WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Design and Analysis of Residential Building Using AUTOCAD and STAAD Pro

C. Roopasri[1], R. Raj Kumar[2], S. Rathna Swamy[3]

[1,] M. Tech Student, Department of Civil Engineering, Viswam Engineering College, Madanapalli,
[2,3]Assistant Professor, Department of Civil Engineering, Viswam Engineering College, Madanapalli,

ABSTRACT

Since structures must now have distinctive architectural features, the uniformity in plan, mass, and rigidity may be disturbed in the present. The structure might develop torsion as a result of this.

A modern building is one that has a unique design from typical buildings. Most modern structures have asymmetrical shapes. It is difficult to construct and analyze such structures. This project's main goal is to plan and evaluate a contemporary home. This project aids in the creation of fresh designs and in the clear comprehension of structures. In this project, STAAD Pro will be used to design and analyze a Modern House. CAD software, Sketch Up. This project also includes footing design, detailed drawings, and 3D modeling.

KEY WORDS: STAAD PRO, LOADS, ANALYSIS, DESIGN,

1. INTRODUCTION

When suggesting a specific type of plan to a client, the engineer must consider the city-based conditions, building bye laws, surrounding conditions, financial management, water supply, sewage arrangement, provision of future, filling with air, which refers to bringing fresh air, ventilation, etc. We conducted the following survey and concluded that the area is suitable for home construction in this setting.

Popular civil engineering software programs like AutoCAD, STAAD pro, Revit, Sketch up were used to complete the project.

Layout of design

IRREGULAR BUILDINGS

⇩

PLANNING

⇩

ANALYSIS

⇩

FOOTING DESIGN

⇩

PROJECT SCHEDULING

⇩

ESTIMATION

2. LITERATURE REVIEW

Ranjan ET. AL. (2020) suggested that an AUTOCAD 2018 layout plan be created for the proposed building. This and many other common texts are used to calculate the bending moment, shear force, deflection, end moments, and foundation responses. The structure was examined using STAAD Pro Connect Edition.

Dhamge ET. AL. (2019)" Damage from earthquake ground motion typically starts at sites where structural vulnerabilities exist in the lateral load resisting frames in multi-storeyed framed buildings. These vulnerabilities may occasionally result from differences in stiffness or mass between neighbouring storeys. Such storey transitions are frequently accompanied by abrupt changes in the vertical geometric irregularity. Structures with soft stories that have vertical abnormalities can be further divided into the many categories of irregularities and their severity to provide a more accurate assessment tool. As one of the methods for assessing buildings against earthquake loads, pushover analysis

3. METHODOLOGY

The planned project covers nearly every facet of building development from beginning to end.

The following is the step-by-step process developed to meet the objectives:

1. The project began with the creation of an AUTOCAD house plan.

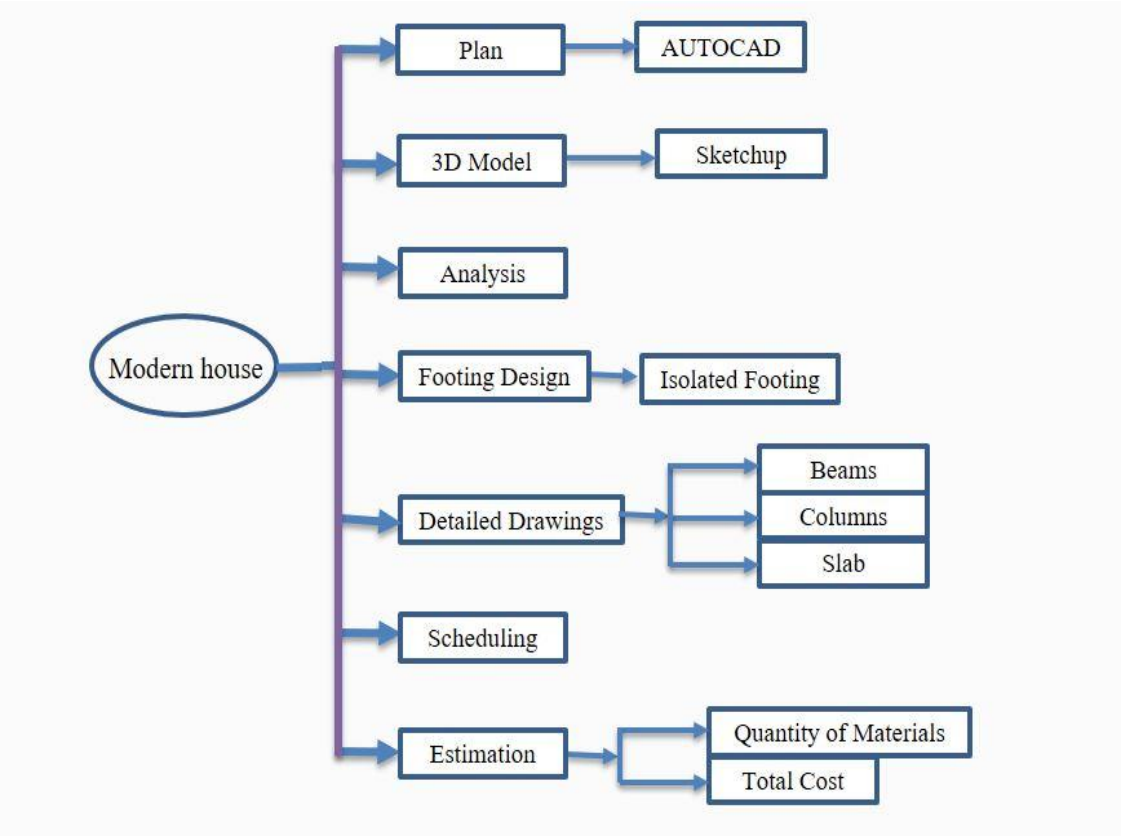
2. A Sketchup 3-D model of the home is created.

3. STAAD Pro is used to analyze the structure.

4. STAAD Foundation for Isolated Footing is used to create the footing.

5. RCDC (Advanced Concrete Design) and STAAD Foundation are used to extract detailed drawings of beams, columns, slabs, and footings.

6. When building the house, scheduling is done to determine the total number of days needed to finish the project and its critical path.



4. ANALYSIS AND MODELLING

For the drafting and design of any construction, AutoCAD is quite beneficial. The fields of architecture and construction also employ this software. The software's several built-in capabilities enable complex drafting. In addition to 2D, 3D, and other dimensions, AutoCAD is also appropriate for perspective design, which refers to a way of perceiving objects. Below are listed the many house plans.

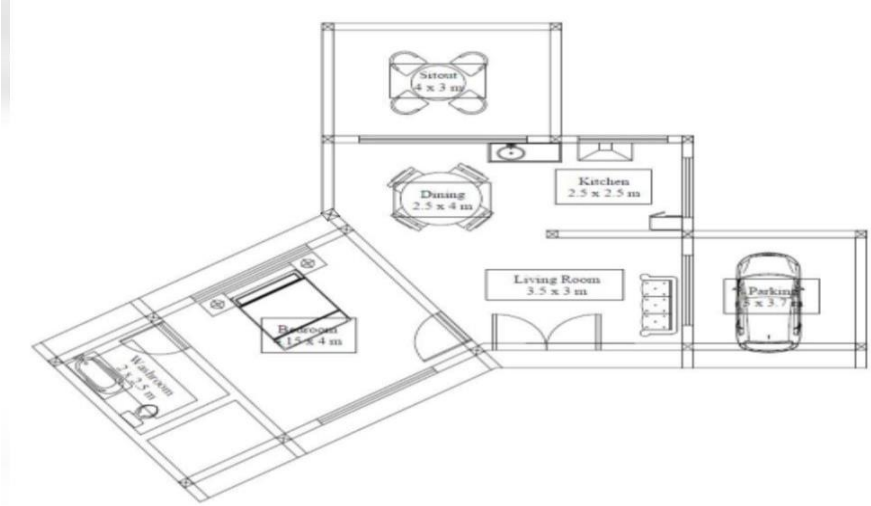


Figure 5.1: Plan of House

5.2 3D MODEL

Layout planning, 3D modeling, and realistic effects are all done with Sketch Up. Additionally, there are certain applications in the creation of movies and video games as well as in architecture, interior design, landscape architecture, civil and mechanical engineering. It is a web-based program. Trimble Inc. owes Sketch up money in August 2000.

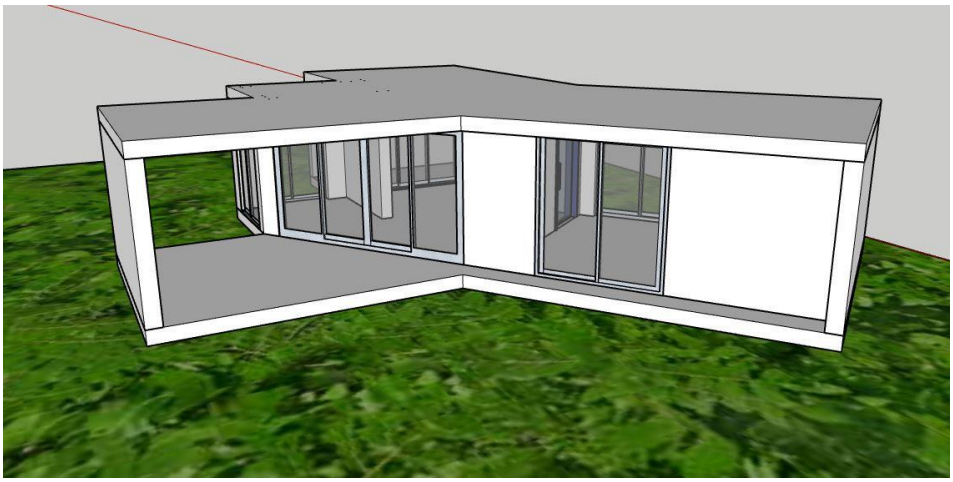


Figure 5.2: Rear View of the House

5.3 ANALYSIS

After the study, we opened Staad Pro and chose the Design option to start designing the structure. All design parameters were entered and the load cases were selected. The beam, column, and slab designs are now finished. Transfer the structure and load cases to the STAAD Foundation program, then launch it to design the foundation. The type of foundation and the soil characteristics are then entered. subsequently to this program analysis and the basic designs."

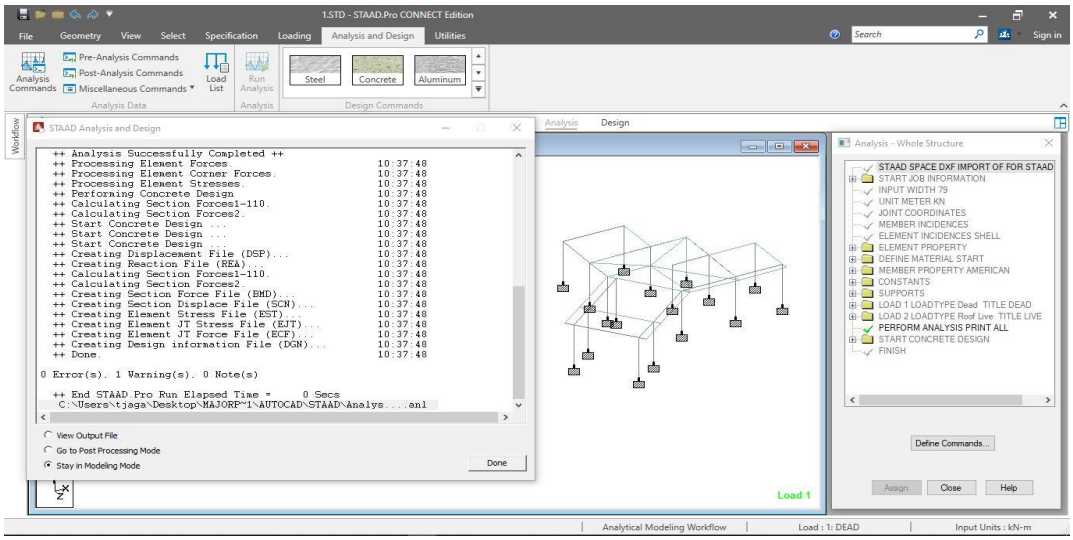


Figure 5.3: Analysis Tab showing zero errors

5.4 DETAILED DRAWINGS

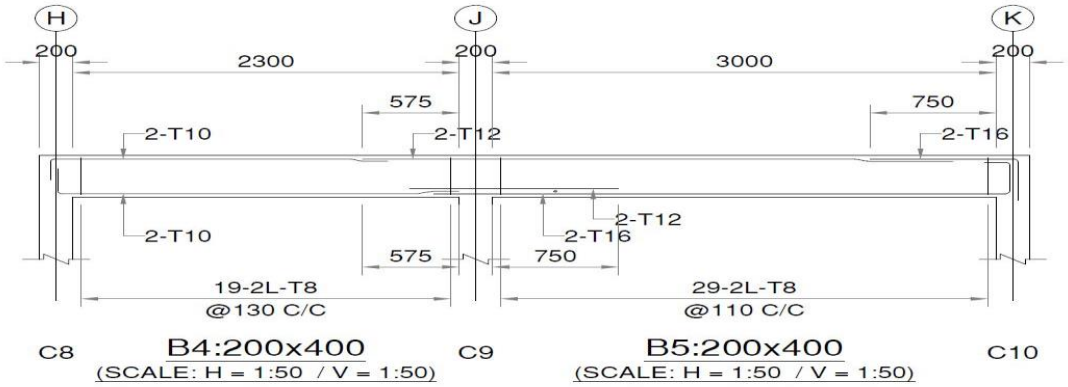


Figure 5.4: Detailed Drawing of Beam

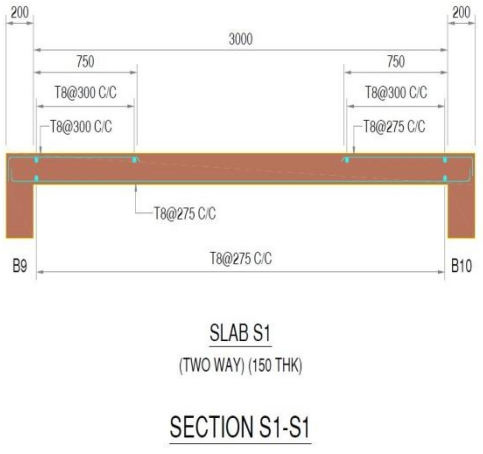


Figure 5.5: Detailed Drawing of a Slab

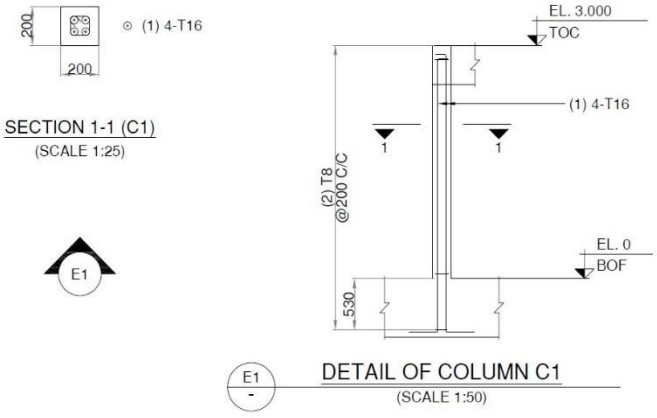
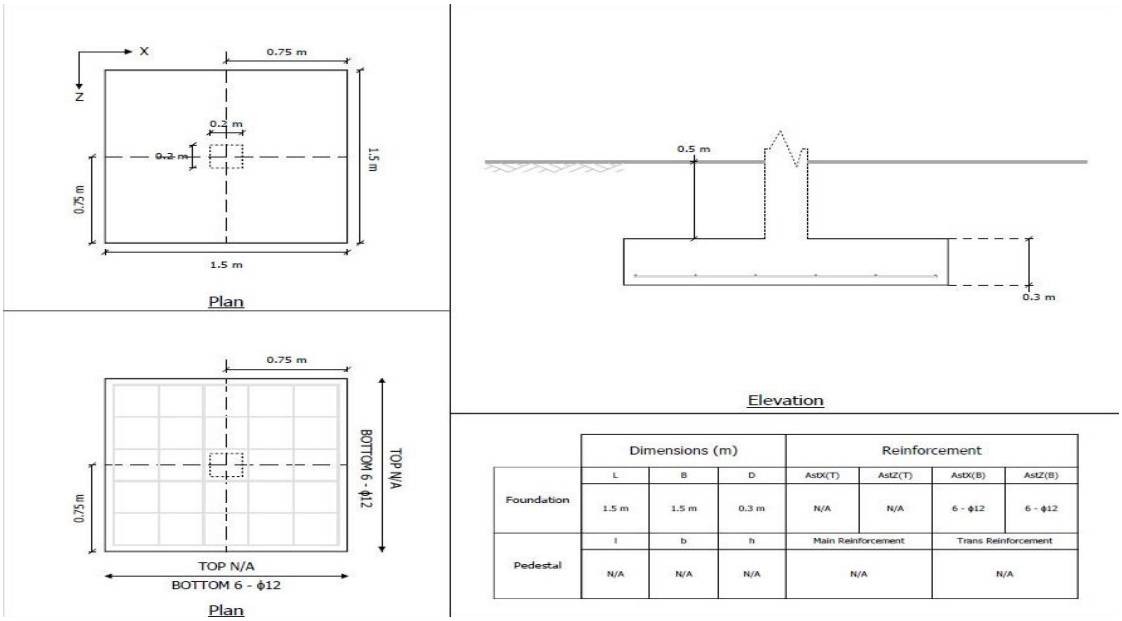


Figure 5.6: Detailed Drawing of Column



	Dimensions (m)			Reinforcement			
	L	B	D	AstX(T)	AstZ(T)	AstX(B)	AstZ(B)
Foundation	1.5 m	1.5 m	0.3 m	N/A	N/A	6 - ϕ12	6 - ϕ12
	l	b	h	Main Reinforcement		Trans Reinforcement	
Pedestal	N/A	N/A	N/A	N/A		N/A	

Figure 5.7: Detailed chart for Footing

6.RESULTS

6.1 BENDING MOMENT DIAGRAMS

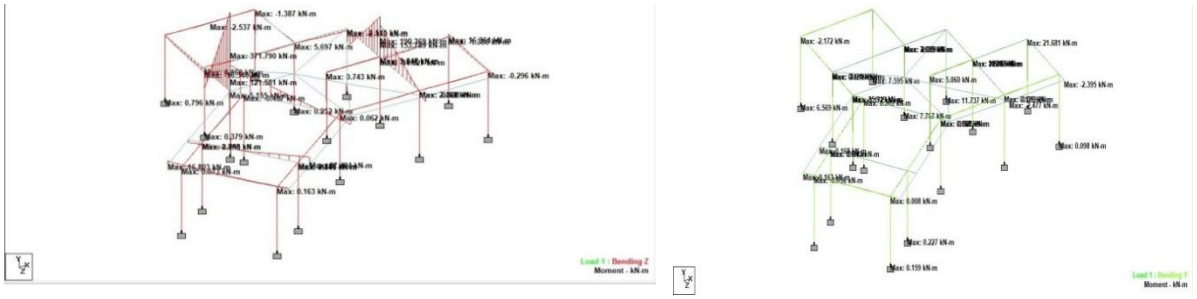
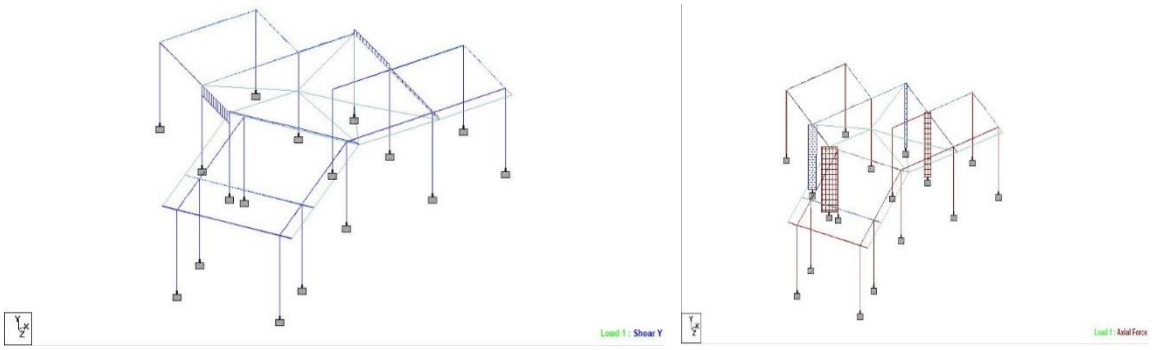


Figure 6.1: Bending Moment about z and Y axis

6.2 SHEAR FORCE DIAGRAM & AXIAL FORCE DIAGRAM

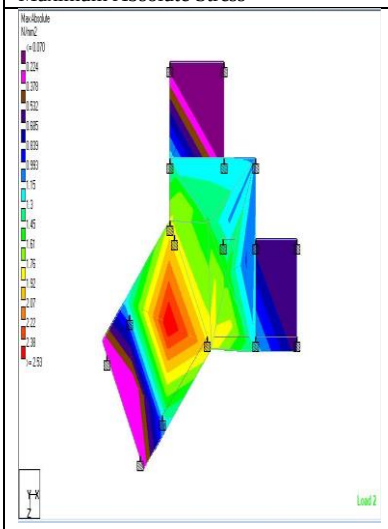
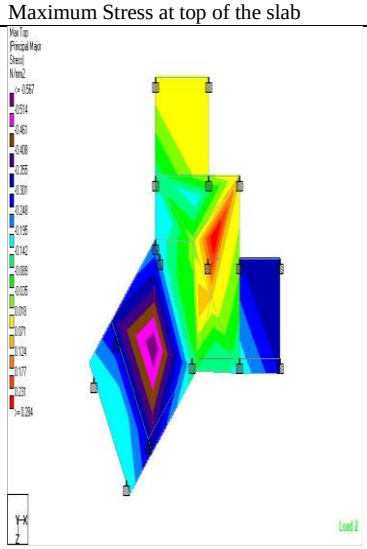
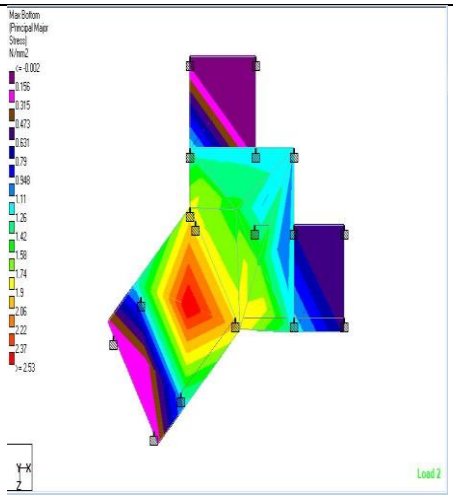


6.3 PLATE STRESSES

The plate stress diagrams for the house are given below.

The different plate stress diagrams given below are

- Maximum top stress diagram
- Maximum bottom stress diagram
- Maximum Absolute stress diagram

Maximum Absolute Stress	Maximum Stress at top of the slab	Maximum Stress at bottom of the Slab
		

use STAAD pro. For designing, we opt to use Indian Design Code for Concrete IS-456. The commands such as "beam design," "column design," "element design" (for slabs), and "concrete take off" are defined. We specify our material characteristics in the model as well. For concrete and steel, we use fck=20 mpa, fy=415 mpa, and fy = 250 mpa for primary reinforcement and shear reinforcement, respectively. We conduct the model analysis and design processes again. The program takes into account various components and outputs results for each section. The software's display of the reinforcing details for the identical beam with the number 46 is as follows.

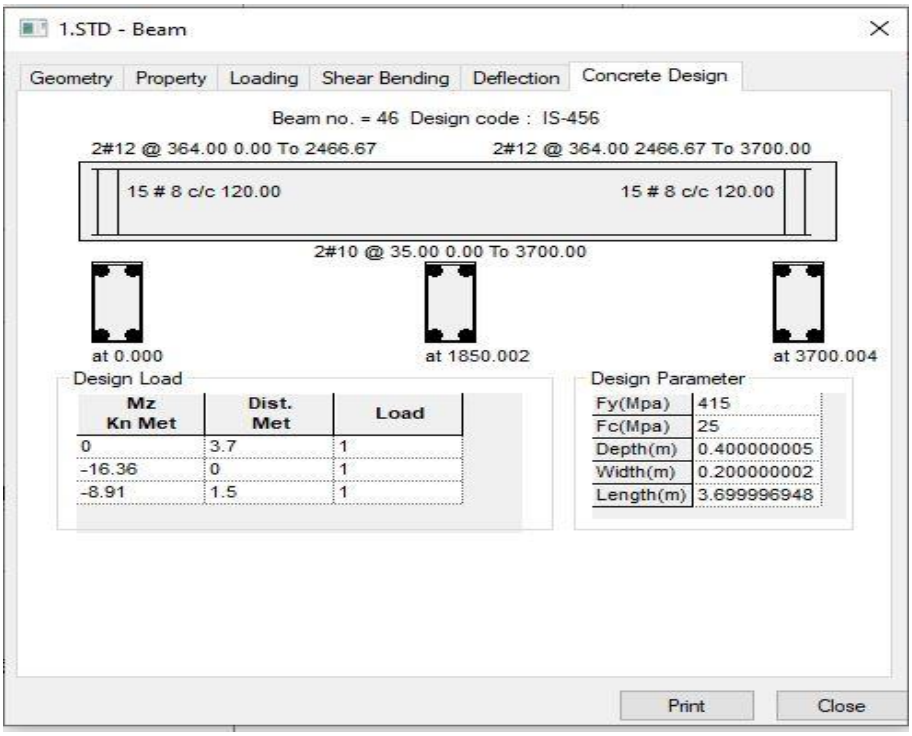


Figure 6.2: Concrete Design for Beam

Table 6.1: Beam Design Result

```
                ================================================
                IS 456 - 2000  B E A M   D E S I G N   R E S U L T S
                ================================================


================================================================================
                IS-456    L I M I T    S T A T E    D E S I G N
                B E A M  N O.      45   D E S I G N  R E S U L T S

      M25                    Fe415 (Main)              Fe415 (Sec.)

    LENGTH:  3200.0 mm      SIZE:   200.0 mm X  400.0 mm   COVER: 30.0 mm

                      SUMMARY OF REINF. AREA (Sq.mm)
--------------------------------------------------------------------------------
SECTION      0.0 mm      800.0 mm     1600.0 mm     2400.0 mm     3200.0 mm
--------------------------------------------------------------------------------
 TOP         149.52        149.52        149.52        149.52        150.33
REINF.      (Sq. mm)      (Sq. mm)      (Sq. mm)      (Sq. mm)      (Sq. mm)

BOTTOM       206.59        186.32        156.35        149.11        149.11
REINF.      (Sq. mm)      (Sq. mm)      (Sq. mm)      (Sq. mm)      (Sq. mm)
--------------------------------------------------------------------------------

                      SUMMARY OF PROVIDED REINF. AREA
--------------------------------------------------------------------------------
SECTION      0.0 mm      800.0 mm     1600.0 mm     2400.0 mm     3200.0 mm
--------------------------------------------------------------------------------
 TOP        2-10d         2-10d         2-10d         2-10d         2-10d
REINF.   1 layer(s)    1 layer(s)    1 layer(s)    1 layer(s)    1 layer(s)

BOTTOM      2-12d         2-12d         2-12d         2-12d         2-12d
REINF.   1 layer(s)    1 layer(s)    1 layer(s)    1 layer(s)    1 layer(s)

SHEAR   2 legged  8d  2 legged  8d  2 legged  8d  2 legged  8d  2 legged  8d
REINF.  @ 120 mm c/c  @ 120 mm c/c  @ 120 mm c/c  @ 120 mm c/c  @ 120 mm c/c
--------------------------------------------------------------------------------
```

Table 6.2: Column Design Results

```
                ============================================================
                IS 456 - 2000   C O L U M N   D E S I G N   R E S U L T S
                ============================================================


================================================================================
                IS-456    L I M I T    S T A T E    D E S I G N
              C O L U M N   N O.     21  D E S I G N   R E S U L T S

      M25                    Fe415 (Main)              Fe415 (Sec.)

LENGTH:  3000.0 mm   CROSS SECTION:  200.0 mm X  200.0 mm  COVER: 40.0 mm

** GUIDING LOAD CASE:    1 BRACED LONG COLUMN


REQD. STEEL AREA   :      572.65 Sq.mm.
REQD. CONCRETE AREA:    39427.35 Sq.mm.
MAIN REINFORCEMENT : Provide   4 - 16 dia. (2.01%,    804.25 Sq.mm.)
                     (Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 200 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
------------------------------------------------------------
Puz :    621.80   Muz1 :     17.60   Muy1 :     17.60

INTERACTION RATIO: 0.99 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
------------------------------------------------------------
WORST LOAD CASE:     1
Puz :    691.27   Muz :     22.98   Muy :     22.98   IR: 0.75
================================================================================
```

6.4 FOUNDATION DESIGN AND RESULTS

This design process will also result in an output file containing calculations for each individual footing and a table containing information about each footing's reinforcement. The output file is used to send a lot of data. Additionally, STAAD Foundation will offer a timetable as a DWG file. The typical plan and section of the footings utilized for this project are shown in the image below.

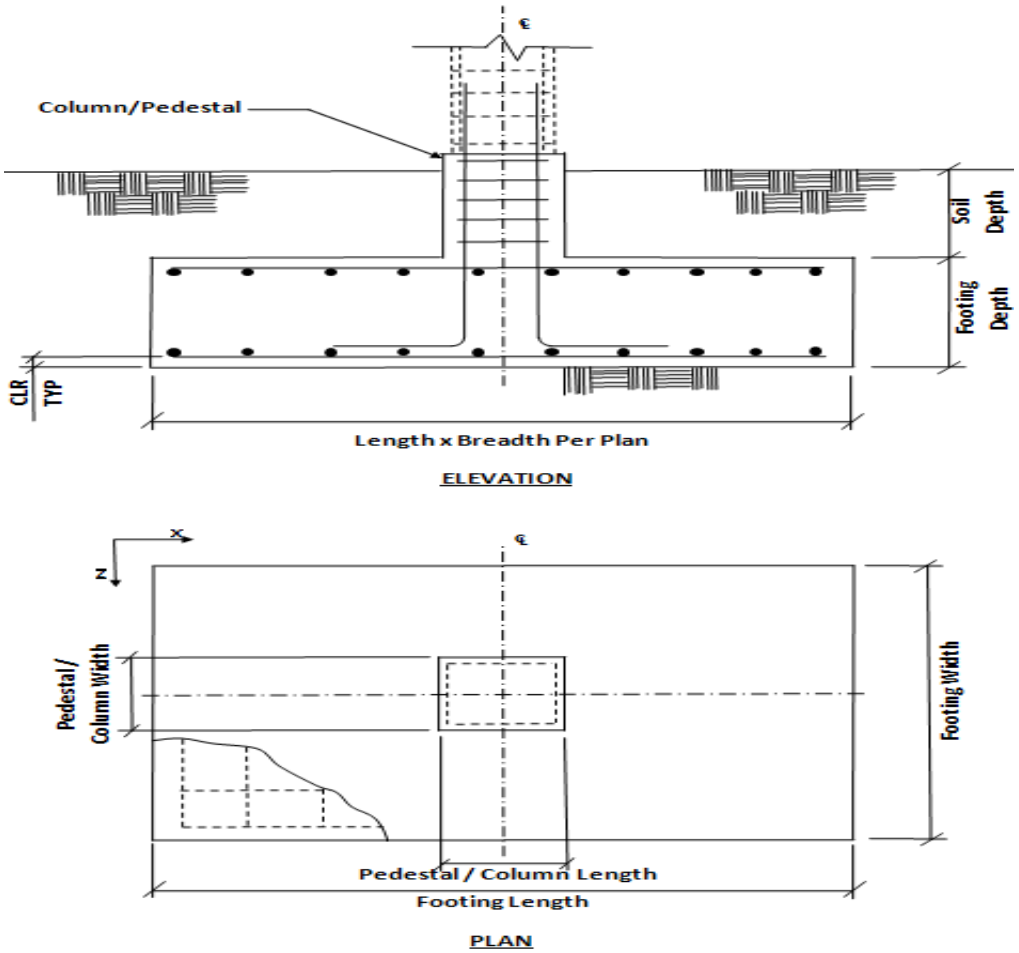


Figure 6.3: Footing Design

7. CONCLUSION

The tasks listed at the beginning of this project were completed successfully.

The tasks and their final results are as follows:

According to analysis,

- The maximum bending moment in Z-direction is 37.494 KN-m;
- The maximum bending moment in Y-direction is 35.919 KN-m;
- The maximum shear force about Y-direction is 52.575 KN;
- The maximum shear force is noted as 33.803 KN and
- The maximum reaction is noted as 108.59 KN.

8. REFERENCES

1) IS 456 2000: Plain and Reinforced Concrete

2) IS 875 (Part - 2): Code of practice for Design Loads

3) IS 800: code of practice for general construction in steel

4) Structural analysis and design of irregular shaped reinforced concrete slabs using a simplified design method, Journal of Structural Engineering & Applied Mechanics 2020, Volume 3, Issue 4.

5) Architectural Design of Irregular Buildings, International Journal of Civil & Environmental Engineering, IJCEE-IJENS, Vol: 12, No: 01

6) Frampton, Kenneth (1980). Modern Architecture: A Critical History (3rd ed.). Thames and Hudson. pp. 210–218.

7) COMMON SCHEDULE OF RATES AS PER A.P. REVISED STANDARD DATA FOR THE YEAR 2020-21, (Effective from 1st June, 2020).

8) ACI (1999). "Building Code Requirements for Structural Concrete (ACI 318-99) and Commentary (ACI 318R-99)", American Concrete Institute, Farmington Hills, U.S.A.

9) Al-Ali, A.A.K. and Krawinkler, H. (1998). "Effects of Vertical Irregularities on Seismic Behavior of Building Structures", Report No. 130, The John A. Blume Earthquake Engineering Center, Department of Civil and Environmental Engineering, Stanford University, and Stanford, U.S.A.

10) Aranda, G.R. (1984). "Ductility Demands for R/C Frames Irregular in Elevation", Proceedings of the Eighth World Conference on Earthquake Engineering, San Francisco, U.S.A., Vol. 4, pp. 559-566.