

Design & Analysis of Multi-Storied Car Parking Building (G+2)

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ABSTRACT: As we all know that day by day there is an increase in traffic congestion due to an increase in the number of vehicles in the nearby region. For the betterment of this reduction in congestion in this particular region of Chandrapur District, we proposed the design of a Multi-Storied Car Parking Building in the most crowded areas like as Bus Stand Area, more likely to be constructed. This Parking Building is of (G+2). In which the Ground Floor can be utilized as Two-Wheeler Parking. Total number of Two-Wheeler parking can be near about 200 vehicles at a time. And in First Floor and Second Floor area is provided for Car Parking. Problem of such parking we are facing due to unplanned roads where width of the road is improper so that the flow of vehicle is improper manner, so that such area may face more congestion problem. Irregular parking of such vehicles may lead to traffic congestion.

Study represents the design of Multi-Storied Car Parking Building for the moderation of traffic challenges in particular region. Total area of building is 80 m x 30 m (2400 m²). Firstly, plan was made on AUTO-CAD software with all details of column and beam design. Further it was placed in STAAD.PRO SOFTWARE to analysis of the frame structure for the vertical and horizontal loads. The design has been studied according to IS 456:2000.

KEYWORDS – Multi-Storied Car parking, AUTOCAD, STAAD.PRO, planning.

I. INTRODUCTION

The traffic survey was carried out from the patch of Gandhi Chowk to Mel, Mul Road. The most congested area from that survey is to be justified as Bus Stand Area where the most no. of vehicular congestion is observed. So we have decided to make such Multi-Storied Car parking Building Near Bus Stand Area so that the traffic congestion of this area may be reduced. As this site lies in center of the city and can be reduced much traffic.

This research presents the design of a multi-storied car park for the mitigation of traffic challenges in public areas using various case studies. Various design aspects which are considered are arrangements of deck and ramp, planning the dimensions, the bay width, aisle width, ramp dimensions, planning grid, alignment paths to exit barriers, means of escape distances, travel distances from the car to the destination, security, visibility, space allowances and lift provision.

A) OVERVIEW OF PROJECT

The idea behind this work is to prepare a detailed plan of Multi-Storied Car Parking with provision for parking area in each floor (G+2).

The total area of the parking system is 2550 m². All the important amenities for a car parking have been included. The design of all components such as slab, beams, columns and footing has been done with aid of STAAD PRO. The access to each floor has been provided using staircase.

B) OBJECTIVE OF PROJECT

- To reduce the parking area by providing multi-storied parking building.
- To provide the safety and secured environment for the parked vehicles.
- To reduce the traffic congestion.
- To propose a multi-storied building near regional area.

C) MOTIVATION OF PROJECT

The number of vehicles has increased on roads. Lacking the facility of parking in regional town. Vehicles are being parked along the highway sides, residential roadway, pathway and green points of the roads. Frequent traffic jams due to irregular parking. In our regional town parking area is unplanned for four-wheeler vehicles. So, there is a need to make an improvement in the parking area by constructing Multi-storied Parking.

D) NEED OF PROJECT

E)

The number of cars and other vehicles has increased on roads of all city of the world. The rural roads construction in the past in old new way has proved competent to accommodate increases number of vehicles.

Our regional towns is also lacking the facility of parking, due to which the vehicles are being parked along the highway sides, residential roadway, pathway and green points of the roads which causes frequent traffic jams. The precious time of workers and local public.

II. LITERATURE SURVEY

A) DESIGN OF MULTILEVEL CAR PARKING BUILDING

A building which reduces the space for parking and also accommodates a large number of vehicles. The study presents the design of a multi-level car parking for the mitigation of traffic challenges in public areas. The area of the building is 6800 m². The building is connected at one level and the levels of other floors are different. All floors are designed to accommodate 50 vehicles. 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 software. The design has been done according to Indian standard code IS 456:2000. The structural elements like slab, beam, columns, footing, staircase and ramp has been designed and detailed.

Authors research: - The multi-level car parking was designed as a complex building with G+5 and G+4 floors and analyzed, which gives a great knowledge about the designing components. The layout of the building was planned with reference of Codes to facilitate maximum utility. For emergency purpose separate dog-legged staircase is provide on back side of structure.

Automatic car parking system could be done as the further improvement of the project. The moments acting on all the RC elements have been identified and the design is done to carry the moments acting on the structure. The various difficulties in designing the RC structure have been understood.

Our Adaptation:- Design using STAAD PRO.

B) DESIGN AND ANALYSIS OF COMMERCIAL BUILDING USING STAAD.PRO

The commercial building having mixed stories with shopping complex and office space, Shopping is a routine activity of each and every one. But they have short of time, so they need a shopping complex and office space under one roof to save the valuable time. In metropolitan cities, very limited areas are available and sold at high cost. This paper will help to build buildings within this limited area satisfying each of every need of the people. It is also designed in such a way that it would be economical. This project work involves planning, analysis, designs, and drawings of a typical multi-storied building. This project attempt has been made to Design and Analysis of a G+8 storied commercial building with seismic resistance. This project involves Planning, Analysis, and Design Drawings. In Analysis various load cases and load combinations are included in this project. R.C.C framed structure is used for Multi storied commercial buildings. Structural design is to be done using Limit state method.

Authors research: - Analysis and Design of a G+8 Commercial building with wind effect using STAAD Pro.

Our Adaptation: - Design using STAAD PRO for commercial buildings in details.

III. METHODOLOGY

- ❖ Planning in AUTOCAD
- ❖ Import Plan in STAAD PRO
- ❖ Modelling
 - (G+2) Multi-Storied Car parking Building in STAAD.PRO
 - Loads (LL+DL+RL)

- ❖ Analysis of Frame Structure
- ❖ Design Parameters
 - Parameter of Building
 - Column (0.70 m x 0.50 m)
 - Beam (0.60 m x 0.55 m)
 - Slab thickness 0.10 m
 - Height of each Floor 3m each

3.1 Planning in AUTOCAD

Planning in AUTOCAD by proper Dimensions which shows Column and Beam frame Structure.

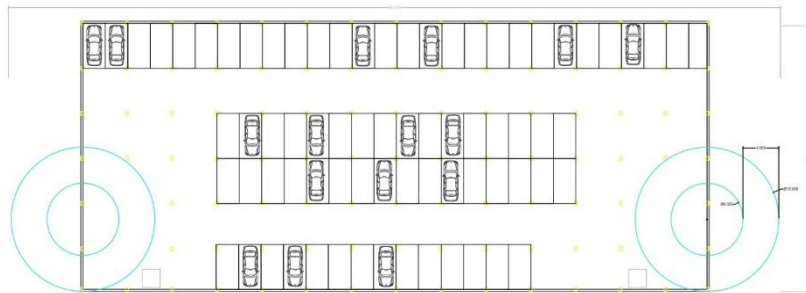


Fig.1 :Showing car parking at FF & SF.

3.2 Import of plan in STAAD PRO

As the STAAD PRO software is very much helpful for the Structural Design of any type of Building as it very less time-consuming software to design frame Structure and Analysis. STAAD.Pro gives more Accurate results than Manual solving techniques.

Working of STAAD PRO

- Start Program
- Click on new project
- Save file as your required name
- Tick on open Structure wizard & Finish
- Select model type as Frame Models
- Click on bay Frame
- Give length, height, width etc. & Apply
- Go to File menu Select merge model with STAAD.PRO Model
 - **Design**
 - Concrete (Code IS 456)
 - Select to assign
 - Assign to view all columns & Beams
 - Analysis for Design possessing ZERO ERROR & ZERO WARNING
 - Report Generation

IV. ANALYSIS BY USING STAAD.PRO

The Model successfully merged in file with STAAD.PRO software

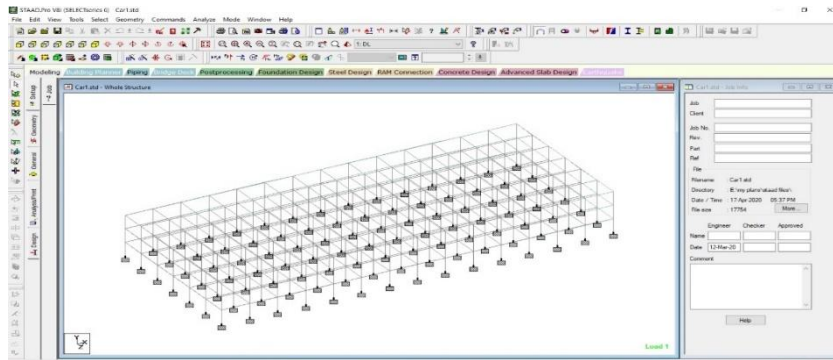


Fig.2. 3D Modelling of (G+2) Multi-Storied Car parking Building in STAAD.PRO

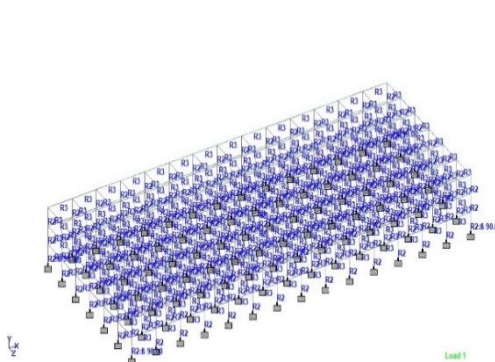


Fig.3. Beam Nos.

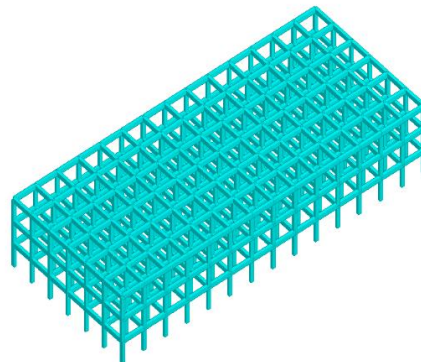


Fig.4. 3D Rendering View

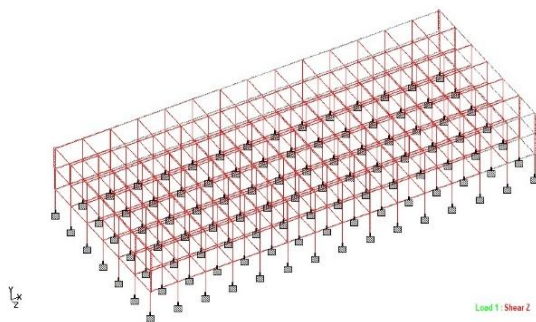


Fig.5. Shear Force Diagram at fz

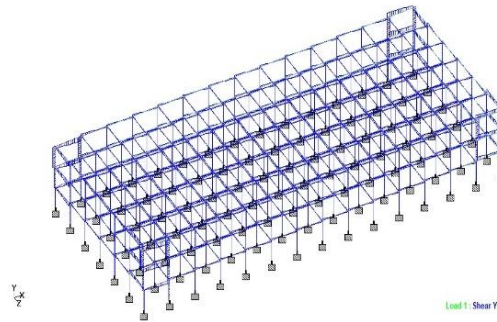


Fig.6. Shear Force Diagram at fy

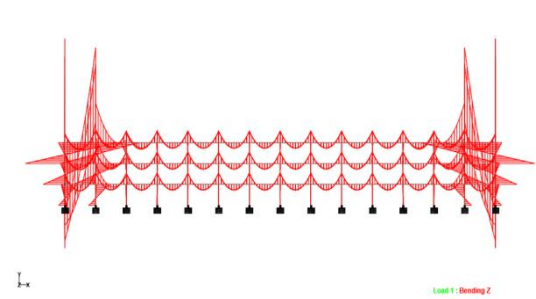


Fig No 7: Bending Moment Diagram (2D)

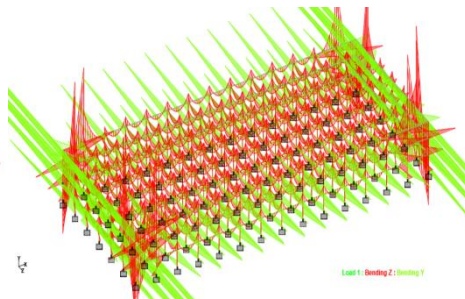


Fig No 8: Bending Moment Diagram (3D)

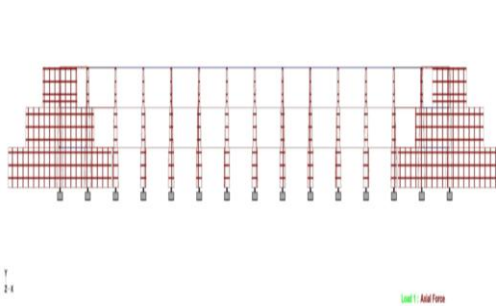


Fig No 9 : Axial Force Diagram (2D)

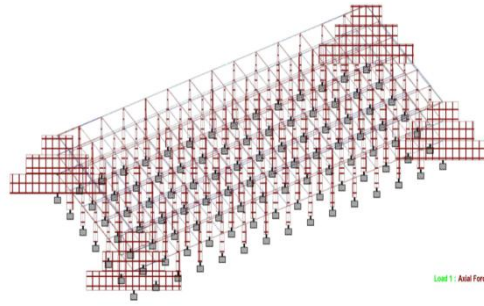


Fig No 10: Axial Force Diagram (3D)

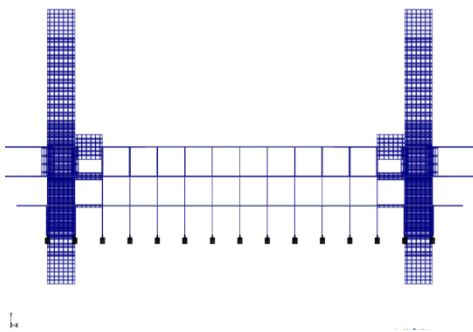


Fig No 11: Torsion Diagram (2D)

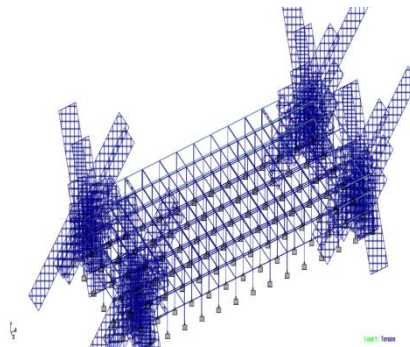


Fig No 12: Torsion Diagram (3D)

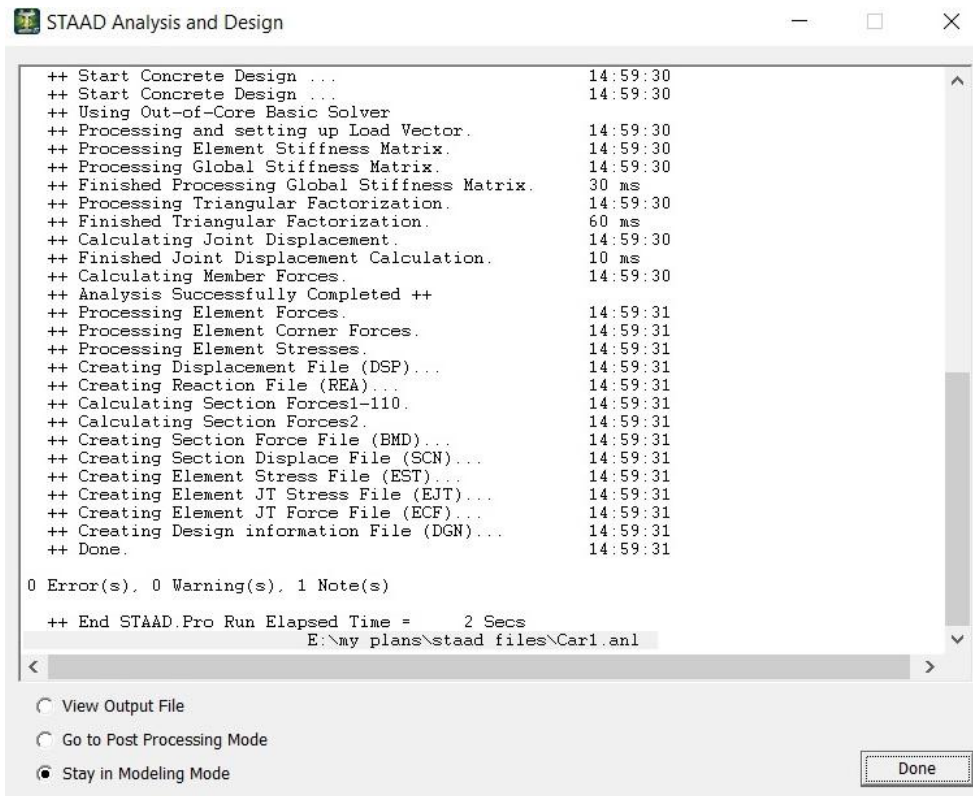


Fig No 13 : Analysis Report

4.1 DESIGN OF SLAB

4.1.1 GENERAL

The most common type of structural element used to cover floors and roofs of buildings is a reinforced concrete slab.

4.1.2 CLASSIFICATION OF SLABS

The slabs are classified into the following types. They are

- 1) One-way slab
- 2) Two-way slab
- 3) Flat slabs
- 4) Grid slabs

4.1.3 LOADS ON SLABS

Generally, in the design of horizontal slabs, two types of loads are considered:

- Dead Load
- Live Load

4.1.4 SLAB DESIGN

The slab which has the maximum span has the maximum moment and hence the detailing result for such span can be used for all other spans as well as. The slab with maximum dimensions in our plan 5.00 m x 5.00 m each span has been continuously provided, which is an interior panel. The design of this particular slab is given in this chapter.

1 General Data

Size of Slab = 5 X 5 m.

Concrete Grade (fck) = 30 N/mm²

Steel Grade (fy) = 415 N/mm²

2. Check For Type Of Slab:

$L_y = 5\text{ m}$ $L_x = 5\text{ m}$

$L_x / L_y = 1 < 2$

Hence, it's a **Two-Way slab**.

3. Depth

Depth = Span / 25

= 2500/25

= 100mm.

OVERALL DEPTH (D) = 125 mm

EFFECTIVE SPAN = 10 + 0.125

= 10.425 m

4. Load Calculation

S.W OF SLAB = (0.225 x 1 x 25) = 3.125KN /m²

Live Load = 0.75 KN /m²

Floor Finish = 1 KN /m²

Total Load = 4.875 KN /m²

Factored Load = (1.5 x 4.875) = 7.312 KN /m²

5.Moment Calculation

From IS 456 Table 26;

$\alpha_x = \alpha_y = 0.047$

$M_{ux} = M_{uy} = (\alpha_x W_u L_x^2)$

= (0.047 x 11.0625 x 5*2)

$M_{ux} = M_{uy} = 9.00\text{ KN.m.}$

6. Check For Depth

$M_{u\max} = 0.138f_c k b d^2$

$d = 0.659\text{m}$

(Depth cannot be provided less than 150mm)

Therefore, Adopt $d = 150\text{mm}$

7. Reinforcements

$M_u = (0.87 f_y A_{st} d)[1 - (A_{st} f_y / f_c k b d)]$

$A_{st} = 767\text{ mm}^2$

Provide 10mm dia. Bars,

$S = (1000 \times 78.53) / 767$

$S = 102.3\text{mm}$

Provide 10mm dia. Bars at 100 c/c in both directions.

4.2.DESIGN OF BEAM

4.2.1. GENERAL

Beams are the members on which the slabs rest upon. Beams are horizontal members over which slabs rest. The reactions from the slab get transferred to the beams. The loading for a beam is given as a uniformly distributed load. The weight of overlying walls also gets transferred to the beams. There are two types of beams. They are as follows-

1. Plinth beams.
2. Roof beams.

4.2.2. LOADS ON BEAMS

As mentioned above the loads on the slab are considered to be uniformly distributed load. The beams are subjected to bending and develop bending stresses. The beams are designed for flexural resistance and are checked for safety against deflection. The loads which are considered for design are as follows:

1. Dead load
2. Live load
3. Wall load

Details of beam:

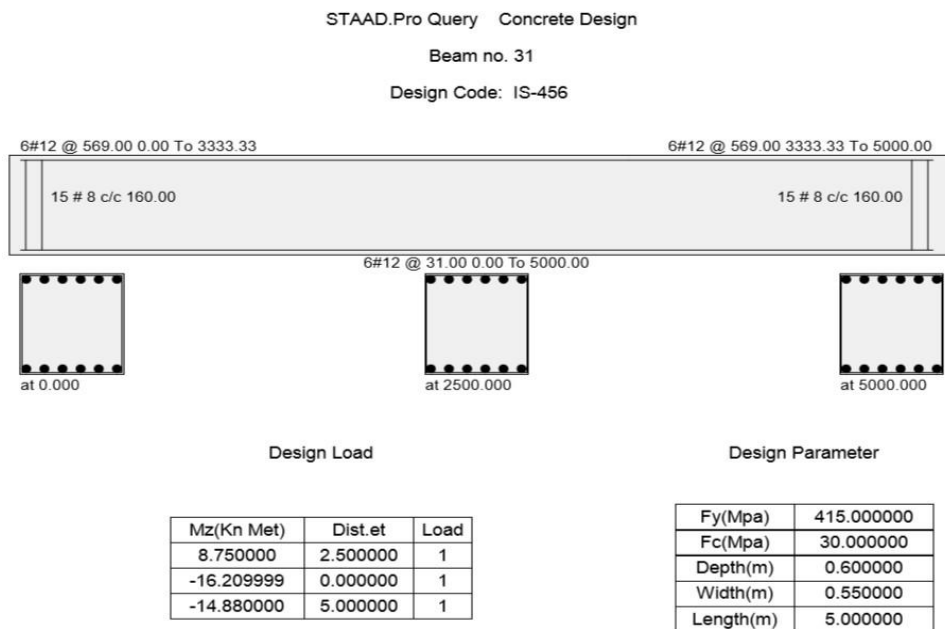


Fig No 14:Details of Beam(STAADPRO Analysis)

4.3 DESIGN OF COLUMN

4.3.1 GENERAL

Columns are the vertical members of a structure. The columns support the beams present in the building. The reactions of the beams are transferred as loads to the column. The loading for a column is given as an axial load. The types of columns are as follows:

1. Short columns- fails by crushing.
2. Long columns- fails by buckling.

4.3.2 LOADS ON COLUMNS

As mentioned above the load to the columns are given as axial loads. The column is subjected to axial stresses. But there are also columns with uniaxial bending and biaxial bending. The loads which are considered for the design are as follows:

1. Dead loads.
2. Live loads

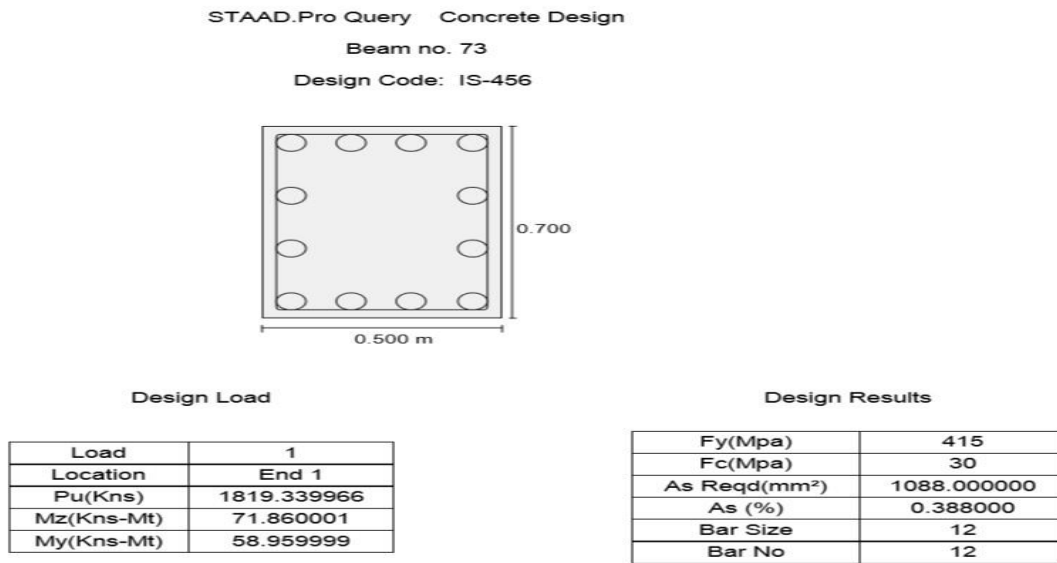


Fig No 15: Details of column(STAADPRO Analysis)

4.4 DESIGN OF FOUNDATION

As the whole Structure depends upon the structure of Building main elements of Structure that transfer the loads from several Columns and beams to the Earth is Foundation. So here is the Design of an ISOLATED FOOTING by using STAAD.PRO Software. There are total 375 nos. of Isolated footing is to be design for the of Multi-Storied Car Parking Building of area 2400 m². Foundation Geometry as length-7.750 m, Width-7.750 m, Thickness- 0.858 m Footing Reinforcement Bottom Reinforcement(Mz) - Ø12 @ 50 mm c/c Bottom Reinforcement(Mx)- Ø12 @ 50 mm c/c Top Reinforcement(Mz) - c Ø6 @ 75 mm c/c Top Reinforcement(Mx)- Ø8 @ 75 mm c/c.

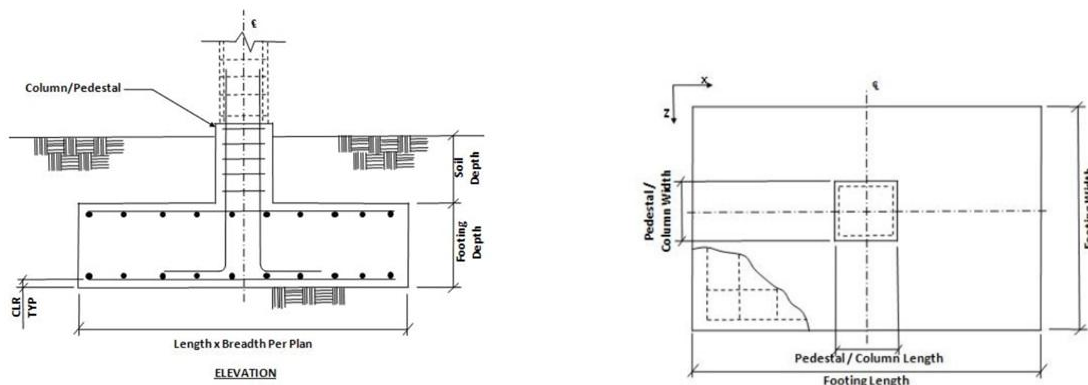


Fig No 16: Details of Isolated Footing(STAADPRO Analysis)

V. RESULTS AND CONCLUSION

1. The Multi Storied Car parking Building was designed as G+2.
2. All the standards values were taken from the reference Codes to facilitate maximum utility.
3. Column size as compare to large span of structure as Column (0.70 m x 0.50 m) also Beam (0.60 m x 0.55 m) & Slab thickness 0.10 mm.
4. As the Designed Structural Components are Safe.
5. There is No Error in Analysis in STAAD.PRO.
6. Further we can make approximate Estimation of Building and also by using Revit Software Architecture to make good modelling of The Multi Storied Car parking Building G+2.



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