054kN
Bending Moment Mz	339.947kNm

The maximum bending moment and shear force is obtained from Table 7. Which are 339.947kNm and 174.054kN. The results can be used for designing the beams.

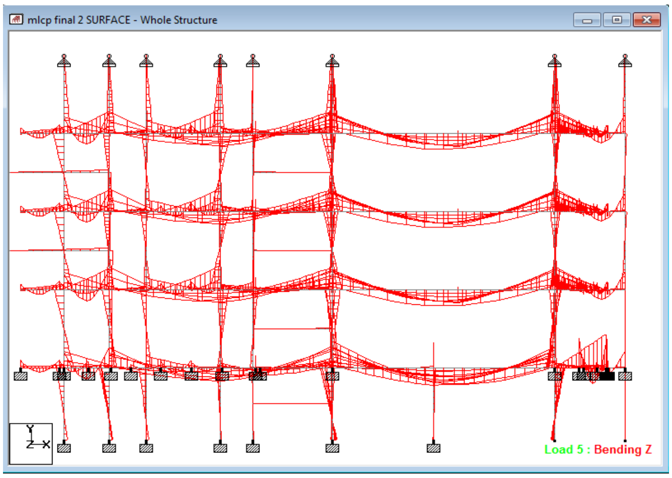

Figure 8: Bending moment in Z-direction

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 9 Issue 07, July-2020

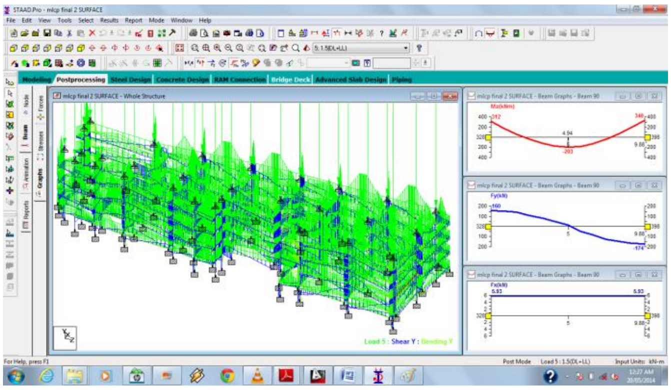

Figure 9: Shear force and Bending Moment

Table 8: Results for Forces in the Steel Roof Truss

Member number	Coefficient for H	Coefficient for W	Force in the member (kN)	
			DL + LL W=14.65, H=0	DL + LL W=4.95, H=0.025
1	0.5	13.84	220.75	68.52
2	1.0	12.3	180.19	60.91
3	2.5	7.69	112.65	38.128
4	0	-14.56	-214.62	-72.072
5	1.05	-14.56	-214.62	-72.04
6	1.05	-11.32	-165.83	-56.00

From Table 8, it can be observed that the maximum force in the member no. 1 is 220.75kN which can be used for the designing.

CONCLUSIONS

1. From the analysis it is observed that the structure is safe for the loading considered.
2. Maximum values of bending moment and shear force can be used for the designing of beams, columns and truss as given in Table 6, 7 & 8.
3. The proposed model provides a parking facility of accommodating 360 cars in multilevel car parking structure, increasing it from existing 60 cars on the same land area.
4. The parking facility increases the capacity of accommodating vehicles by almost 5 times that of existing system.
5. The increasing capacity of parking reduces the blockages of the main road of the market area.
6. The public will have safe relief for parking problem in the area.
7. The pedestrian traffic will feel pleasant without any roadside parked vehicles.

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