

Design of Automated Multilevel Carparking System Using STAAD Pro

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ABSTRACT: A building which reduces the space for parking and also accommodates a large number of vehicles. The basic multi-level car parking system with three floors is considered to show the use of control systems in parking systems. The control system will play a major role in organizing the entry to and exit from the parking lots. It also presents the design of multi-level parking lots which occupies less need on the ground and contains the large number of cars. In the modern world, where parking-space has become a very big problem, it has become very important to avoid the wastage of space in modern big Automatic multi-level car parking system helps to minimize the car parking area companies and apartments. The parking lots have an elevator to carry cars to different floors according to the vacancies. The elevator is controlled by a programmable logic controller (PLC) along with the help of some sensors. The building is connected at one level and the levels of other floors are different. The automatic car parking system enables the parking of vehicles floor after floor and thus reducing the space used. These makes the system modernized and thus space-saving one. The plan for this building was prepared using Auto CAD software. The analysis of the frame was carried out for vertical and horizontal loads using STAAD Pro v8i software. The design has been done according to Indian standard code IS 800:2000, IS 875 Part I, Part II, Part III.

KEYWORDS: Car Parking, CAD software, STAAD Pro v8i software and automatic car parking.

I. INTRODUCTION

This project is based on proposing the design of a multilevel car parking system at Chengannur railway station. Chengannur railway station is the nearest rail station to reach famous pilgrimage places like Sabarimala, Pandalam, Aranmula Parthasarathy Temple, Parumala Church and Maramon. The railway station has been declared as 'Gateway of Sabarimala' by Indian Railways in 2009. It serves the people of 3 districts - Alappuzha, Kottayam and Pathanamthitta.

Multi-level car parking system serve advantages like safety, saving of space, time and fuel, but also need to have an extra and a very detailed assessment of the parking required, space availability and traffic flow. These can be further categorised into fully automatic or semi-automatic systems. It is essential especially in regions facing space shortages, also in areas which cater huge crowds. Failing to accommodate the growing number of cars, it has become imperative to come up with more efficient parking solutions. In this regard, multi-level automated car parking is considered effective in tackling the issue of parking.

Multi-level car parks offer greatest possible flexibility for the realization of optimum parking solution. Multi-level car parks offer provide a fast parking process in which the driver does not have to manoeuvre his car on each level. If there is no vacant space on the first floor, the lift automatically will go to the second floor and so on. A multi-level car parking is in fact a building with number of floors or layers for the cars to be parked. The different levels are accessed through interior or exterior ramps. An automated car parking has mechanized lifts which transport the car to the different levels. Therefore, such car parks need less building volume and less ground space and thus save the cost of parking. It also does away with the need for employing too many personal to monitor the place.

II. RELATED WORK

Arnott and Rowse (2000) developed an integrated model of curve side parking and traffic congestion in a downtown area. Curve side parking is exogenously priced below its social opportunity cost, and the stock of cars cruising for parking, which contributes to traffic congestion, adjusts to clear the market for curve side parking spaces. Spatial

competition between parking garages, as model in Arnott determines the equilibrium garage parking fee and spacing between parking garages. Also, the stock of cars cruising for parking adjusts to equalize the full prices of curve side and garage parking. This paper combines the ingredients of these two models, hence presenting an integrated model of curve side parking, garage parking, and traffic congestion, and examines curve side parking policy in this context through a numerical example with parameters representative of a medium-sized US city. The central result is that raising the curve side parking fee appears to be a very attractive policy since it generates efficiency gains that may be several times as large as the increased revenue raised.

P. Bhauguna, U. Mehta, K. A. Mamun (2009) Automatic multi-level car parks provide lower building cost per parking slot, as they typically require less building volume and less ground area than a conventional facility with the same capacity. However, the cost of the mechanical equipment within the building that is needed to transport cars internally needs to be added to the lower building cost to determine the total cost. Other costs are usually lower too, for example there is no need for an energy expensive ventilating system, since cars are not driven inside and human cashiers and security personnel may not be needed.

III. METHODOLOGY

- Site Visitation- a research that involve the presence of the researchers in analysing and observing different factors that is exist at the site case.
- Study Research- An in-depth investigation of issues at specific instances and locations.
- Comparative Research- A comparison of different analyses, that compares attributes, characteristics, or particular treatments across two or more situations.
- Demographic Analysis- A tool used to study the characteristics of human populations, such as size, growth, density, and distribution.
- Ethnographic Research- A method for obtaining an in-depth understanding of the history, practices, values, traditions, and circumstances of the groups and surrounding resources being studied.
- Observation- An information-gathering technique based on personal observation and recording of human activities and behaviours.
- Social Assessment- A method of data collection and analysis used to characterize the social environment in the area in which one manages (e.g., watershed, protected area).
- Social Impact Assessment- To identify how people and communities could potentially react to changes and to predict probable impacts of the implementation of rules and regulations.
- Survey- A standardized list of questions administered by mail, telephone, Internet, or in person.

IV. STRUCTURAL MODELLING ANALYSIS & DESIGN

A 3D view of the frame building is shown in Fig. 1. In this beams and columns are built up of steel.No internal walls are considered as the building deals with the storage of vehicles. The building has been analysed and designed for medium class soil, for earthquake zone III using Equivalent Static Method of Analysis. The same building has also been analysed and designed with concrete members with minimal changes in the geometry. Designs are based as per the present Indian standard codel provisions IS 875 Part I, Part II, Part III. Limit state method in IS 800:2007 is referred for the design.

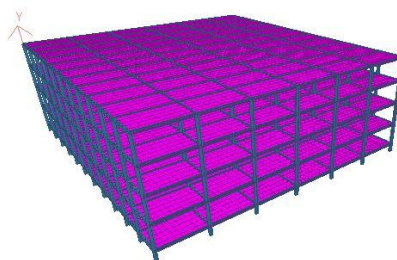


Fig. 1

Geometrical Data

- Type of building : Car Parking Structure
- Location of building : Chengannur (Kerala)
- Height of building from GL : 20.8 m
- Typical storey height : 3.2 m

Dimensions of building :

- Length (L) : 35.00 m (in X– direction)
- Breadth (B) : 32.50 m (in Z – direction)
- Area in Sqm : 1120sqm
- Loading Data Dead Load (DL) at any typical floor level & roof level = 3.71 kN/m²
- Live Load (LL) at any floor level : 4.50 kN/m²

Earthquake Load (EL)

- Zone factor : 0.16
- Importance factor : 1.0
- Utility ratio – Below 1.4

Capacity of the Structure:

- 44 cars per floor
- Maximum capacity of 176 cars at a time.

V. ASSUMPTION

Following are some assumptions made for general arrangement of building, analysis and design:

- Floor is made of reinforced cement concrete with steel deck acting as form work and bottom reinforcement, with topping for floor finish.
- All beams, columns and bracings are made of steel.
- The effective width of beam is taken as span/4 for T beams and span/8 for L-beams as per code provisions.
- The model is analysed & design with rigid condition prevailing in steel structure and for concrete complete fixity is assumed to act.
- The model is assumed to have fixed support at base constructed on medium type of soil, located in zone III with depth of foundation of 1.8 meters.

VI. RESULT

SECTION USED:

BEAMS - ISHB 200

COLOUMNS – ISHB 250

FLOORING – STEEL DECK OF 10cm THICKNESS

ROOF – G.I SHEETS

UTILITY RATIO – BELOW 1.4

DEFLECTION LIMITS

- IS 800:2000 TABLE 6
- Deflections are to be checked for the most adverse but realistic combination of service loads and their arrangement, by elastic analysis, using a load factor of 1.0.
- Suitable provisions in the design shall be made for the dynamic effects of live loads, impact loads and vibration/fatigue due to machinery operating loads.

SHEAR FORCE AND BENDING MOMENT DIAGRAM

➤ Shear force diagram obtained after analysis by STAAD Pro V8i:

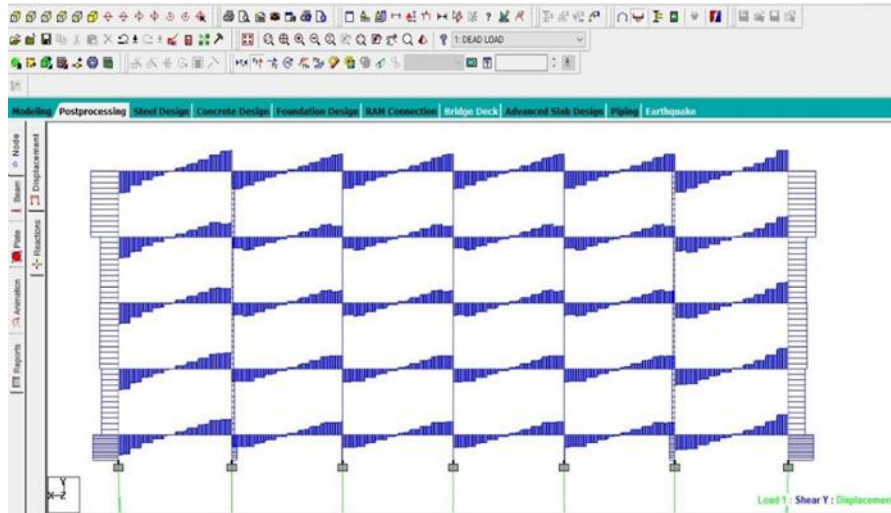


Fig. 2

➤ Bending moment diagram after analysis by STAAD Pro V8i:

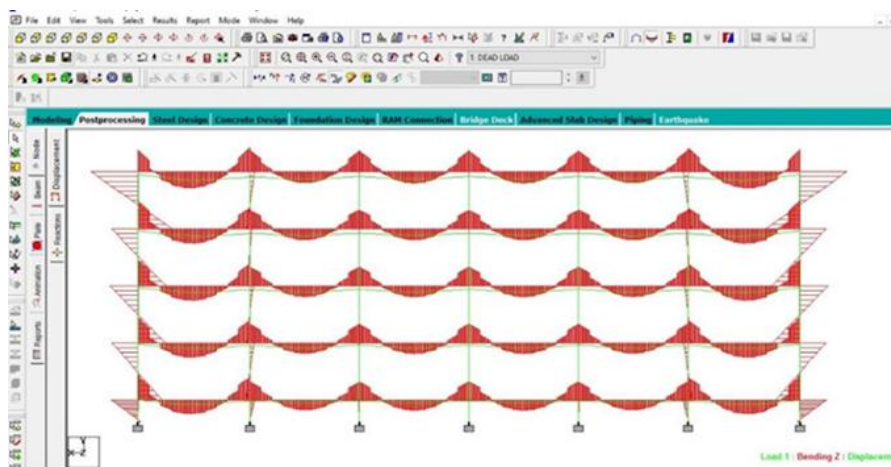


Fig. 3

VII. CONCLUSION

- The multi-level car parking was designed as a complex building with G+5 and G+4 floor sand analysed, which gives a great knowledge about the designing components.
- The layout of the building was planned with reference of Codes to facilitate maximum utility.
- The various difficulties in designing the steel structure have been understood.
- The overall bending moment is reduced in structural component when bracings are provided. It leads to decrease the size of component.
- Also the profile deck floor system is lighter than the solid concrete slab system and this reduction in weight will affect the total cost.
- Displacement is also reduced in braced frame than moment resisting frame.
- Base shear is also reduced in braced frame structure compare to moment resisting frame.
- The 3.73% weight reduces while considering braced frame over the moment resisting frame.

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