Static And Dynamic Ananysis Of Commercial Building Using Staad Pro

Riya V. Rajurkar[1], Prof. Girish Savai[2]
[1]Dept of Civil Engineering
[2]Professor and H.O.D., Dept of Civil Engineering
[1, 2] V. M. I. E. T., Nagpur, India

Abstract- *The rapid urbanization and population growth in modern cities have led to an increased demand for commercial buildings that make efficient use of limited urban space. Traditionally, such buildings have been constructed using materials like reinforced concrete, known for their proven performance and reliability. The discipline of structural design is both an art and a science, focused on creating structures that are economical, elegant, safe, serviceable, and durable. Beyond creativity and innovation, the entire process of structural planning and design requires a strong foundation in structural engineering principles, as well as practical knowledge of relevant design codes and standards.*

This project involves the design of a multi-story commercial building.In civil engineering, a building is defined as a structure composed of various components, including foundations, walls, columns, floors, roofs, doors, windows, ventilators, staircases, and different types of surface finishes. These components are designed through structural analysis to ensure the structure can safely withstand all anticipated loads throughout its intended lifespan without failure. To facilitate this process, engineers commonly use STAAD.Pro, a widely utilized structural analysis and design software developed by Bentley Systems. It is especially popular among civil and structural engineers for designing and analyzing a wide range of structural systems. Additionally, AutoCAD is a widely used commercial computer-aided design (CAD) software known for its capabilities in drafting and creating detailed construction drawings. STAAD.Pro, on the other hand, is commonly utilized by civil and structural engineers for the analysis and design of a wide range of structural systems. For drafting and creating detailed construction drawings, AutoCAD remains one of the leading commercial computer-aided design (CAD) software tools.

In construction projects, architects incorporate structural design considerations—such as safety, serviceability, durability, and cost-effectiveness—while also ensuring the building meets functional needs and aesthetic goals.This project involves the comprehensive planning, analysis, design, and preparation of drawings for a multi-story building.
Specifically, the focus of this project is the planning, analysis, and structural design of a G+5 (Ground plus five floors) commercial building. It encompasses the development of structural drawings and considers multiple load cases and load combinations during the analysis phase.

The building's structural system is composed of Reinforced Cement Concrete (R.C.C.), and the design is performed using the limit state method to ensure compliance with safety, durability, and serviceability requirements.

The study integrates various software applications and engineering techniques, with AutoCAD used for drafting and STAAD.Pro V8i applied for structural analysis and design.Both static and dynamic analyses are conducted using STAAD.Pro, following the design parameters outlined in IS 1893:2016 (Part 1) for Seismic Zone III. The results obtained from the post-processing phase are evaluated, interpreted, and summarized in this report.

Keywords- RCC Building, Static Analysis, Dynamic Analysis, Is-1893-2016 Part -1, STAAD.Pro.

I. INTRODUCTION

The main goal of this project is to perform the structural analysis and design of a commercial building using STAAD.Pro. STAAD, which stands for Structural Analysis and Design, is a widely used software tool for analyzing and designing various types of structures, including buildings, towers, bridges, and industrial facilities.This project focuses on the analysis of a G+5 (Ground plus five floors) commercial building with a rectangular-shaped layout. The analysis involves calculating total loads, determining reinforcement details, and evaluating key structural parameters such as shear forces, bending moments, deflections, and maximum absolute displacements.The structural elements analyzed in this study include beams, columns, and slabs. The loads considered in this project include dead loads and live loads, in compliance with standard design codes. The building has an overall height of 24 meters. STAAD.Pro, developed by Bentley Systems, is a widely utilized software for structural analysis and design. is a widely used software for structural analysis and design.It is extensively employed by civil and structural engineers for the analysis and design of a wide range of structures, including buildings, bridges, dams, towers, and more.

STAAD.Pro offers an extensive range of tools for structural analysis, including static and dynamic analysis, linear and nonlinear assessments, buckling analysis, and response spectrum evaluation. The software is compatible with numerous international design codes—such as AISC, ACI, and Eurocodes—making it ideal for engineering projects across the globe.In this project, the structure under consideration is a G+5 (Ground plus five floors) commercial building with a rectangular-shaped layout. The building accommodates various functional spaces such as hotels, retail shops, grocery stores, fashion outlets, restrooms, elevators, and other commercial facilities.

STAAD.Pro is extensively used by civil and structural engineers for the analysis and design of diverse structural systems. For drafting and preparing detailed construction drawings, AutoCAD serves as a leading commercial computer-aided design (CAD) software.

]In building projects, architects integrate structural design considerations—such as safety, serviceability, durability, and cost-efficiency—with the overall functionality and aesthetic objectives of the structure. This project involves the planning, structural analysis, design, and preparation of drawings for a multi-story commercial building.

]The primary focus is on the planning, analysis, and design of a G+5 commercial building, including the development of structural drawings and consideration of various load cases and load combinations during the analysis phase. The building's structural system is based on Reinforced Cement Concrete (R.C.C.), and the design follows the limit state method to ensure safety, durability, and serviceability.

This study utilizes a range of engineering methodologies and software tools, including AutoCAD for drafting and STAAD.Pro V8i for conducting structural analysis and design.Both static and dynamic analyses are performed using STAAD.Pro, in accordance with the design guidelines provided in IS 1893:2016 (Part 1) for Seismic Zone III. The outcomes from the post-processing phase are thoroughly analyzed and summarized in this report.

Characteristics

The analysis of a commercial building using STAAD.Pro involves two primary methods: static and dynamic analysis, each with distinct characteristics. Static analysis is based on the assumption that loads are applied slowly and remain constant over time, without accounting for inertia or time-dependent effects. It is typically used to evaluate the structure under dead loads, live loads, and other static forces. This method is straightforward and efficient, making it suitable for low-rise buildings or structures in regions with minimal seismic activity. It provides key outputs such as shear forces, bending moments, axial forces, and deflections. On the other hand, dynamic analysis considers time-dependent or transient loads, such as those caused by earthquakes or wind. It accounts for the effects of mass, stiffness, damping, and inertia, making it more accurate for analyzing structures located in seismic zones or subject to significant dynamic forces. STAAD.Pro performs dynamic analysis using techniques such as response spectrum analysis and time history analysis, as per seismic design codes like IS 1893:2016 (Part 1). This method offers detailed insights into the building's behavior, including natural frequencies, mode shapes, and base shear. While dynamic analysis is more complex and computationally intensive, it provides a more realistic representation of the building's performance under dynamic loading conditions.

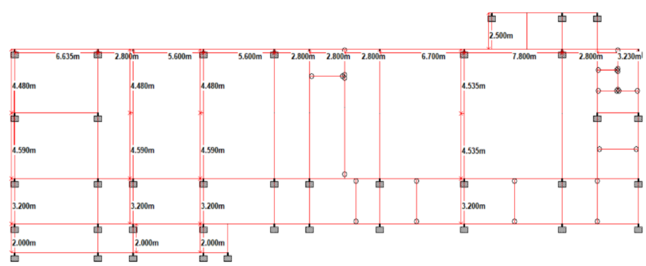


Figure 1: -Plan of G+5 Floor Building

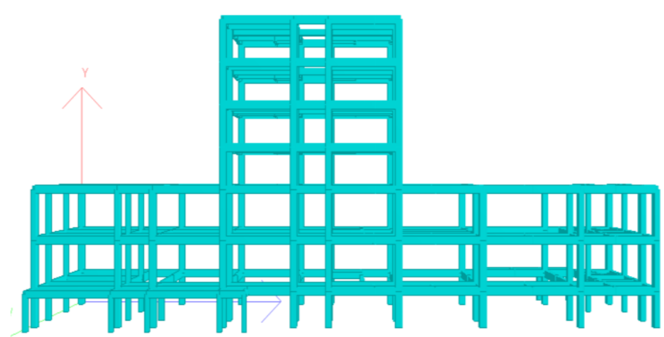


Figure 2: -3D Render View

Scope of the Proposed Study

The proposed study aims to investigate the structural behavior of a commercial building under both static and dynamic loading conditions using STAAD.Pro, a widely used structural analysis and design software. The scope includes the following key aspects:

1. Modeling of the Structure
   - Develop a 3D model of a multi-storey commercial building using STAAD.Pro.
   - Define geometric parameters, material properties (concrete, steel), member specifications, and boundary conditions based on relevant standards (e.g., IS 456, IS 1893, IS 875).
2. Static Analysis
   - Apply dead loads, live loads, and other relevant static loads (e.g., floor finish, partition walls).
   - Analyze internal forces (bending moment, shear force, axial force) and deflection under static loading.
   - Design of structural elements (beams, columns, slabs) as per code provisions.
3. Dynamic Analysis
   - Perform modal analysis to determine natural frequencies and mode shapes.
   - Conduct response spectrum analysis and/or time history analysis for earthquake loading based on IS 1893 or other applicable seismic codes.
   - Study the building's dynamic behavior under seismic events, including displacement, base shear, and story drift.
   -
4. Comparative Study
   - Compare the results from static and dynamic analyses to evaluate critical load cases.
   - Identify the most vulnerable structural components under dynamic conditions.

Objectives:

- Evaluate structural safety and performance under static and dynamic loads.
- Optimize structural design for cost-effectiveness and efficiency.
- Ensure compliance with relevant building codes and standards.
- Assess seismic performance and design to withstand earthquakes.
- Analyze wind load effects and design to resist wind-induced stresses.

II. METHODOLOGY

The building analyzed in this study is a G+5 (Ground plus five floors) R.C. framed structure with a symmetrical rectangular plan. The building has a plan area of 49m x 13m, with a story height of 3.75m for the Ground and First floors, and 3.150m for the Second to Fifth floors. The total height of the building, including the foundation depth, is 22.8m. A thorough analysis is conducted for dead loads, live loads, and seismic loads using STAAD.Pro software. The Response Spectrum Method is utilized for dynamic analysis.Loading combinations are determined according to IS 1893:2002. Both static and dynamic analyses are performed using STAAD.Pro, with design parameters derived from IS 1893:2016 (Part 1) for Seismic Zone III. The results obtained during the post-processing phase are subsequently summarized.

Applications in Building Design:

Modelling Structures:STAAD Pro connect Edition is capable of modeling, geometries, of the building. The software's flexibility in handling various structural elements make it ideal for Commercial building design projectsProvide Supports: Boundary Conditions

Load Analysis:

It includes tools for applying various load types specific to Commercial building, such as vehicular loads, Horizontal Load (wind, earthquake). These tools ensure accurate analysis and design under real-world conditions.

Dynamic Analysis:

The software supports dynamic analysis methods required for Building design, including modal analysis and response spectrum analysis, which are crucial for assessing the building performance under dynamic loads.

In summary, STAAD Pro CONNECT Edition offers a robust platform for structural engineers to perform detailed analysis and design of a wide range of structures. Its advanced features, comprehensive design code support, and integration capabilities make it an invaluable tool for modern structural engineering projects.

Analysis using STAAD Pro CONNECT Edition

To perform analysis in STAAD Pro following steps must be followed:

i. Geometric Modeling
ii. Sectional Properties and Material Properties
iii. Supports: Boundary Conditions

iv. Loads & Load combinations
v. Analysis command

Sectional & Material Properties

For accurate analysis in STAAD Pro, sectional and material data must be assigned to all structural model elements. This entails determining the geometric dimensions and material properties for each sort of element. Properties for beam elements include width, depth, and material type (for example, steel, concrete). Node elements' thicknesses and material qualities are predetermined. These assignments ensure that the model effectively depicts the structure's physical behavior under different loads, allowing for precise predictions of stresses, deflections, and overall structural performance. This thorough specification enables the study to mirror real-world situations, ensuring the design's reliability and safety.

Support and boundary condition

After assignment of sectional and material parameters in STAAD Pro, the next critical step is to specify the boundary conditions by providing supports to the structure. These supports show how the structure is connected to the ground or other parts, which affects how it responds to loads. Fixed supports are common types of supports. By correctly allocating these supports, the model can realistically replicate the limitations and load distribution, which is critical for calculating the proper responses, internal forces, and overall structural behavior. This stage guarantees that the analysis findings accurately.

Load and load combination

Loads are a crucial factor in building design as they ensure the structure's safety and functionality throughout its lifespan.In the current project, the analysis takes into account a variety of loads, including self-weight, which accounts for the weight of the building materials; Live load as specified by IS:456-2000, IS:1893(Part-1)-2016. These loads are blended in numerous scenarios to imitate real-world conditions, ensuring that the bridge can withstand diverse stresses and conditions over time. In the current project work, the following loads are considered for analysis:

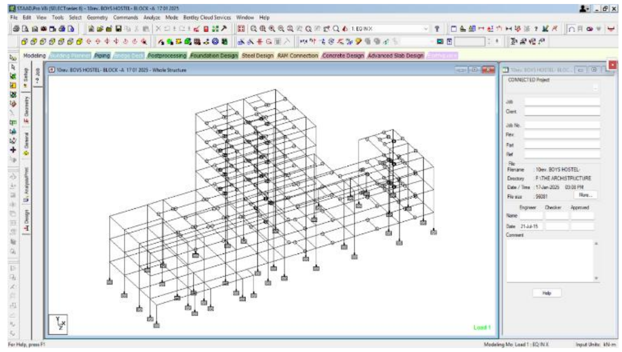


Figure: STAAD Pro and Load definitions

III. MODELING AND ANALYSIS

DEAD LOAD

Dead loads are generally expressed in terms of weight per unit area (e.g., kilonewtons per square meter, kN/m²) or weight per unit length (e.g., kilonewtons per meter, kN/m), depending on how the loads are applied in the design model.

Formula for Dead Load Calculation for Brick Masonry Walls:
Brick wall density = 20Kn/m3. And 25mm thick Plaster Load on wall, the wall height is 3.75 and 3.150 meters, Plinth Height = 1.5m, First floor Beam depth=0.500m
Wall Load for 230mm Red Brick wall for Plinth Level Outer wall height 3.75m
Wall Load = ((0.23 x 20) + (0.025 x 20)) x (3.75+1.5-0.5-0.15) m = 23.72 kN/m

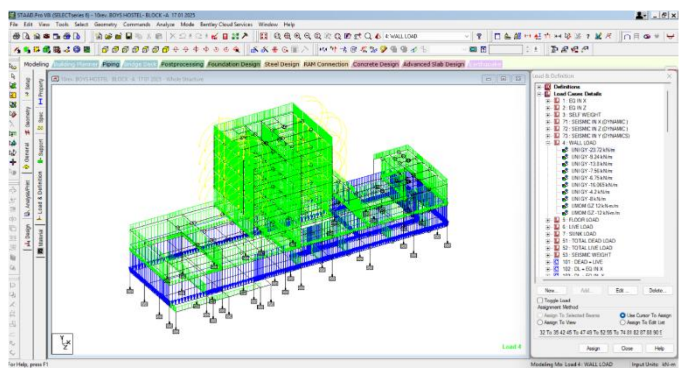


Fig 1: Assigning Dead Loads (Wall load)

Dead Load = Slab Thickness x Density of Concrete + Floor Finished ,For example, if the slab thickness is 0.15 meters and the density of concrete is 25 kN/m²: Dead Load = 0.15 x 25 +0.1= 5.25 kN/m³

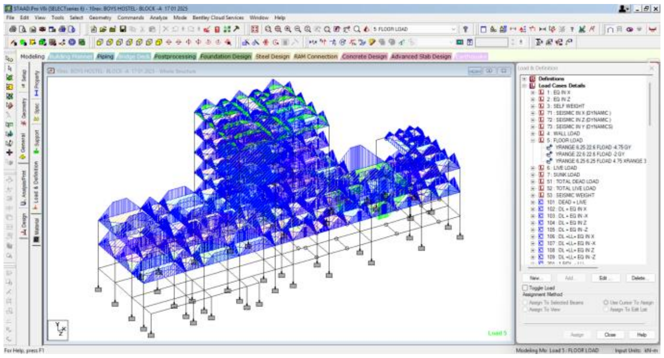


Fig 2: Assigning Dead Loads (Slab load)

LIVE LOAD

we are designing a commercial building. As per the guidelines provided in IS 875 Part 2, the recommended live load for commercial floors in kilonewtons per square meter (kN/m²), depending on the occupancy classification and specific design requirements. Accordingly, for our design, we have adopted a live load value depending upon the requirement of floor areas. This conservative value ensures that the structure can safely support the expected loads imposed by occupants, furniture, and other movable items without exceeding the permissible limits or compromising the safety and serviceability of the building. By incorporating the maximum live load values prescribed in the IS 875 code, we ensure that our structural design is compliant with national building regulations and aligns with established industry standards for live load considerations in residential construction. Live loads:

Following live loads are considered while designing the structural elements apart from the dead loads as per code IS875: Part II.

SR. No.	Particulars.	Loads Considered.
1.	Room	200 kg / m2
2.	Dining & Cafeteria	400 Kg / m2
3.	Corridor, passage, Staircase	400 Kg / m2
4.	Toilets & Bathrooms	200 Kg / m2
5.	Terrace	150 Kg / m2 or as per actual

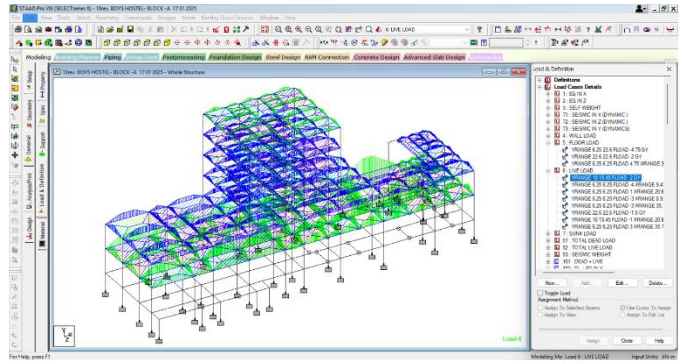


Fig 3: Assigning Dead Loads (Slab load)

DYNAMIC ANALYSIS: -

Dynamic analysis in STAAD.Pro involves assessing the structural response of a building or any other structure when subjected to time-dependent loads. Unlike static analysis, which assumes constant loading conditions, dynamic analysis takes into account the variation of loads with time and evaluates their impact on the structure's behavior over a specified duration.

Key Aspects of Dynamic Analysis in STAAD.Pro:

Types of Dynamic Loads – Seismic Loads: Dynamic analysis is used to evaluate how a structure responds to earthquake-induced ground motions, taking into account factors such as acceleration, displacement, and inter-story drift.

Wind Loads: Dynamic analysis assesses the effects of wind on a building, including phenomena such as vortex shedding, buffeting, and resonance, to ensure structural stability and occupant comfort.

Analysis of models

To provide an analysis of a model using STAAD Pro for a project titled "Static and Dynamic Analysis of Multistorey Commercial Building Using STAAD Pro," we can break it into a structured format. This kind of analysis is usually part of a civil engineering research or design project and involves comparing structural behavior under different loading conditions. Here's a detailed outline and example analysis you can use or adapt:

The study involves analyzing a multistorey commercial building using STAAD Pro under:

- Static Loading (DL + LL + SIDL + imposed loads)
- Dynamic Loading (Seismic and Wind Loads as per IS Codes)

Objective:

- To determine the structural performance, displacements, base shear, and stress under various load combinations.
- To compare static and dynamic results for safety and serviceability.

Load Combinations:

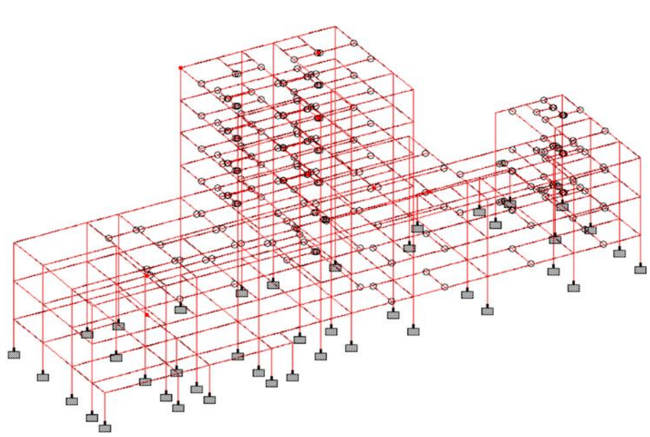
- As per IS 456:2000, e.g.:
  - 1.5(DL + LL)
  - 1.2(DL + LL + WL)
  - 1.5(DL + EQ)
  - 0.9DL ± 1.5EQ etc.

Outcomes of Analysis

The analysis of a multistorey commercial building using STAAD Pro through both static and dynamic methods provides critical insights into the structural performance under various loading conditions. Static analysis, which considers constant or gradually applied loads such as dead loads and live loads, helps in understanding the overall load-bearing capacity and internal force distribution of the structure. On the other hand, dynamic analysis, which accounts for time-dependent forces such as wind and seismic activity, reveals how the building behaves under real-time loading scenarios, particularly identifying natural frequencies, mode shapes, and potential resonance effects. By comparing the outcomes of both methods, engineers can evaluate the building's safety, serviceability, and compliance with relevant design codes. The analysis also highlights areas of high stress concentration, deflection patterns, and possible design optimizations, ultimately guiding safer and more efficient structural design.

STATIC DEFLECTION

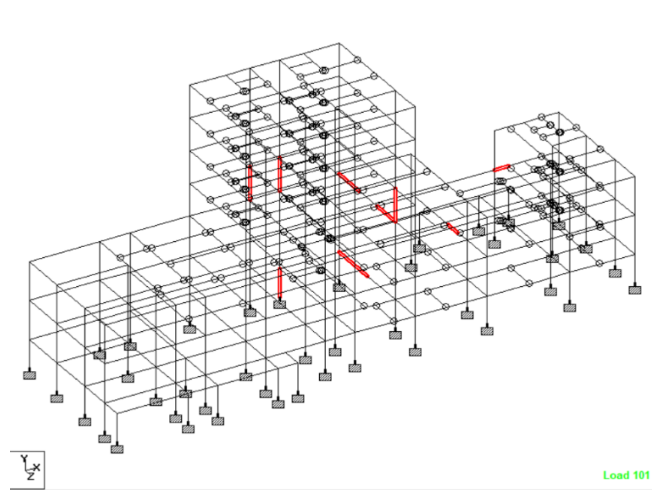
(Maximum and Minimum Deflection)



			Horizontal	Vertical	Horizontal	Resultant	Rotational		
	Node	L/C	X mm	Y mm	Z mm	mm	rX rad	rY rad	rZ rad
Max X	413	202 1.5(DL + EQ IN X)	**51.237**	-4.805	-5.472	51.752	0.001	-0.000	-0.001
Min X	413	211 0.9 DL + 1.5 EQ IN -X	**-49.875**	-4.139	1.486	50.069	0.001	0.000	0.001
Max Y	467	213 0.9 DL + 1.5 EQ IN -Z	0.065	**0.769**	-2.136	2.272	0.000	-0.000	-0.000
Min Y	386	201 1.5(DL + LL)	0.677	**-26.000**	-2.110	26.095	0.005	-0.000	-0.001
Max Z	413	212 0.9 DL + 1.5 EQ IN Z	-0.044	-2.919	**43.849**	43.946	0.002	0.000	-0.000
Min Z	413	205 1.5(DL + EQ IN -Z)	1.406	-6.026	**-47.835**	48.234	-0.000	-0.000	-0.000
Max rX	249	201 1.5(DL + LL)	0.307	-16.135	-0.051	16.138	**0.006**	0.000	-0.002
Min rX	221	204 1.5(DL + EQ IN Z)	0.289	-14.823	15.790	21.659	**-0.005**	0.000	0.000
Max rY	413	211 0.9 DL + 1.5 EQ IN -X	-49.875	-4.139	1.486	50.069	0.001	**0.000**	0.001
Min rY	413	202 1.5(DL + EQ IN X)	51.237	-4.805	-5.472	51.752	0.001	**-0.000**	-0.001
Max rZ	238	201 1.5(DL + LL)	0.208	-13.779	-0.025	13.780	0.003	0.000	**0.005**
Min rZ	222	201 1.5(DL + LL)	0.210	-14.266	0.029	14.268	0.002	0.000	**-0.004**
Max Rs	435	202 1.5(DL + EQ IN X)	49.822	-19.059	-0.813	**53.349**	0.003	-0.000	-0.001

STATIC BENDING MOMENT

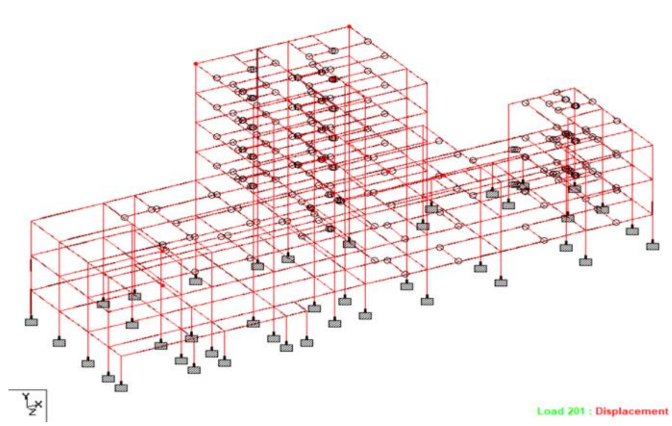
Maximum and Minimum B.M



	Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx kN-m	My kN-m	Mz kN-m
Max Fx	10601	202 1.5(DL + EQ IN X)	6	**4273.273**	23.510	-73.278	0.769	164.893	25.121
Min Fx	41	201 1.5(DL + LL)	43	**-85.937**	31.026	-0.024	-0.016	0.199	50.094
Max Fy	285	201 1.5(DL + LL)	163	0.000	**455.397**	-0.000	-4.413	0.000	772.170
Min Fy	372	201 1.5(DL + LL)	174	-0.000	**-435.154**	-0.000	1.309	0.000	756.493
Max Fz	10604	203 1.5(DL + EQ IN -X)	162	1984.615	198.598	**282.320**	-4.269	-466.412	325.834
Min Fz	10504	202 1.5(DL + EQ IN X)	161	1897.468	183.656	**-270.448**	4.918	449.188	301.962
Max Mx	406	201 1.5(DL + LL)	240	0.000	-168.113	-0.000	**108.557**	0.000	-259.715
Min Mx	174	205 1.5(DL + EQ IN -Z)	97	0.000	203.769	-0.000	**-112.368**	-0.000	187.244
Max My	10504	202 1.5(DL + EQ IN X)	161	1897.468	183.656	-270.448	4.918	**449.188**	301.962
Min My	10604	203 1.5(DL + EQ IN -X)	162	1984.615	198.598	282.320	-4.269	**-466.412**	325.834
Max Mz	285	205 1.5(DL + EQ IN -Z)	163	0.000	425.060	-0.000	-7.357	0.000	**823.515**
Min Mz	11804	204 1.5(DL + EQ IN Z)	174	1203.621	-369.822	-20.183	0.182	24.314	**-635.794**

DYNAMIC DEFLECTION

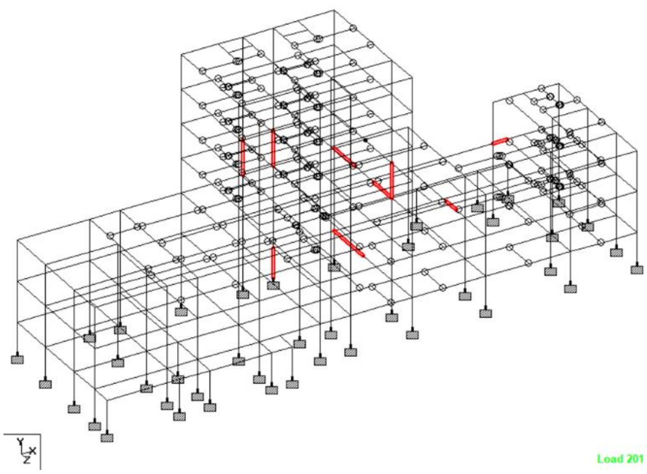
(Maximum and Minimum Deflection)



			Horizontal	Vertical	Horizont	Resultant	Rotational		
	Node	L/C	X mm	Y mm	Z mm	mm	rX rad	rY rad	rZ rad
Max X	413	5052 1.5 (DL+DY EQ X+0.3*DY EQ Y+0.3*DY EQ Z)	**56.277**	-5.021	5.413	56.759	0.001	-0.001	-0.001
Min X	413	5053 1.5 (DL-DY EQ X-0.3*DY EQ Y-0.3*DY EQ Z)	**-54.574**	-6.160	-10.396	55.895	0.001	0.001	0.001
Max Y	467	3005 DL- DY. EQ Z	-0.104	**0.802**	-3.018	3.125	0.000	-0.000	-0.000
Min Y	386	5006 1.5 (DL+EQ Y+0.3*EQ X+0.3*EQ Z)	13.972	**-27.403**	10.336	32.449	0.005	-0.000	-0.001
Max Z	413	3004 DL+ DY. EQ Z	3.575	-5.102	**48.119**	48.521	0.002	0.000	-0.001
Min Z	413	3005 DL- DY. EQ Z	-1.872	-6.079	**-53.102**	53.482	-0.000	-0.000	-0.000
Max rX	249	5006 1.5 (DL+EQ Y+0.3*EQ X+0.3*EQ Z)	5.341	-17.507	4.835	18.931	**0.006**	0.000	-0.002
Min rX	221	5006 1.5 (DL+EQ Y+0.3*EQ X+0.3*EQ Z)	5.455	-19.504	4.751	20.803	**-0.005**	0.000	0.000
Max rY	413	3003 DL- DY. EQ X	-53.739	-6.464	4.631	54.324	0.001	**0.001**	0.000
Min rY	413	3002 DL+ DY. EQ X	55.442	-4.717	-9.614	56.467	0.001	**-0.001**	-0.001
Max rZ	238	201 1.5(DL + LL)	0.208	-13.779	-0.025	13.780	0.003	0.000	**0.005**
Min rZ	222	201 1.5(DL + LL)	0.210	-14.266	0.029	14.268	0.002	0.000	**-0.004**
Max Rs	416	5052 1.5 (DL+DY EQ X+0.3*DY EQ Y+0.3*DY EQ Z)	56.277	-7.537	19.009	**59.877**	0.001	-0.001	-0.001

DYNAMIC BENDING MOMENT

Maximum and Minimum B.M



	Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx kN-m	My kN-m	Mz kN-m
Max Fx	10601	5006 1.5 (DL+EQ Y+0.3*EQ X+0.3*EQ Z)	6	**4779.811**	18.504	6.853	0.358	25.665	-26.195
Min Fx	41	201 1.5(DL + LL)	43	**-85.937**	31.026	-0.024	-0.016	0.199	50.094
Max Fy	285	201 1.5(DL + LL)	163	0.000	**455.397**	-0.000	-4.413	0.000	772.170
Min Fy	372	5006 1.5 (DL+EQ Y+0.3*EQ X+0.3*EQ Z)	174	-0.000	**-452.989**	0.000	9.756	-0.000	814.839
Max Fz	10604	5053 1.5 (DL-DY EQ X-0.3*DY EQ Y-0.3*DY EQ Z)	162	1822.220	226.287	**313.803**	-9.039	-522.399	386.322
Min Fz	10504	5052 1.5 (DL+DY EQ X+0.3*DY EQ Y+0.3*DY EQ Z)	161	1959.680	164.223	**-306.820**	9.687	512.788	262.143
Max Mx	406	201 1.5(DL + LL)	240	0.000	-168.113	-0.000	**108.557**	0.000	-259.715
Min Mx	174	5055 1.5 (DL-DY EQ Z-0.3*DY EQ X-0.3*DY EQ Y)	97	0.000	225.894	0.000	**-123.128**	-0.000	239.763
Max My	10504	5052 1.5 (DL+DY EQ X+0.3*DY EQ Y+0.3*DY EQ Z)	161	1959.680	164.223	-306.820	9.687	**512.788**	262.143
Min My	10604	5053 1.5 (DL-DY EQ X-0.3*DY EQ Y-0.3*DY EQ Z)	162	1822.220	226.287	313.803	-9.039	**-522.399**	386.322
Max Mz	372	5004 1.5 (DL+EQ Z+0.3*EQ X+0.3*EQ Y)	174	-0.000	-431.931	0.000	10.664	-0.000	**853.766**
Min Mz	11804	5054 1.5 (DL+DY EQ Z+0.3*DY EQ X+0.3*DY EQ Y)	174	1190.126	-408.171	-63.727	-1.318	121.089	**-709.293**

After applying both static and dynamic loads to the columns and beams of the multi-story building using STAAD Pro, we obtained the following summary of results.

Static Load Analysis Results: The static load analysis provides information about the internal forces and moments experienced by the structural members under various loading conditions. The summary includes maximum and minimum values of forces (Fx, Fy, Fz) and moments (Mx, My, Mz) for both beams and columns.

Result comparison in Static andDynamic Result

Particulars	Static Analysis	Dynamic Analysis
Max Moment		
MxkNm	108.557	108.557
MykNm	449.188	512.788
MzkNm	823.515	853.766
Max Forces		
FykN	455.397	455.397
FzkN	282.32	313.803
Axial Forces		
FxkN	4273.273	4779.811
Deflection mm	51.237	56.277

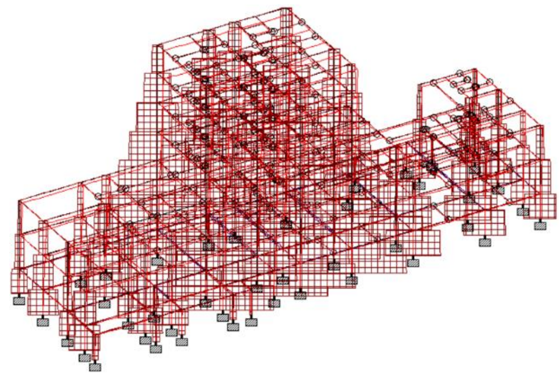


Figure 3: Axial Force Diagram (Static)

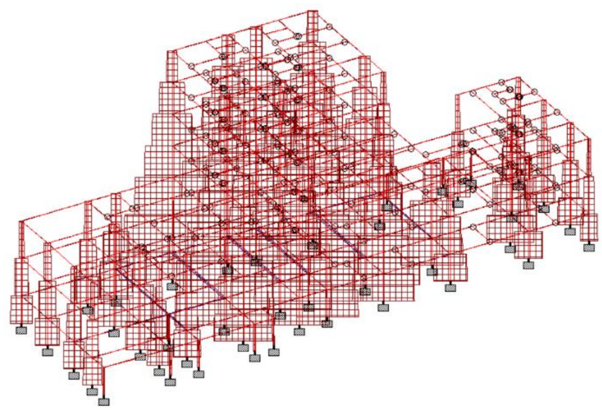


Figure: Axial Force Diagram (Dynamic)

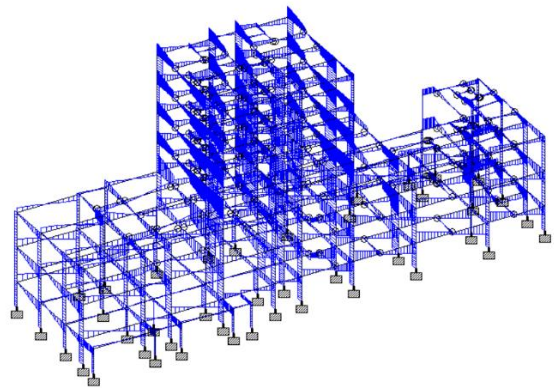


Figure: Shear Force Diagram (Static)

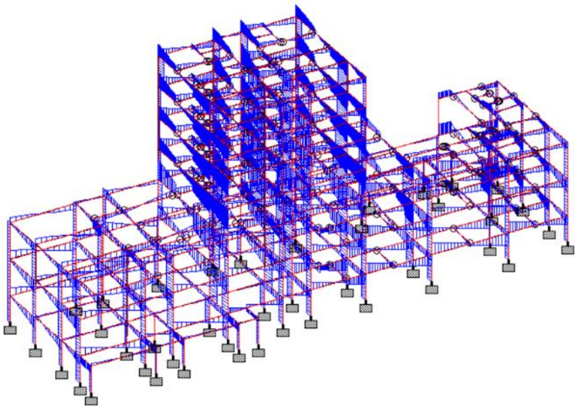


Figure: Shear Force Diagram (Dynamic)

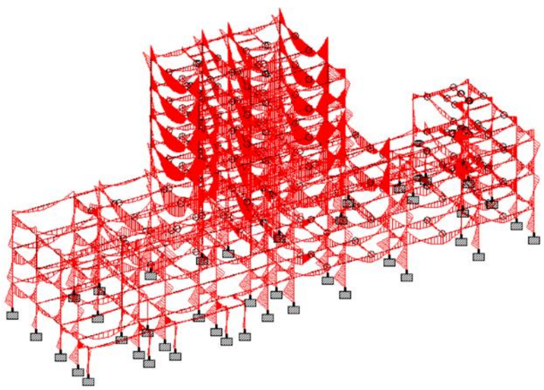


Figure: Bending Moment Diagram (Static)

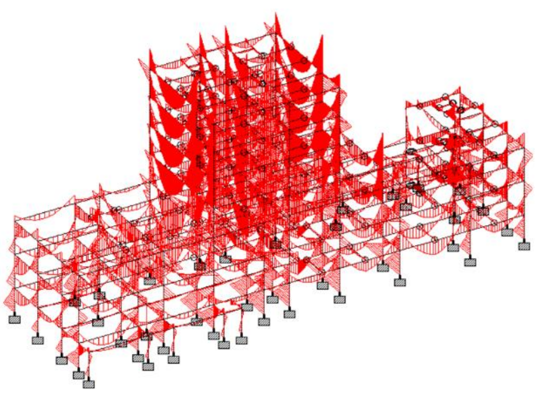


Figure: Bending Moment Diagram (Dynamic)

MODE SHAPES

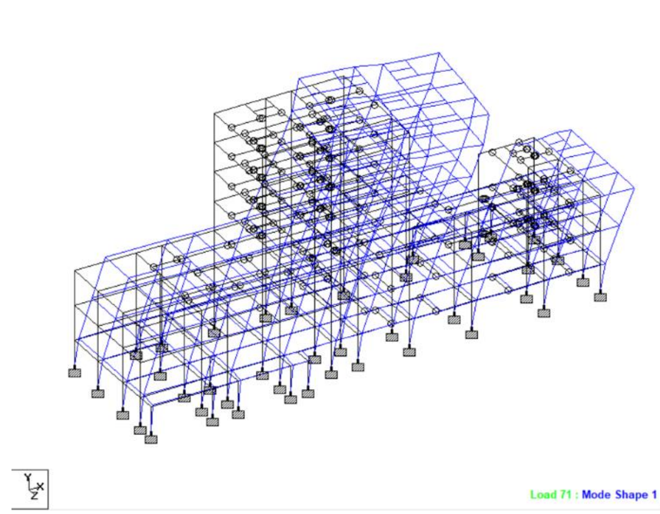


Figure: Mode Shape -1

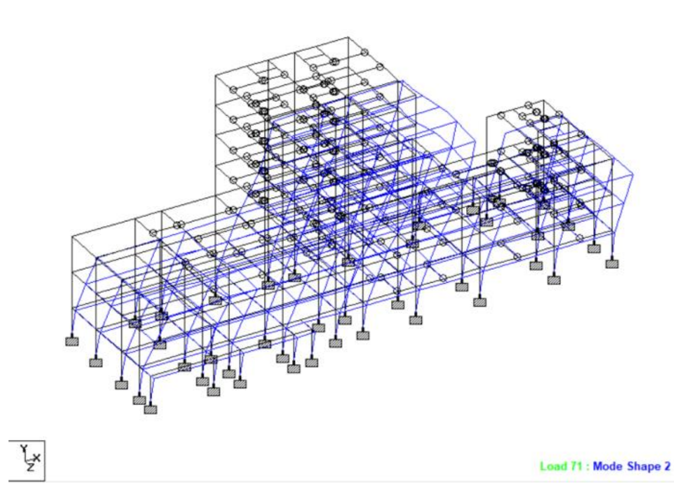


Figure: Mode Shape -2

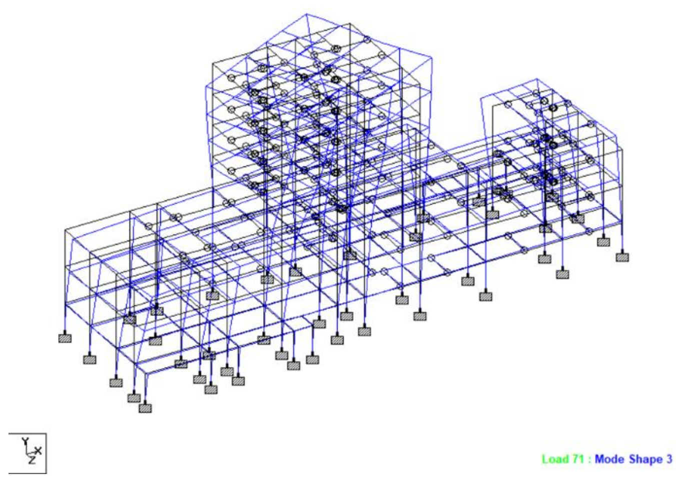


Figure: Mode Shape -3

IV. RESULTS AND DISCUSSION

Dynamic effects significantly influence the building behavior. Seismic loading governs the design for higher safety and performance.

Concrete structures demonstrated strong performance under the specified loading conditions. While steel beams and columns exhibited higher axial and shear force capacities, concrete members showed comparable moment resistance and displacement behavior. This comprehensive comparison offers valuable insights for selecting suitable materials in structural design, balancing performance criteria with material properties and construction feasibility.

Concrete remains a robust and cost-effective option, particularly for certain building types and load conditions. However, for multi-story buildings requiring high load-bearing capacity, flexibility under dynamic loads, and efficient construction methods, steel is the preferred choice. This recommendation ensures structural integrity, durability, and compliance with modern construction standards, while also supporting sustainability objectives.

STAAD Pro enables efficient modeling and analysis of complex multistorey structures.
Static analysis alone is not sufficient for safe design in seismic zones.
Dynamic analysis helps identify critical behavior not captured in static cases.
The structure satisfies all IS code requirements in both static and dynamic cases.

V. ACKNOWLEDGEMENTS

The authors express gratitude to the V. M. Institute of Engineering and Technology for providing guidance and technical help during the research process.

REFERENCES

[1] Model and Material which are used is presented in this section. Table and model should be in prescribed format.
[2] Shrikant M. Harle (2017), "Structural Analysis Using STAAD-Pro and Design of Elements Through MATLAB", Journal of Asian Scientific Research, Vol. 7, Issue 5, pp. 145–164.
[3] S. P. Sharma (2017), "Seismic Performance Evaluation of Multi-Storey Buildings with Varying Shear Wall and Diagrid Locations", International Journal of Science and Research (IJSR), Vol. 6, Issue 6, June, 2017.
[4] Mohit Sharma and Dr. Savita Maru (2014), "Dynamic Analysis of a Multi-Storeyed Regular Building", IOSR Journal of Mechanical and Civil Engineering, Vol. 11, Issue 1, pp. 37–42, January 2014.
[5] Foram N. Pachchigar, Falguni R. Patel, and Minal H. Patel (2016), "Analysis of Multi-Storeyed RCC Building with Soft Storey Using STAAD.Pro", Global Research and Development Journal for Engineering, March 2016.
[6] Romy Mohan and C. Prabha (2011), "Dynamic Analysis of RCC Buildings with Shear Walls", International Journal of Earth Sciences and Engineering, Vol. 4, No. 6, pp. 659–662.B.I.S Code 456-2000.
[7] B.I.S Code 1893 Part I- 2002.
[8] B.I.S Code 875(Part-3) – 1987.
[9] National Building Code.