Available online: www.ijsrmes.com

International Journal for Scientific Research in Modern Engineering and Science

International Journal for Scientific Research in Modern Engineering and Science, 4(3): 28 - 40 (2023)

DESIGN AND ANALYSIS OF SHOPPING MALL (2B, G+2) COMPLEX BUILDING USING STAAD.PRO

Prateek Kashyap [1]*, Amani Sahu [2]

[1]*B. Tech. Student, Department of Civil Engineering, Shri Shankaracharya Technical Campus, Bhilai (C.G.), India.*

[2]*Assistant Professor, Department of Civil Engineering, Shri Shankaracharya Technical Campus, Bhilai (C.G.), India.*

Abstract

The main aim of structural engineer is to design the structures for a safe technology in the computing field; the structural engineer can dare to tackle much more large and complex structure subjected to various type of loading condition. In order to compete in the ever-growing competent market, it is very important for a structural engineer to save time. As a sequel to this an attempt is made to analyze and design a shopping mall complex building by using a software package Staad Pro. The main goal of this project is to use Staad Pro to investigate and construct a mall shopping complex building. The architecture entails manually calculating loads and testing the whole system with Staad pro. As specified by the Indian Standard code of practice limit state Architecture is used in the Staad Pro research. Staad pro comes with a cutting-edge User experience. simulation software and versatile Research and modelling engine to perform sophisticated it is a model generation choice for professional, study, design and simulation and outcome verification. We began by analyzing essential manually test two-dimensional frames with the software accuracy against our findings. The outcomes were correct.

Keywords: Analysis, Design, STAAD PRO, Residential Building, Gravity Load, Shear Force, Bending Moment, Axial Force.

** Corresponding author*

1. INTRODUCTION

In every aspect of human civilization, we needed structures to live in or to get what we need. But it is not only building structures but to build efficient structures so that it can fulfill the main purpose for what it was made for. Here comes the role of civil engineering and more precisely the role of analysis of structure. The design consists of SHOPPING MALL (2B, G+2) Commercial building. The building is designed for the three commercial flats. The floor-to-floor distance is 4.5m. There are many classical methods to solve design problem, and with time new software's also coming into play. Here in this project work based on software named "STAAD. Pro" has been used. Few standard problems also have been solved to show how "STAAD. Pro" can be used in different cases. These typical problems have been solved using basic concept of loading, analysis, condition as per IS code. These basic techniques may be found useful for further analysis of problems. STAAD Pro features a state-of the-art user

interface, visualization tools, powerful analysis and design engines with advanced finite element and dynamic analysis capabilities.

From model generation, analysis and design to visualization and result verification, STAAD Pro is the professional's choice for steel, concrete, timber, aluminum and cold-formed steel design of low and high-rise buildings, culverts, petrochemical plants, tunnels, bridges, piles and much more.

To perform an accurate analysis a structural engineer must determine such information as structural loads, geometry, support conditions, and materials properties. The results of such an analysis typically include support reactions, stresses and displacements. This information is then compared to criteria that indicate the conditions of failure. Advanced structural analysis may examine dynamic response, stability and non-linear behavior. Few standard problems also have been solved to show how "STAAD. Pro" can be used in different cases. These typical problems have been solved using basic concept of loading, analysis, condition as per IS code. These basic techniques may be found useful for further analysis.

2. LITERATURE REVIEW

- Borugadda Raju et al., (2015)- has been designed and analysed G+30 multi-storey building adopting STAAD. Pro in limit state methodology. STAAD.Pro contains an easy interface that permits the users to produce the mount and the load values and dimensions are inputted. The members are designed with reinforcement details for RCC frames. The analysis is completed for two dimensional frames and then it is done for more multi-storeyed 2-D and 3-D frames under various load combinations. Anoop. A, (2016) has explained that the scope of the project is to provide a multi storied building of G+ 5 floors. Revit 2011 and Auto CAD 2014 software is used for developing 3-D models. The structure analysis and design are done using STAAD.Pro. The results are checked for selected members using limit state method of design as per IS 456-2000.
- Sreeshna KS (2016)- This paper deals with structural analysis and design of B+G+4 storied apartment building. The work was completed in three stages. The first stage was modelling and analysis of building and the second stage was to design the structural elements and the final was to detail the structural elements. In this project STAAD.Pro software is used for analysing the building. The IS:875 (Part 1) and(Part 2) were referred for dead load and live load. Design of structuralelements like beam, column, slab, staircase, shear wall, retaining wall,pile foundation is done according to IS Codes.
- Sowrav Saha(2021) - The present project deals with the design & analysis of a multi storied residential building of G-14 consisting of 2 apartments in each floor. The dead load &live loads are applied and the design for beams, columns, footing is obtained STAAD Pro with its new features surpassed its predecessors and compotators with its data sharing capabilities with other major software like AutoCAD. We conclude that staad pro is a very powerful tool which can save much time and is very accurate in Designs. Thus, it is concluded that staad pro package is suitable for the designof a multistoried building.

3. MATERIAL AND METHOD

3.1 Material & Density of materials used

Concrete – M30

Steel- Fe500

MATERIAL:	**DENSITY**
Reinforced	25.0KN/m
Brick masonry	19.0KN/m3
Plain concrete	24.0KN/m
Flooring material(c.m)	20.0KN/m
Fly ash	5. OKN/m3

3.2 Building Details

- Utility of building: Commercial building
- Area of Building : 19000 sqm
- Total Shops of building : 119
- No. of cinema hall : 4
- No. of Lifts : 4
- No. of Emergency stairs all floor : 3
- Ground floor: 4.5m
- No of storeys: 2B,G+2
- Shape of the building: H Shape Rectangular
- Height of building: 18 m
- Type of construction: R.C. C Framedstructure
- Floor height: 4.5m
- Basement 1 height: 3.5 m
- Basement 2 height: 4.5 m
- Total height of building: 27 m
- Dimension of building: 150 X 180 m
- Slab thickness: 200mm
- Live load: 3 KN/m2mlm

3.3 Loads

The different loads used in the project are,

- Dead load
- Live load

- Wind load in X direction
- Wind load in -X direction
- Wind load in Z direction
- Wind load in -Z direction
- Seismic load in X direction
- Seismic load in Z direction

4. OBJECTIVES

- Test for safe bearing capacity of soil.
- Generating structural framing plan
- Creating model in STAAD PRO
- Application of loads on the member
- Analysis of the structure
- Design the structure (manual design).

5. MODELING AND ANALYSIS

It is one of the effective software which is used for the purpose of analysis and design of structure by the structural engineers. Our project is aimed to complete with the help of Staad.pro STAAD Pro gives more precise and accurate results than manual techniques.

- Analysis and design tool
- GUI based modeling
- Input file/Output file
- Results as per Indian & other standards
- Report generation

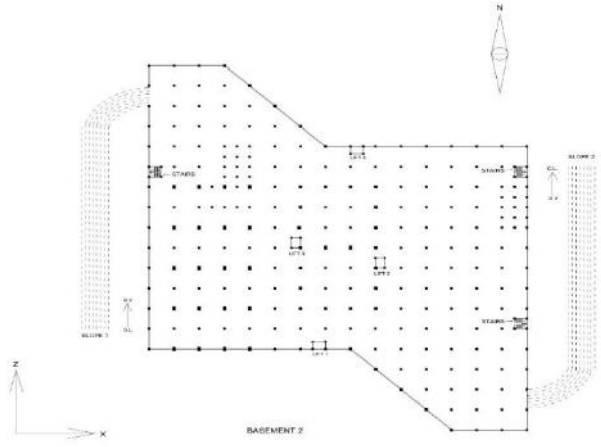


Figure 1- Basement 2 Plan Basement space - 19000 sqm

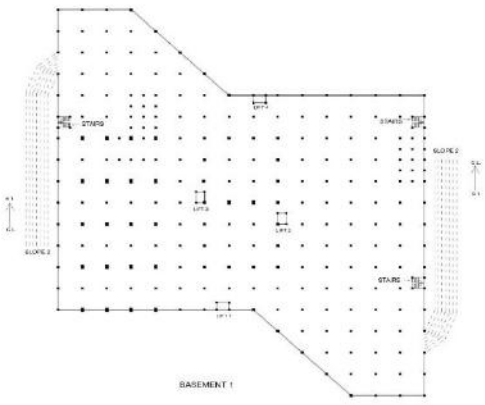


Figure 2 - Basement 1 Plan Basement space - 19000 sqm

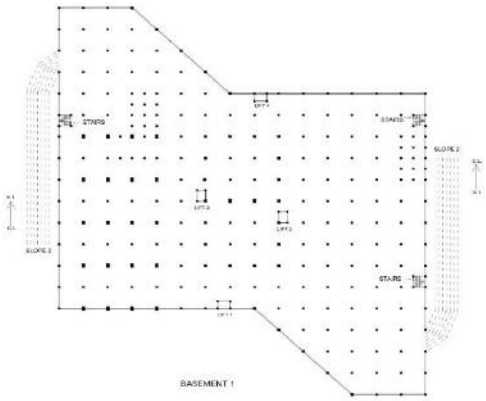


Figure 3 - Ground floor plan Area of Ground floor - 19000 sqm

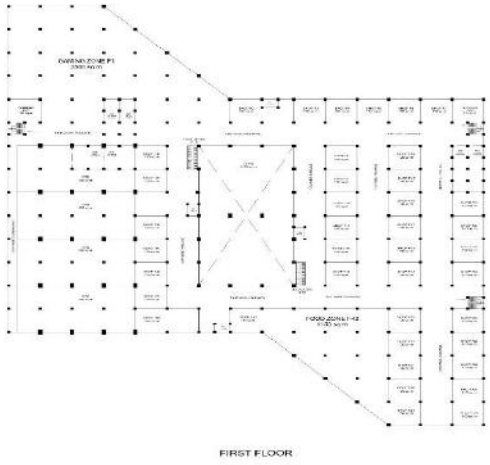


Figure 4 - First floor plan Area of first floor - 19000 sqm

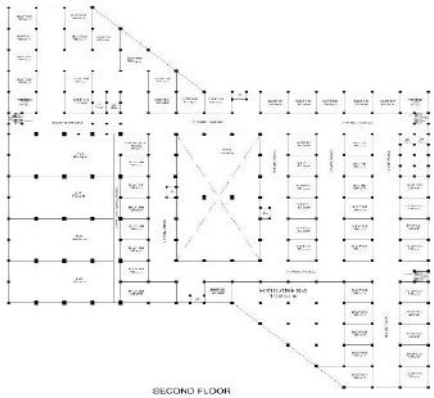


Figure 5- Second floor plan Area of Second floor : 19000 sqm

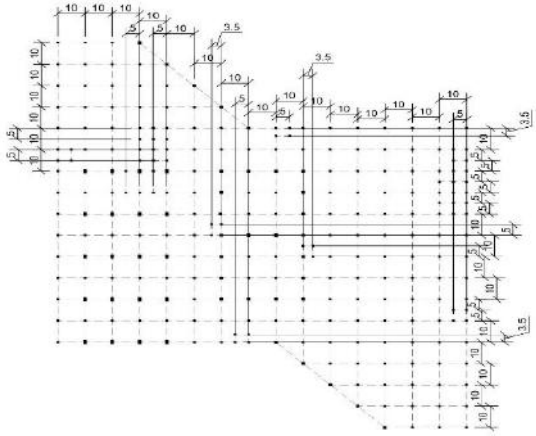


Figure 6 - Column layout center to center distance

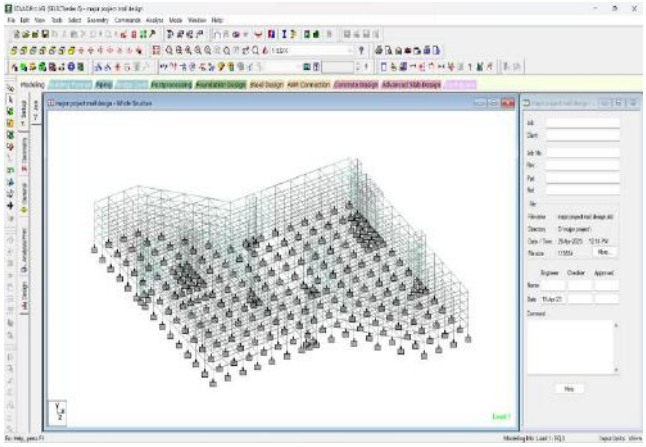


Figure 7 - 3D View of model structure

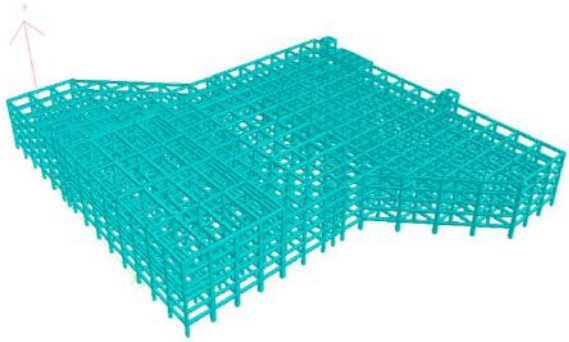


Figure 8 - 3D Rendering Beams & coulmns

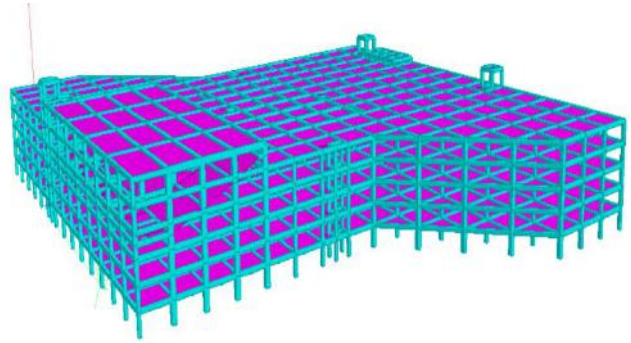


Figure 10 : 3D Rendering with slab

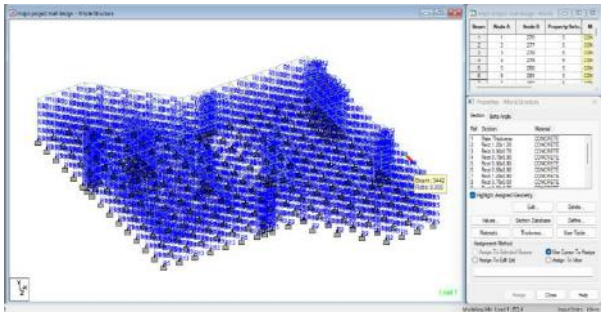
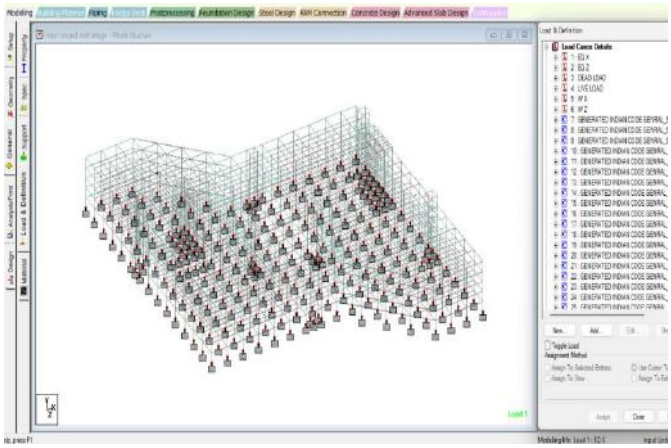
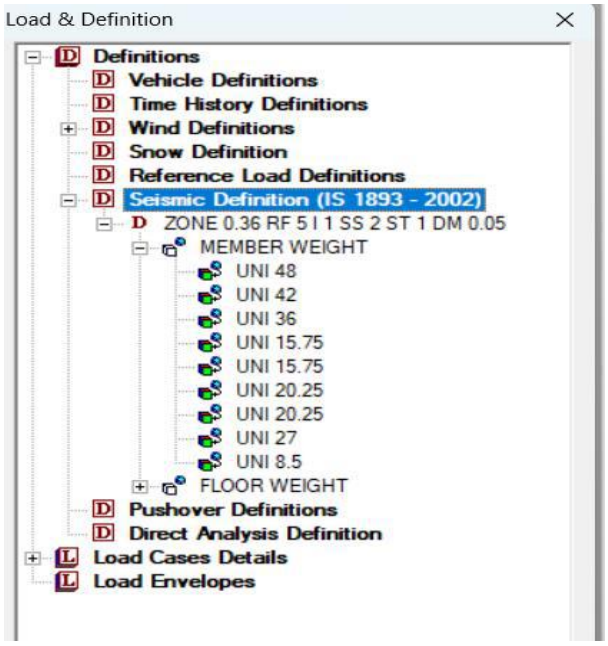


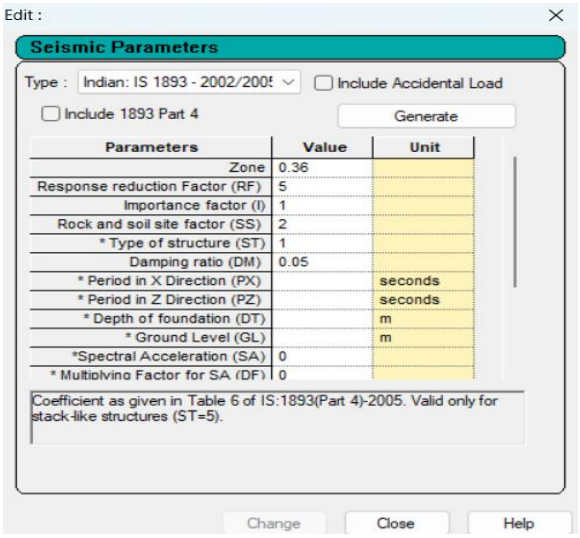
Figure 12:Property Assign structure



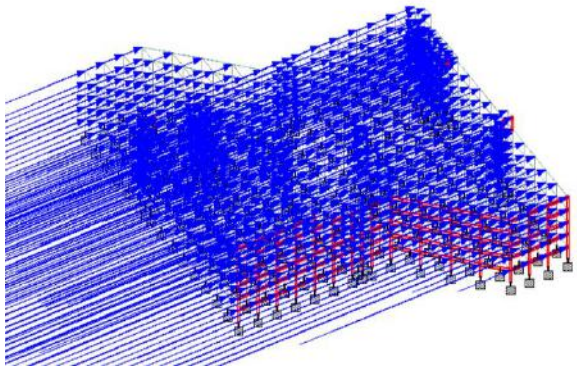
LOAD APPLY



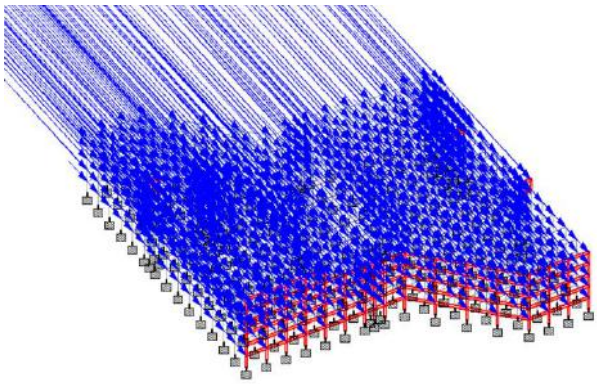
Seismic load (Zone 5, Zone factor 0.36)



Seismic load (Zone 5, Zone factor 0.36)



Seismic load at X direction



Seismic load at Z direction

Dead Loads

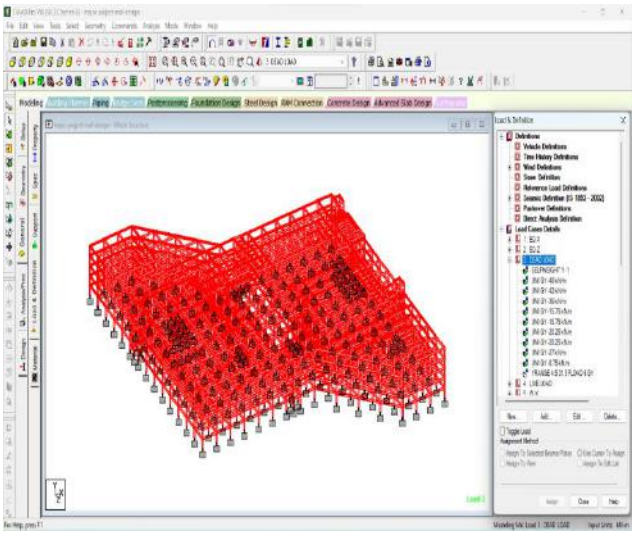
Dead Loads are those loads which are calculated to act abidingly; they are "dead," stationary, and unable to be removed.

Live Loads

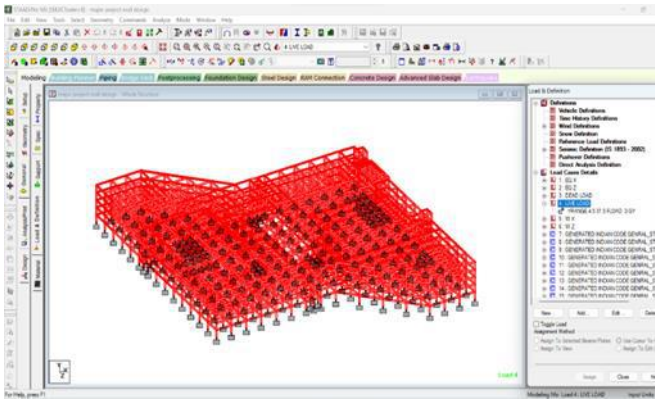
Live loads, referred to as probabilistic loads or settled loads, are transient, of short duration, or moving.

Wind Loads

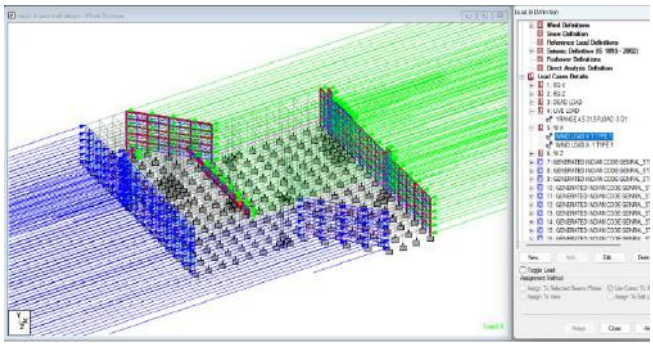
Wind is the correlative motion of air to the surface of the earth. Wind speed in atmospherically boundary layer increments with height form zero at ground level to maximum at gradient height, the slight change in wind direction, within this height is disregarded. Typically, buildings are planned to resist a potent wind with a very long return period, such as 50 years or more. The design wind speed is destined from historical records using ultimate value theory to forecast future absolute windspeeds.



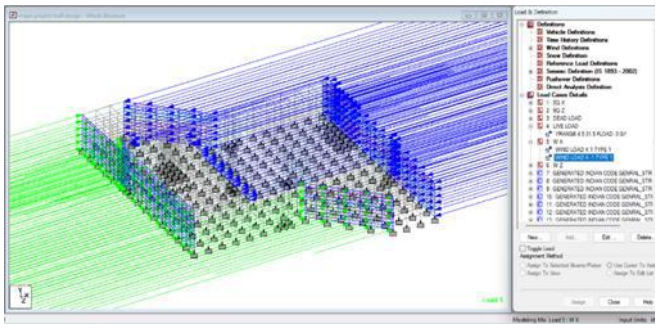
Wind loads in X direction



Wind loads in X direction



Wind loads in Z direction



Wind loads in Z direction

LOAD COMBINATION

IS 1893 discusses various load combinations for design of structures while considering earthquake forces. For limit state design of reinforced concrete and prestressed concrete structure, the following load combination should be used.

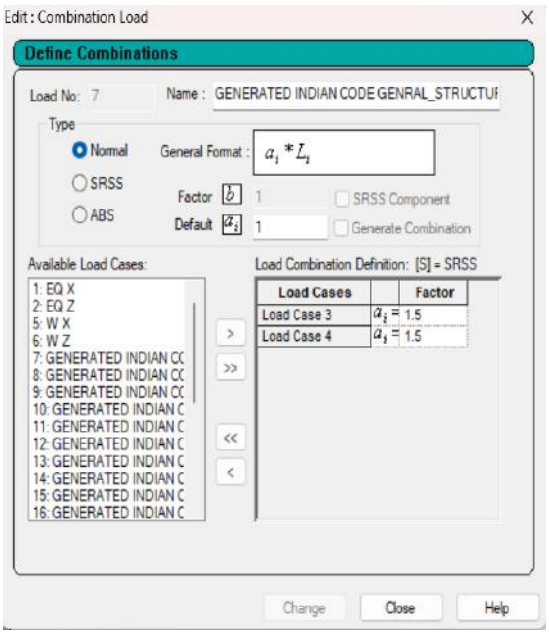
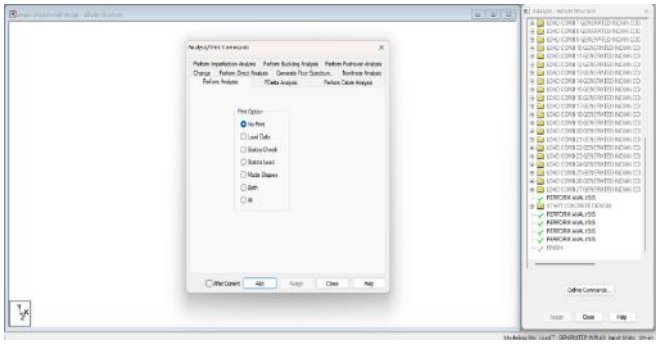


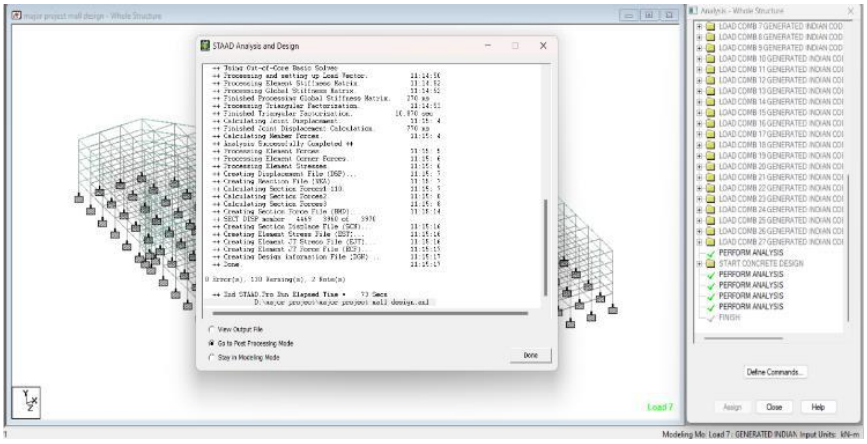
Figure 5. 2nd mode shape of un-cracked geometry

6. RESULT AND DISCUSSIONS

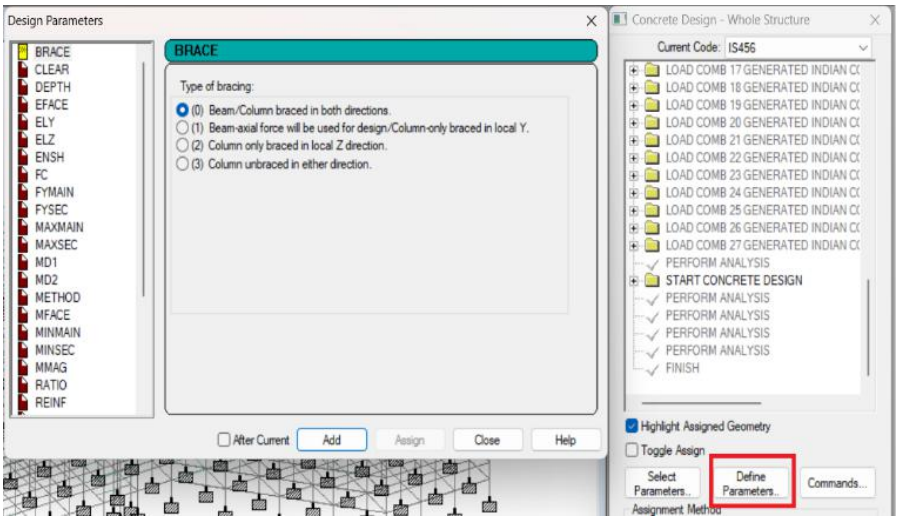
6.1 Print Analysis window

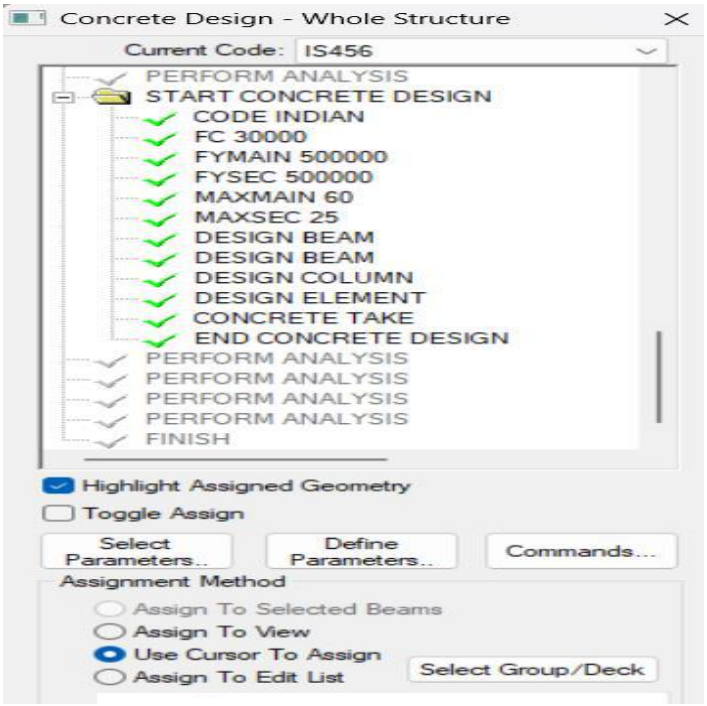


Error Analysis Window

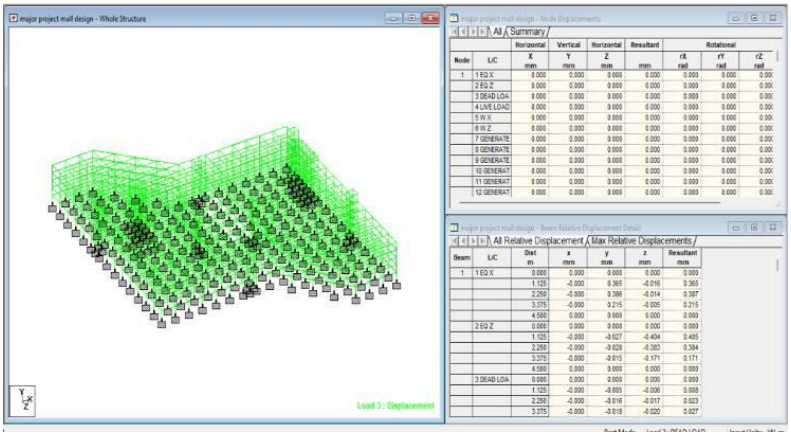


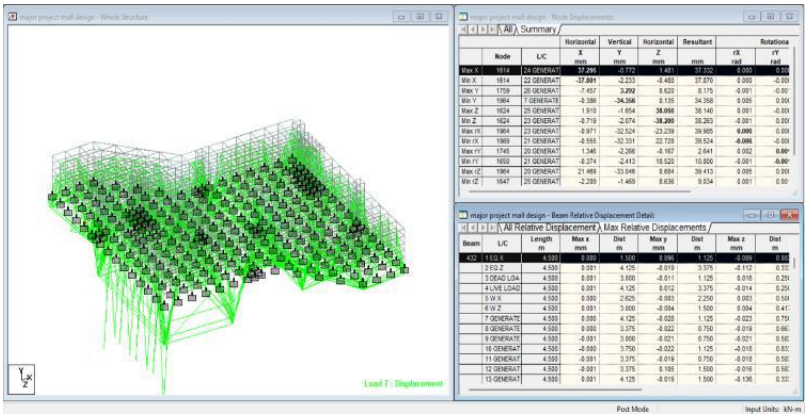
Concrete Design



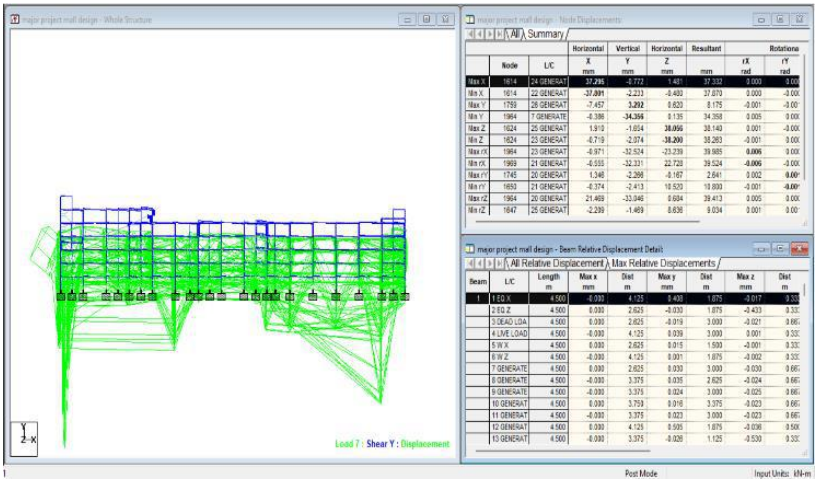


Displacement

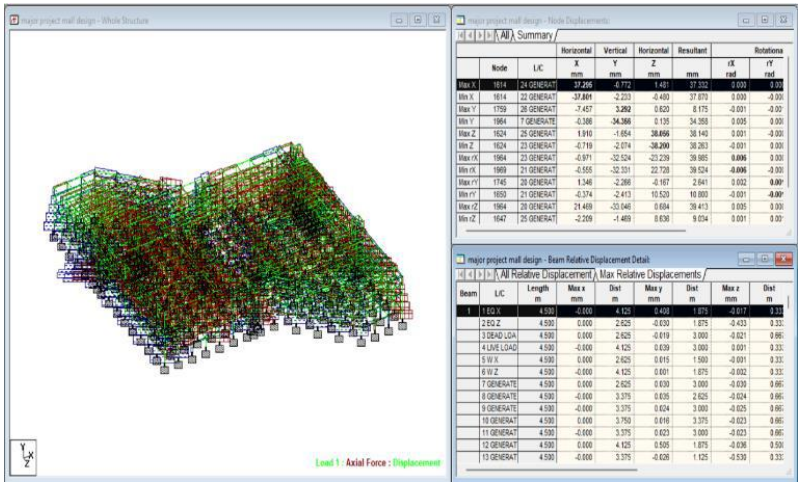




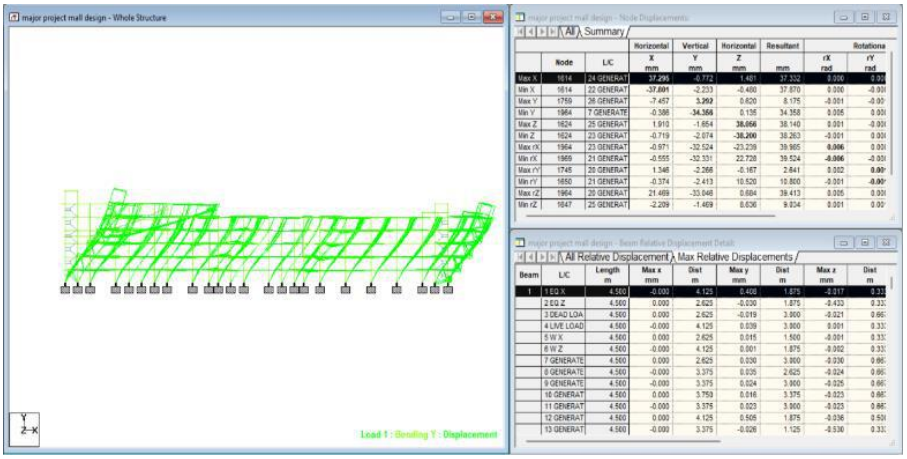
Shear force

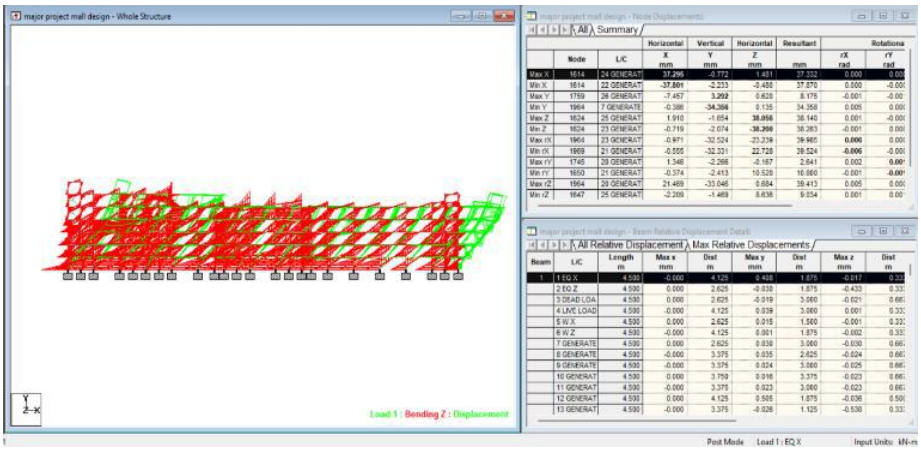


Axial force

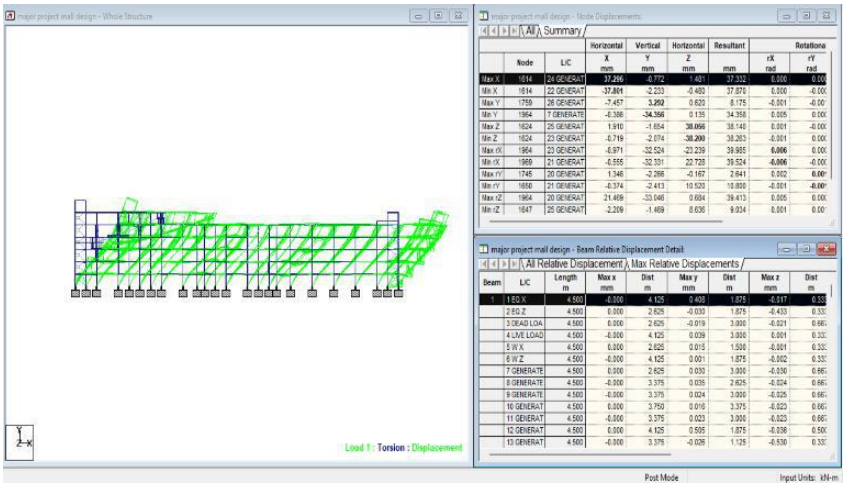


Bending Moment





Torsion



7. SUMMARY AND CONCLUSION

STAAD PRO has the capability to calculate the reinforcement needed for any concrete section. The program contains a number of parameters which are designed as per IS: 456(2000). Beams are designed for flexure, shear and torsion.

Design for Flexure:

Maximum sagging (creating tensile stress at the bottom face of the beam) and hogging (creating tensile stress at the top face) moments are calculated for all active load cases at each of the above-mentioned sections. Each of these sections are designed to resist both of these critical sagging and hogging moments. Where ever the rectangular section is inadequate as singly reinforced section, doubly reinforced section is tried.

Design for Shear:

Shear reinforcement is calculated to resist both shear forces and torsional moments. Shear capacity calculation at different sections without the shear reinforcement is based on the actual tensile reinforcement provided by STAAD program. Two-legged stirrups are provided to take care of the balance shear forces acting on these sections.

Beam Design Output:

The default design output of the beam contains flexural and
shear reinforcement provided
along the length of the beam.

Column Design:

Columns are designed for axial forces and biaxial moments at the ends. All active load cases are tested to calculate reinforcement. The loading which yield maximum reinforcement is called the critical load. Column design is done for square section. Square columns are designed with reinforcement distributed on each side equally for the sections under biaxial moments and with reinforcement distributed equally in two faces for sections under uni-axial moment. All major criteria for selecting longitudinal and transverse reinforcement as stipulated by IS: 456 have been taken care of in the column design of STAAD.

The aim of our project was bringing idea to plan, analysis and design of a multi-storeyed, earthquake resistant residential building. We were unsuccessful to fully complete the project in a successful and efficient manner by considering all the relevant features given. The design is completely depend on relevant Indian Standard Codes. The analysis and design has been done with the help of STAAD Pro and RCDC software and also the drawings have been made with the help of AutoCAD

The structural components of the building are safe in shear and flexure. We will complete this project to the best of our knowledge and ability.

References

[1]. Aman, Manjunath Nalwadgi, Vishal T, Gajendra, "Analysis and design of the multistorey building by using STAAD Pro" , International Research Journal of Engineering and Technology IRJET), Pg. 887-891, Volume: 03 Issue: 06, June- 2016.

[2]. Mahesh Ram Patel, R.C. Singh," Analysis of a Tall Structure using Staad Pro providing different Wind Intensities as per 875 Part-111" , International Journal of Engineering Sciences & Research Technology, Pg. 2018-2025, May, 2017.

[3]. Anoop. A FousiyaHussian, Neeraja.R, Rahul Chandran, Shabina.S, Varsha.S, "Planning Analysis and Design of Multi Storied Building by Staad.Pro.v8i", International Journal of Scientific & Engineering Research, Volume 7, Issue 4, April-2016.

[4]. D.R. Deshmukh, A.K. Yadav, S. N Supekar, A. B. Thakur, H. P Sonawane, I. M. Jain, "Analysis and Design of G+19 Storied Building Using Staad-Pro" Pg. 17- 19, ISSN: 2248-9622, vol. 6, Issue 7, (Part-I) July 2016.

[5]. Borugadda Raju, Mr. R. Rattaiah, 'Analysis AND Design of High-Rise Building (G+30) UsingSTAAD.PRO' , International Journal of Research Sciences and Advanced Engineering, Volume 2, Issue 12,PP: 50 - 54, OCT - DEC' 2015.

[6]. Anoop.A, FousiyaHussian, Neeraja.R, Rahul Chandran, Shabina.S, Varsha.S, 'Planning Analysis andDesign of Multi Storied Building by STAAD.PRO.V8i', International Journal of Scientific & EngineeringResearch, Volume 7, Issue 4, ISSN 2229-5518, April-2016.