

# Design and Analysis of Proposed Multi Storey Building Including Smart Parking in MP Nagar Zone II: A Case Study

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## Abstract

The population of India recorded in 2014 was 1266.26 million and estimated to record 1443.03 by end of 2024. India follows with one of the largest road network after United States spanning over 5.89 million Km as per Industry report. Such huge population even seek for proper management in case of parking at cumbersome or heavy traffic zones. This project deals with one such case in Bhopal capital of Madhya Pradesh. The identified location is situated in MP nagar zone II surrounded with commercial buildings, coaching institutions, Habibgang Railway Station and Proposed Metro Station which is now under construction. All these reasons lead to heavy traffic entire day.

Multi level Smart parking is proposed with a structure G+4 and the designing of the structure is done using computer aided applications namely Autodesk Autocadd and Autodesk 3d Max and analyzed the structure considering seismic zone as per I.S. 1893-I:2016 using Bentley Staad.Pro.

The results stated Building displacement was found to be within permissible limit in all direction, hence safe in seismic hazards. Unbalance forces are observed linear in all the stories as sections adopted are safe in designing. Vertical forces are observed linear in distribution of load. Bending moment is observed linear in all the storey which will provide

linear requirement of steel in the RCC members.

**Keywords:** Smart Parking, Staad.Pro, Seismic Analysis, Bending Moment, Building Displacement.

## I. Introduction

Parking is a critical component of transportation policy and management for any locality especially for the large central cities. The policies and management practices affecting parking lead to outcomes that, in turn, can affect land use, air quality, traffic congestion, travel behaviour, safety, and economic development, not to mention revenue lines. Yet, effectively managing parking is an ongoing battle for the large central cities as they face competing, and sometimes contradictory, objectives along with an ever increasing demand for space.

Road transport system is a sub system of transportation which requires automobile and requisite facilities such as road network, the terminal, the vehicle and other traffic facilities. This has therefore created a reawakening on the need for statutory vehicles to be accommodated at popular terminals and must be carefully sited, designed and planned with the same care in urban centers.

In this study we are designing a multilevel parking at a prime location of Bhopal city, this location is proposed for multilevel parking by Smart city Bhopal

department. In this study we will prepare a plan in autocad for parking which is G+4 structure with commercial shops at the ground floor, for analysis and designing of this structure we are using analysis tool staad.pro.



Fig 1 Proposed Location for Multilevel Parking

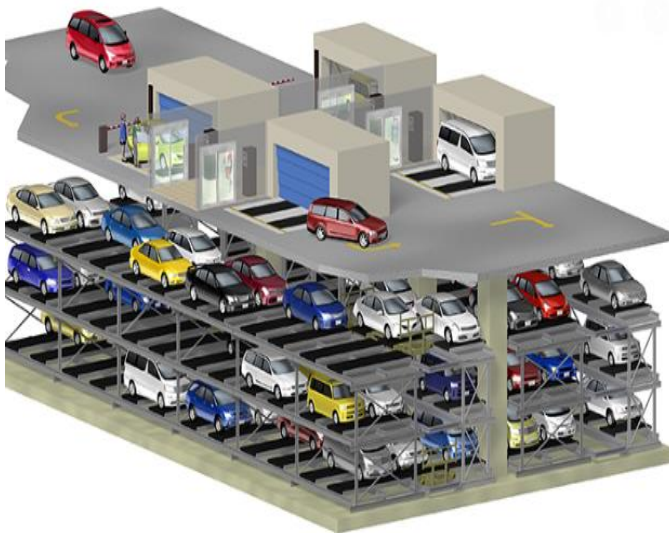


Fig 2 Smart Parking

### 1.1 Advantages & Application:

Smart Parking has many advantages over general parking as it has following advantages over general parking:

- It requires less space to settle down more number of vehicles as it provides floor wise parking area.
- It is easy to maintain smart parking as it is constructed by RCC structure.
- It is more safer for vehicles as it has tolls at entry and exit area with camera.
- It has higher revenue as it settle more number of vehicles.

Table 1 Geometrical description of parking area

Data	Description
Area	66 x 36 m
Structure	G+4
Height each floor	4.2 m
Column Size	0.8 x 0.8 m
Beam Size	0.6 x 0.3 m
Concrete	M-25
Rebar	HYSD 415

### 1.2 Objectives of the study

The main objectives of our study are as follows:

- To prepare a suitable planning for proposed area to settle down maximum number of vehicles.
- To prepare traffic survey of the locality at peak and low traffic time.
- To analyze and design the G+4 Structure of the multilevel parking using an analysis tool

Staad.pro.

- To determine the present condition of area where parking is proposed and number of

vehicles to be parked.

- To Analyze the structure considering seismic zone as per I.S. 1893-I:2016.

## II. Methodology

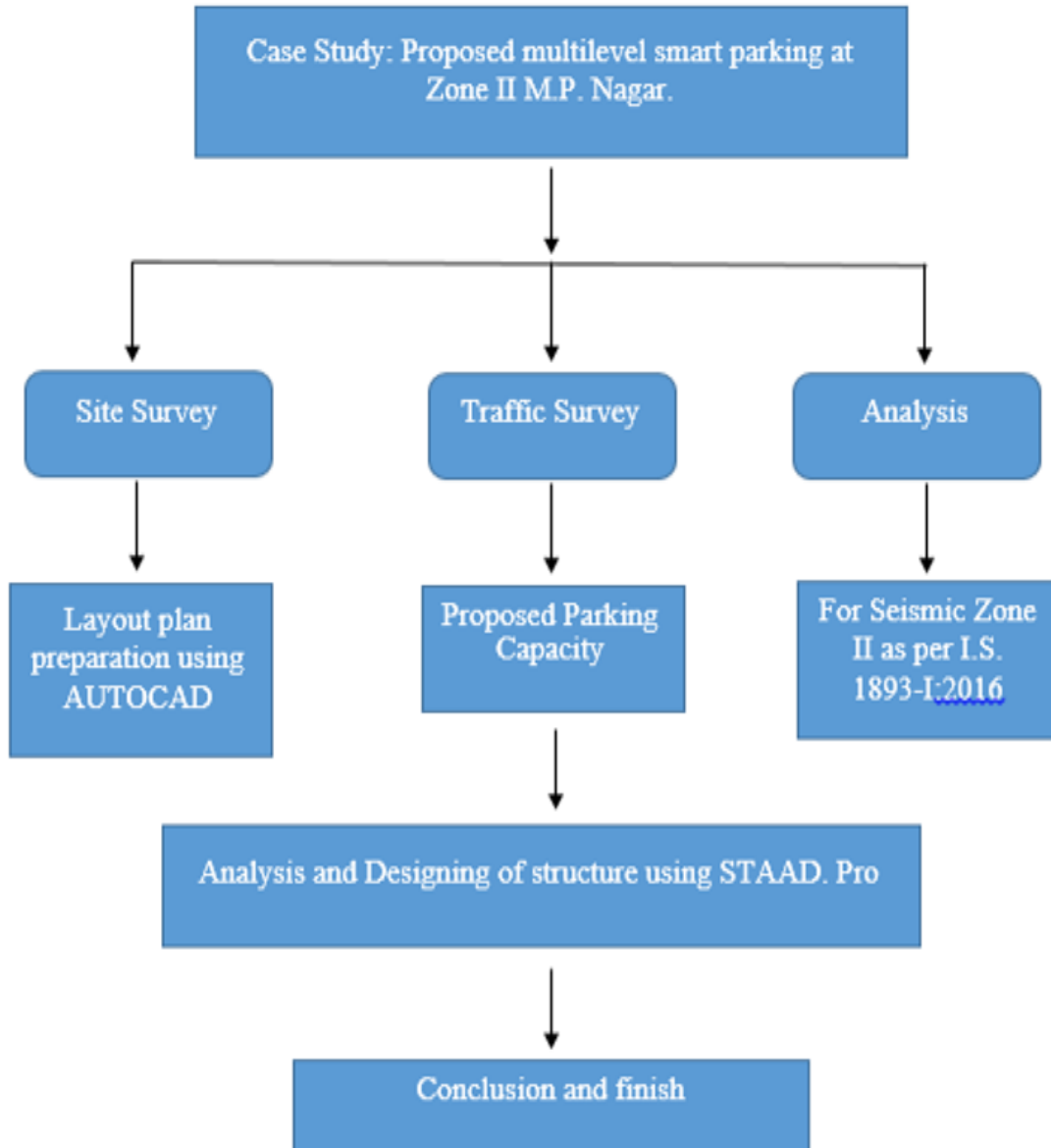
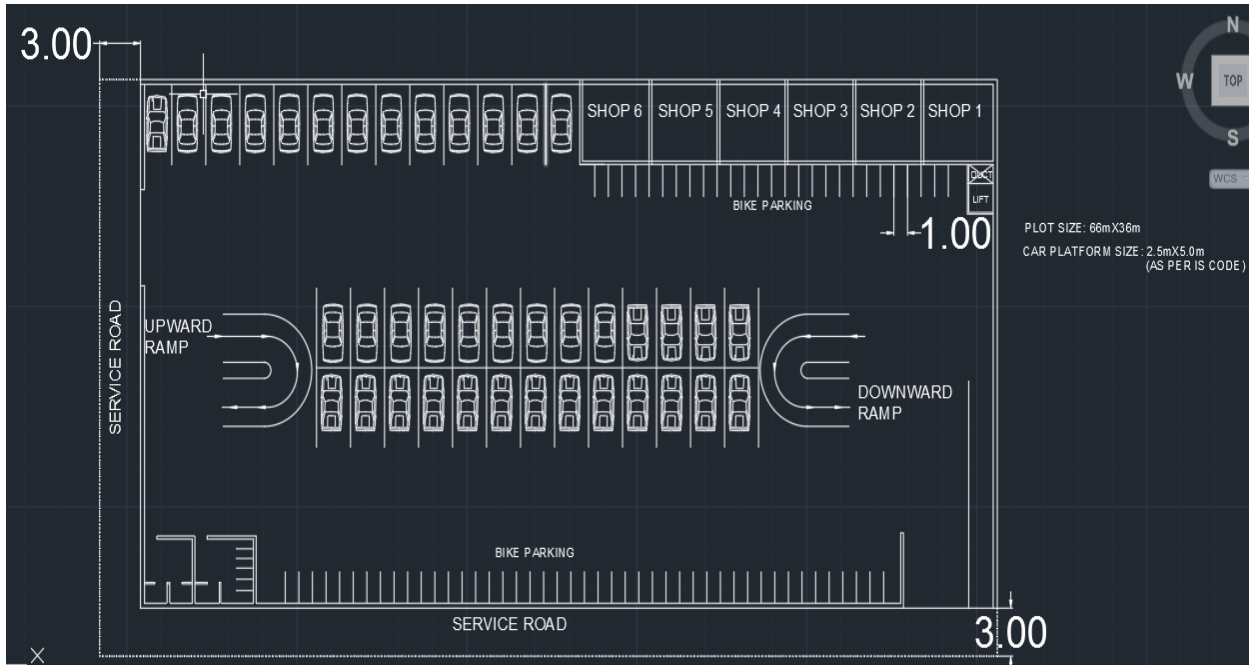


Fig 3 Flow Chart of the Study



**Fig 4 Planning Proposed for parking by Autocad plot size 66m\*36m car platform size:2.5m\*5m (As per IRC SP-12-2015)**



**Fig 5 3-D elevation of the multilevel parking proposed**

**Following steps were followed to complete the design process:**

**Step-1** First step is to review the literature related to our work done in past to justify the scope of work. This can be considered as the main aspect to select the scope of the study and to consider the objectives of the study. In this step we studied the publications and researches related to designing of multilevel parking, analysis of the structure and providing safe and economical design.

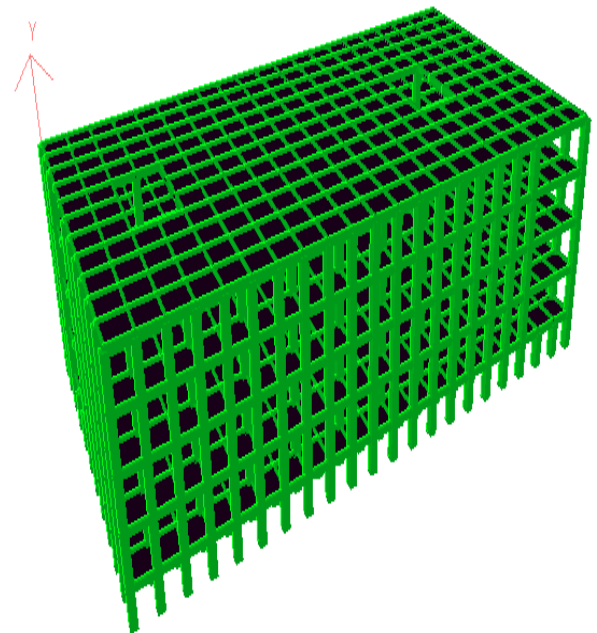
**Step-2** Second step is to select Parking Area in which design can be performed. As this study is based on the proposed parking area assigned at zone II M.P. nagar Bhopal. For details and descriptions of the project I took help of Bhopal smart city divisions in performing site inventory survey, designing work with there help.

**Step-3** third step is to calculate daily traffic flow and wrong parking vehicle. In this step with the proper team of smart city engineers we performed traffic survey to count the number of vehicles flowing and stopping at the proposed location also the increment in traffic at peak time. This procedure is necessary to calculate the parking capacity.

**Step-4** Fourth step is to assign suitable type of parking design for given area to settle down large number of vehicles. In this step planning is prepared considering number of vehicles and commercial shops at the ground floor.

**Step-5** To analyze the structure on the parameters of axial force, bending moment, Storey displacement. In this study we are analyzing the structure considering finite element method and checking forces, moment, displacement and stresses of the structural members.

**Step-6** To conclude our study in terms of sophisticated design. Here in this study our main objective is to perform this analysis and design process for alive project. And we did it with the help of Bhopal smart city. Thus in conclusion we can describe the procedure which is needed to be adopted before analysis and design of a multilevel parking.



**Fig 6 Modelling in staad.pro**

## 2.1 Application of Loads

DEAD LOAD as per I.S. 875-I

Self load Y -1

Wall load: Thickness x height x density  $0.23 \text{ m} \times (4.2 - 0.6)\text{m} \times 20 \text{ kN/m}^3 = 16.56 \text{ kN/m}$

Parapet load: Thickness x 1m x density  $0.23 \text{ m} \times 1\text{m} \times 20 \text{ kN/m}^3 = 4.6 \text{ kN/m}$

Slab Load: Depth x Density of RCC 0.2 m x 25  
 $kN/m^3 = 5 kN/m^2 + 0.9$  (Floor finish)

LIVE LOAD as per I.S. 875-II Considering  $5 kN/m^2$

Seismic Load: As per I.S. 1893-I:2002

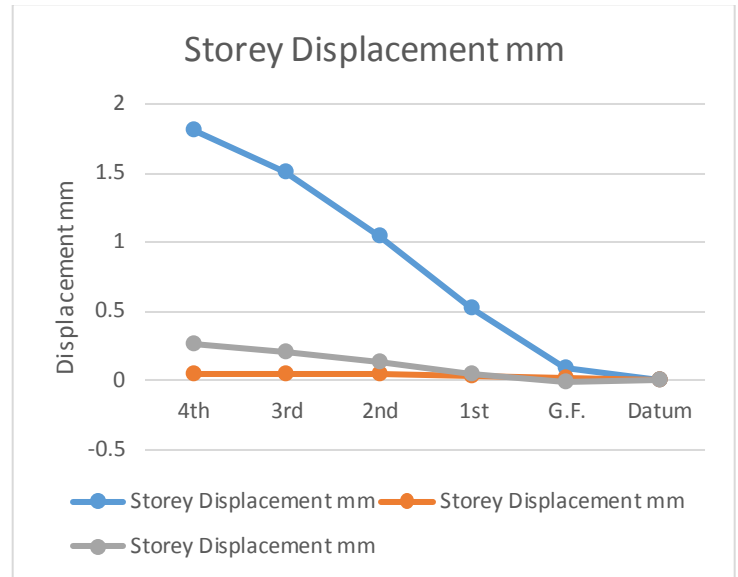
**SEISMIC DATA**

S.NO	CRITERIA	VALUE
ZONE	II	0.1
RESPONSE REDUCTION	(S.M.R.F)	5
IMPORTANCE FACTOR	ALL GENERAL BUILDING	1.0
SOIL TYPE	SOFT SOIL	-
DAMPING RATIO	-	.5%

**Table2 Seismic Data**

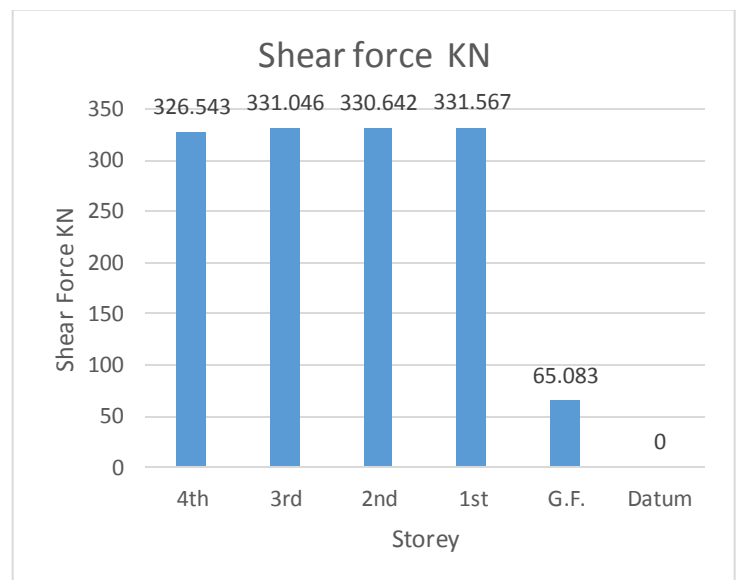
**III. Results and Discussion**

**Storey Displacement in mm:**



**Fig 7 Storey Displacement**

**Shear Force in KN**



**Fig 8 Shear Force KN**

**Axial Force in KN**

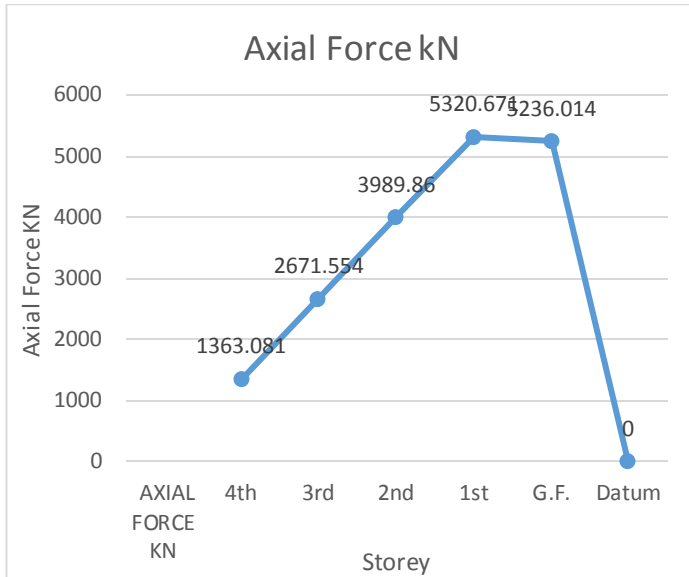


Fig 9 Axial Force KN

**Bending Moment in KN-m**

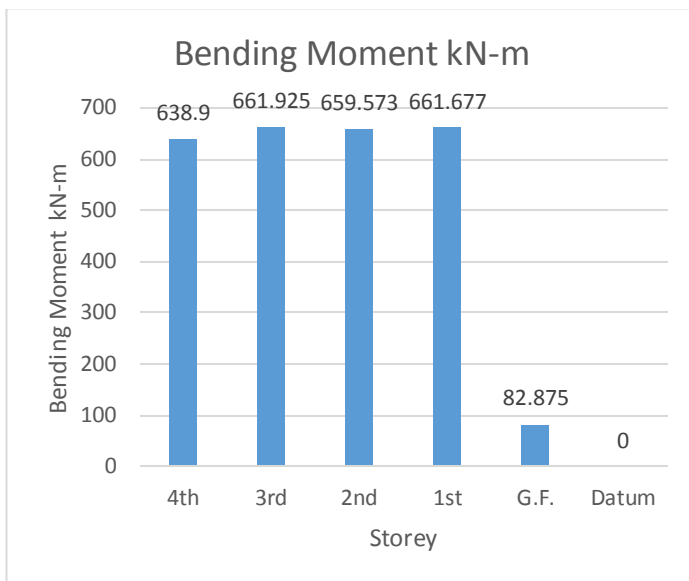


Fig 10 Bending Moment in KN-m

**IV. Conclusions & Recommendations**

A four storey structure is proposed at 2376 sq meter where the detailed design was prepared using AutoCad 2019 and the elevation was presented using Autodesk 3d Max 2019 with code name Neptune.

The structure design and analysis was done using STAAD.Pro v8i.

- a) Building displacement was found to be within permissible limit in all direction, hence safe in seismic hazards.
- b) Unbalance forces are observed linear in all the stories as sections adopted are safe in designing.
- c) Vertical forces are observed linear in distribution of load.
- d) Bending moment is observed linear in all the storey which will provide linear requirement of steel in the RCC members.

**Safety Aspect**

- Parking Safety lock.
- Convex mirrors on the corners of parking lot for further visibility.
- Speed bumps on the every intervals.
- Speed Limiters
- 24 hours CCTV invigilation

**Structural Aspect**

In future we can use composite materials for the construction of the structure in order to reduce the construction cost.

**Technology**

- Elevators
- Accelerators
- Stack
- Automated Parking Exits

## References

- [1] M.O. Reza, M.F. Ismail, A.A. Rokoni, M.A.R. Sarkar “Smart Parking System with Image Processing Facility” IJ. Intelligent Systems and Applications, 2012, 3, 41-47.
- [2] Trupti Y. Nirwan , Akash S. Waghmare , Gaurav R. Rahate, KartikBhujade, Asaraf Ali Saiyyad, AdarshShahu, Prof. A.D. Anjekar ” Introduction to vertical multistage car parking system” IRJET Volume: 03 Issue: 04 | Apr-2016.
- [3] Swanand S .Vaze, Rohan S. Mithari, Sanjay T. Sanamdikar” PLC Based Automatic Multistoried Car Parking System” Swanand S .Vaze et al. Int. Journal of Engineering Research and Applications ISSN: 2248-9622, Vol. 4, Issue 12(Part 6), December 2014, pp.67-71.
- [4] Infrastructure Development Department by “Development of multi level car parking facilities” KSIIDC-IL&FS Project Development Company (KIPDC) at KARNATAKA. 2018, pp.70.
- [5] FakultiKejuruteraanElektrik” Automated Parking System” University Teknikal Malaysia Melaka. [6] Ankit Gupta, AnkitJaiswar, Harsh Agarwal, Chandra Shankar” Automatic Multilevel Car Parking” International Journal of Electrical and Electronics Research ISSN 2348-6988 Vol. 3, Issue 2, pp.: (438-441), Month: April - June 2015.
- [6] Sawankumar G. Narone, Swapnil S. Chabukwar, Shriharh A. Valyal, Ravikant B. Hirapure, Prof. V. R. Solapure” Vertical Car Parking – A Prototype” International Journal of Emerging Technology and Advanced Engineering Volume 5, Issue 4, April 2015.
- [7]KushwahaShivam, Dr.Goliya S.S.“Evaluation of Traffic Rotary and Design of Traffic signal at

Habibganj Naka Bhopal” International Journal Of Science Technology and Engineering Volume 5,Issue:3, 1 October 2018.