STATIC AND DYNAMIC ANALYSIS OF MULTISTORY BUILDING USING STAAD PRO

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Abstract: Reinforced concrete frame buildings are most common type of construction in urban India, which is subjected to several types of forces during their life time such as static forces and dynamic forces due to wind and earthquakes. The static loads are constant with time, while dynamic loads are time varying, causing considerable inertia effects .It depends mainly on location of building, importance of its use and size of the building. Its consideration in analysis makes the solution more complicated and time consuming and its negligence may sometimes become the cause of disaster during earthquake. So it is growing interest in the process of designing civil engineering structures capable to withstand dynamic loads. The behaviour of building under dynamic forces depends upon its mass and stiffness properties, whereas the static behaviour is solely dependent upon the stiffness characteristics.

Keywords:-Multistory Building, Composite Structure, Static Analysis, Dynamic Analysis, AutoCAD, Staad Pro,Finite Element Analysis, Indian Construction Industry

I. Introduction

The rapid urbanization and population growth in modern cities have necessitated the construction of multistory buildings that efficiently utilize limited urban space. Traditionally, these buildings have been constructed using materials like reinforced concrete or steel due to their established performance and reliability. However, the advent of composite structures has introduced a transformative approach to building construction, combining the advantageous properties of multiple materials to enhance overall structural performance.
Composite structures typically integrate steel and concrete, capitalizing on the strengths of both materials. Steel, known for its excellent tensile strength, and concrete, renowned for its compressive strength, work synergistically in composite systems to create buildings that are not only stronger but also lighter and more material-efficient. This integration leads to significant benefits in terms of construction speed, cost savings, and structural efficiency.

II. ANALYSIS AND DESIGN

1)STATIC ANALYSIS:-

Static loads are those that do not change over time and are typically steady or slowly varying. They include:

- **Dead Loads:** The permanent weight of the building itself, including structural elements, floors, walls, roofs, and any fixed equipment or finishes.
- **Live Loads:** Temporary loads imposed on the building, such as the weight of people, furniture, equipment, and other movable objects.

Application of Static Loads:

In our static analysis, we'll consider the following load combinations as per relevant design codes and standards:
*Gravity Loads:*Combining dead loads (DL) and live loads (LL) acting vertically downward due to the weight of the building and its contents.

*Load Combinations:*Various load combinations are considered to assess the structure's behavior under different conditions. These combinations typically include different factors applied to dead loads, live loads, and other imposed loads to simulate realistic scenarios.

Analysis Process:

Using STAAD Pro, we input the building's geometry, material properties, and support conditions. Then, we apply the defined load combinations and execute the static analysis.

Results Interpretation:

Internal Forces: We examine the distribution of internal forces, such as axial forces, shear forces, and bending moments, within the structural members. This helps us identify critical sections and evaluate their capacity to resist these forces.

*Displacements:*We assess structural displacements to ensure they comply with serviceability requirements, including deflection limits and structural stability.
*Support Reactions:*Analysis of support reactions helps us verify equilibrium and evaluate the load-carrying capacity of the foundation and support elements.

Structural Evaluation:

Based on the analysis results, we evaluate the structure's overall stability, strength, and safety under static loading conditions. Any deficiencies or areas of concern are identified for further investigation and potential design modifications.
By focusing solely on static loads, we ensure a thorough assessment of the building's response to steady loads, providing valuable insights into its structural behaviour and performance under typical loading conditions.

2)DEAD LOADS & LIVE LOADSCOMBINATIONS:-

Dead Loads:

Dead loads refer to the permanent or stationary weight of structural components, materials, and fixtures that make up a building or structure. These loads remain constant over time and typically include elements such as walls, floors, roofs, beams, columns, and permanent equipment. Dead loads are a crucial consideration in structural design as they form the basis for calculating the overall weight and load distribution of a structure. In the context of civil engineering and structural design, dead loads are commonly specified and regulated by building codes and standards.
Dead load refers to the permanent or fixed weight of the structural components and non-structural elements of the building. These include the weight of walls, floors, roofs, columns, beams, and any other permanent fixtures. Dead loads remain constant over time and are always acting on the structure. They are typically expressed in terms of weight per unit area or weight per unit length, such as kilonewtons per square meter (kN/m^2) or kilo newtons per meter (kN/m).

Formula for Dead Load Calculation for Brick Masonry Walls:

Dead Load = Wall Thickness x Wall Height x Unit weight of Brick
For example, if the wall thickness is 0.23 meters and the wall height is 3 meters, and assuming the unit weight of the brick is 20 kN/m^3:
Dead Load = 0.23 x 3 x 20 = 13.8 kN/m^3

Formula for Dead Load Calculation for Slabs:

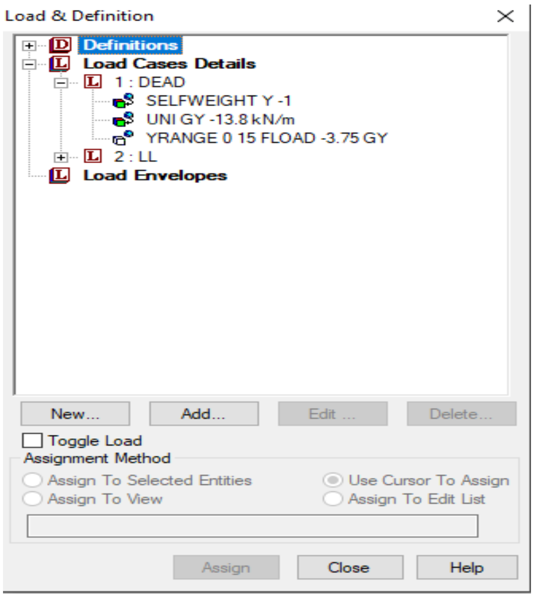
Dead Load = Slab Thickness x Density of Concrete
For example, if the slab thickness is 0.15 meters and the density of concrete is 25 kN/m^2:
Dead Load = 0.15 x 25 = 3.75 kN/m^3
Code Book Details:
For our project, we reference relevant building codes and standards to determine the dead load requirements. Commonly used codes include:

1. International Building Code (IBC)
2. American Society of Civil Engineers (ASCE) standards

3. Indian Standards (IS) codes, such as IS 875 (Part 1): 1987 for dead loads on buildings and structures.

Calculating Dead Loads:

While dead loads can vary based on the specific materials and construction methods used in the project, there are some standard thumb rules that can be applied for estimation:
*Concrete Slabs:*Typically, concrete slabs have a dead load ranging from 2.4 to 3.6 kN/m², depending on the thickness and reinforcement.
*Brick Masonry Walls:*Brick masonry walls have a dead load of approximately 12 to 16 kN/m².



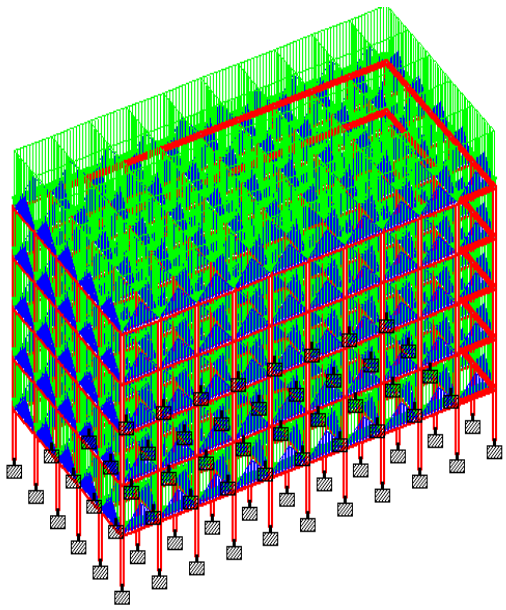


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Fig 1:Defining Dead Loads *Fig 2:Assigning Dead Loads*

Steel Beams and Columns:*The dead load for steel beams and columns is typically calculated based on the weight of the steel sections used.*

Live loads:-

Live loads in civil engineering refer to the temporary or movable loads that a structure may experience during its intended use. These loads are not permanent and can vary in magnitude, duration, and location. Live loads typically include the weight of people, furniture, equipment, vehicles, and other movable objects.In our project, live loads are a critical consideration as they directly impact the structural design and safety of the building. We need to ensure that the structure can safely support the anticipated live loads without exceeding design limits or causing excessive deflections. In India, the Bureau of Indian Standards (BIS) provides guidelines and standards for structural design, including live loads, in the IS 875 Part 2: 1987 (Reaffirmed 2017) code book titled "Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures - Live Loads." This standard outlines the methodology for determining live loads for various occupancy categories based on their intended use and occupancy type The IS 875 Part 2 code book categorizes live loads into different occupancy categories and provides recommended values for each category. These categories include residential, office, industrial, storage, and special-purpose structures. For instance, in residential buildings, live loads are typically lower compared to commercial or industrial structures. The IS 875 code book specifies the minimum live load requirements for different areas within a building, such as floors, balconies, stairs, and roofs.
For our project, let's assume we are designing a residential building. According to IS 875 Part 2, the maximum live load value for residential floors is typically in the range of **2 to 3 kilonewtons** per square meter (kN/m²), depending on the occupancy category and the design considerations.
Therefore, for our project, we have considered a maximum live load value of 3 **kN/m²** for residential floors. This value ensures that the structural design can safely accommodate the anticipated loads from furniture,

occupants, and other movable objects without exceeding the design limits or compromising the safety of the building.

By incorporating the maximum live load values specified in the IS 875 code book, we ensure that our structural design meets the relevant regulatory requirements and industry standards for live load considerations in building construction.

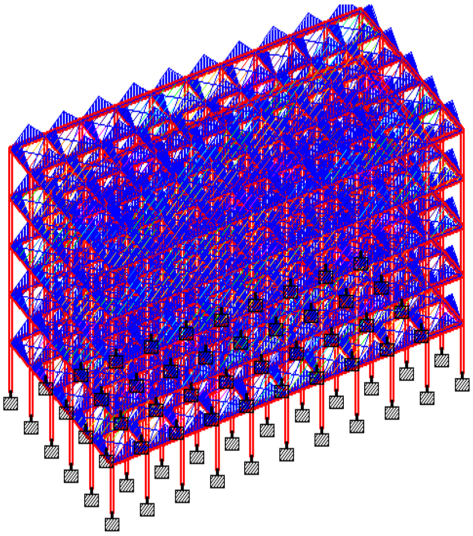


Fig 3:Asigning Live Loads

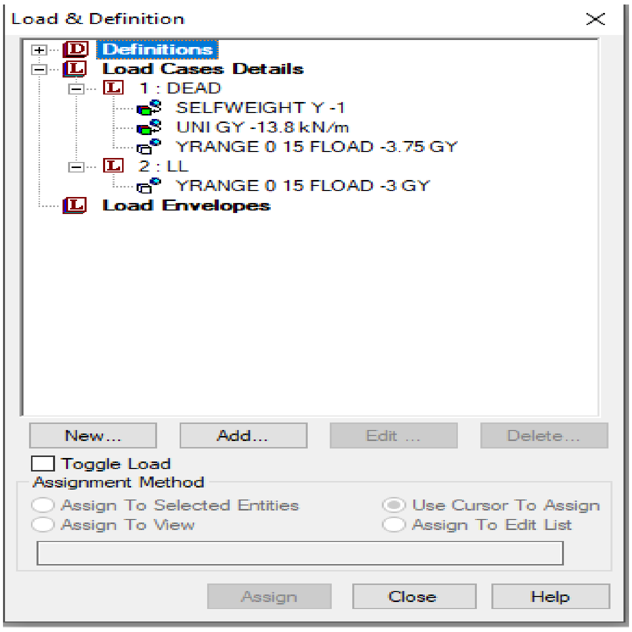


Fig 4:Defining Live Loads

3)DYNAMIC ANALYSIS:-

Dynamic analysis in STAAD.Pro refers to the process of evaluating the structural response of a building or any other structure under dynamic loads that vary with time. Unlike static analysis, which assumes steady-state conditions, dynamic analysis considers the time-varying nature of loads and their effects on the structure's behavior over time.

Key Aspects of Dynamic Analysis in STAAD.Pro:

Types of Dynamic Loads:

*Seismic Loads:*Dynamic analysis helps assess how the structure responds to earthquake-induced ground motions, including accelerations, displacements, and inter-story drifts.

*Wind Loads:*It evaluates the dynamic effects of wind on the building, including vortex shedding, buffeting, and resonant responses, ensuring structural stability and occupant comfort.**Analysis Methods:**

*Response Spectrum Analysis:*This method evaluates the structure's response to a range of seismic frequencies defined by a response spectrum. It's commonly used for seismic design and assessment.

*Time History Analysis:*Time history analysis involves applying actual ground motion records or synthetic accelerograms to simulate earthquake loading. It captures the full time history of ground motion, enabling a detailed examination of the building's response over time.

Consideration of Dynamic Characteristics:

Dynamic analysis helps determine the natural frequencies, mode shapes, and damping ratios of the structure, providing insights into its dynamic behavior. This information is crucial for identifying potential resonance issues and designing appropriate mitigation measures.

Code Compliance:

Dynamic analysis ensures that the structural design complies with relevant building codes and standards governing seismic and wind-resistant design. It verifies that the building can withstand expected dynamic loads without compromising safety or structural integrity.

Optimization of Lateral Load-Resisting Systems:

By analyzing the dynamic response of the structure, engineers can optimize the design of the lateral load-resisting systems, such as shear walls or braced frames, to meet performance objectives and minimize structural vulnerabilities under dynamic loading conditions.

Assessment of Structural Performance:

Dynamic analysis provides valuable information for assessing the structural performance and resilience of the building under dynamic loads. It helps identify critical areas of the structure that may require reinforcement or retrofitting to enhance its overall performance and safety.
In our project, we are conducting dynamic analysis specifically focused on wind analysis and response spectrum analysis using STAAD.Pro. These analyses are crucial for evaluating the structural response of the multistory building to dynamic wind loads and seismic forces, ensuring its safety, stability, and resilience under these dynamic loading conditions.

4)WIND ANALYSIS:

Wind analysis is a critical aspect of structural engineering that evaluates the dynamic effects of wind on buildings and other structures. In our project, wind analysis is essential for assessing the structural response of the multistory building to varying wind loads. Here's an overview of wind analysis in our project:

Importance of Wind Analysis:

*Structural Stability:*Wind analysis ensures that the building can withstand wind-induced forces without experiencing excessive deformation or structural failure.
*Occupant Comfort:*It assesses wind-induced vibrations and oscillations to ensure occupant comfort and safety within the building.
*Design Optimization:*Wind analysis helps optimize the design of structural elements, such as beams, columns, and lateral bracing systems, to enhance the building's resilience against wind loads.

III .RESEARCH METHODOLOGY

1) Structural Modeling
2) Static Analysis
3) Dynamic Analysis
4) Finite Element Analysis (FEA)

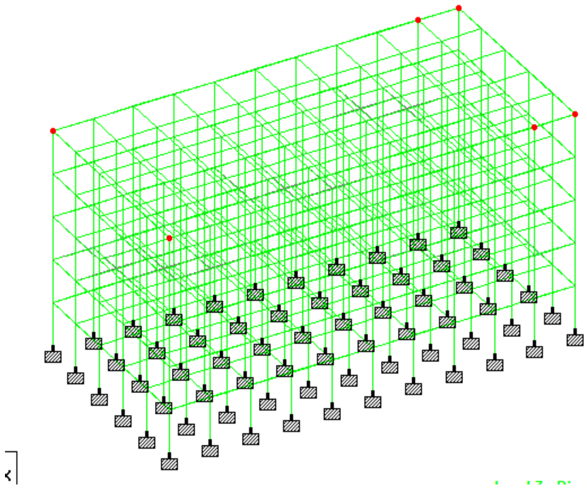
1) Structural Modeling:
Begin by creating detailed structural models of multistory buildings using AutoCAD.Incorporate composite materials such as steel-concrete composite beams and columns into the models to accurately represent real-world construction practices.
2)Static Analysis:
Conduct static analysis to determine the distribution of loads and stresses on the structural components.
Evaluate the structural integrity and stability of the building under static loads such as dead loads, live loads, and environmental loads.
3)Dynamic Analysis:
Perform dynamic analysis to assess the response of the building to dynamic forces such as wind, earthquakes, and vibrations.
Conduct modal analysis to identify the natural frequencies and mode shapes of the building, crucial for understanding its dynamic behavior.
4)Finite Element Analysis (FEA):
Utilize Staad Pro, an advanced software tool, for finite element analysis (FEA).
Apply FEA techniques to simulate and analyze the behavior of the building under various loading conditions, including static and dynamic loads.

IV RESULTS AND DISCUSSION

steel - Node Displacements:

All | Summary

			Horizontal	Vertical	Horizontal	Resultant	Rotational		
	Node	L/C	X mm	Y mm	Z mm	mm	rX rad	rY rad	rZ rad
Max X	67	20 Generate	**1.820**	-7.700	0.012	7.913	-0.001	-0.000	-0.001
Min X	387	22 Generate	**-1.820**	-7.700	-0.012	7.913	0.001	-0.000	0.001
Max Y	57	2 RSA2	-0.017	**0.052**	3.777	3.777	0.000	0.000	0.000
Min Y	57	7 Generated	-0.048	**-7.808**	0.010	7.808	-0.001	0.000	0.001
Max Z	57	21 Generate	-0.076	-7.569	**5.675**	9.461	-0.001	0.000	0.001
Min Z	387	23 Generate	-0.076	-7.569	**-5.675**	9.461	0.001	-0.000	0.001
Max rX	387	21 Generate	-0.024	-7.726	5.655	9.574	**0.001**	0.000	0.001
Min rX	57	23 Generate	-0.024	-7.726	-5.655	9.574	**-0.001**	-0.000	0.001
Max rY	396	23 Generate	0.110	-2.627	-4.064	4.840	-0.000	**0.000**	-0.001
Min rY	66	21 Generate	0.110	-2.627	4.064	4.840	0.000	**-0.000**	-0.001
Max rZ	387	22 Generate	-1.820	-7.700	-0.012	7.913	0.001	-0.000	**0.001**
Min rZ	397	20 Generate	1.820	-7.700	-0.012	7.913	0.001	0.000	**-0.001**
Max Rs	387	21 Generate	-0.024	-7.726	5.655	**9.574**	0.001	0.000	0.001



After applying static loads and dynamic loads to the steel columns and beams of the multi-story building in STAAD Pro, we obtained the following result summary:

Static Load Analysis Results:

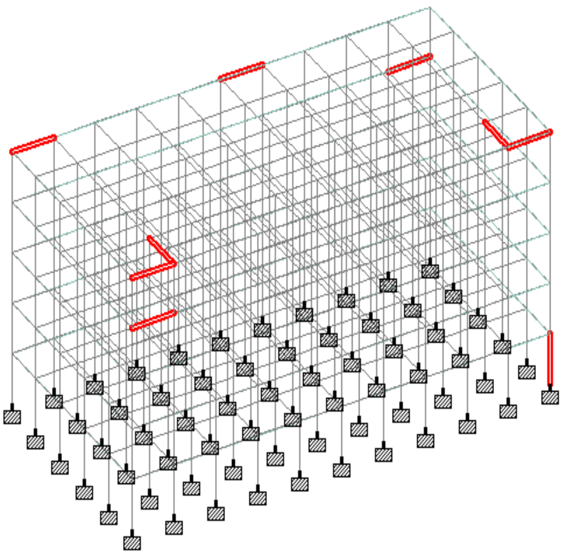
The static load analysis provides information about the internal forces and moments experienced by the structural members under various loading conditions. The summary includes maximum and minimum values of forces (Fx, Fy, Fz) and moments (Mx, My, Mz) for both beams and columns.

Node displacement summary for steel

steel - Beam End Forces:

All | Summary | Envelope

	Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
Max Fx	576	7 Generated	332	**2924.939**	4.449	2.119	-0.000	-2.019	3.643
Min Fx	567	22 Generate	388	**-51.015**	47.887	2.886	0.003	-4.548	49.321
Max Fy	40	22 Generate	55	20.968	**130.100**	-1.098	0.014	2.293	153.589
Min Fy	31	20 Generate	47	20.968	**-130.100**	1.098	-0.014	2.293	153.589
Max Fz	620	23 Generate	376	558.925	47.852	**26.396**	0.000	-37.261	59.900
Min Fz	95	21 Generate	46	558.925	47.852	**-26.396**	-0.000	37.261	59.900
Max Mx	50	7 Generated	66	27.875	115.668	0.289	**0.021**	-0.527	129.480
Min Mx	575	7 Generated	396	27.875	115.668	-0.289	**-0.021**	0.527	129.480
Max My	620	23 Generate	387	553.359	47.852	26.396	0.000	**41.926**	-83.657
Min My	95	21 Generate	57	553.359	47.852	-26.396	-0.000	**-41.926**	-83.657
Max Mz	556	20 Generate	377	20.968	-130.100	-1.098	0.014	-2.293	**153.589**
Min Mz	31	20 Generate	46	20.968	-49.882	1.098	-0.014	-1.003	**-116.385**

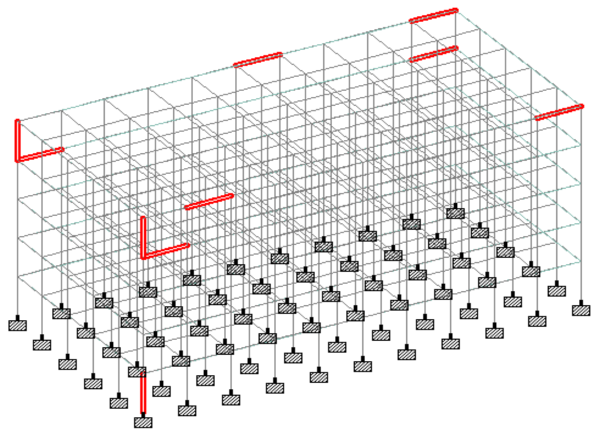


Beam end forces summary for steel

RCC 1 - Beam End Forces:

All | Summary | Envelope

	Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
Max Fx	586	7 GENERATE	342	3327.586	0.970	-1.368	0.004	1.352	0.806
Min Fx	575	24 GENERAT	396	-90.033	47.675	-4.241	-4.575	8.486	41.792
Max Fy	40	22 GENERAT	55	60.785	92.389	-3.115	5.383	6.267	87.422
Min Fy	556	20 GENERAT	377	60.773	-92.417	-3.112	5.389	-6.264	87.456
Max Fz	904	21 GENERAT	330	-3.948	53.905	29.550	5.648	-40.160	21.389
Min Fz	896	21 GENERAT	322	-3.946	53.904	-29.532	-5.647	40.133	21.389
Max Mx	566	21 GENERAT	387	-12.316	7.118	29.111	8.865	-53.407	-41.130
Min Mx	575	21 GENERAT	396	-12.517	84.316	-29.119	-8.864	33.939	74.675
Max My	41	23 GENERAT	57	-12.435	7.436	-29.095	-8.836	53.377	-40.608
Min My	575	21 GENERAT	397	-12.517	-7.140	-29.119	-8.864	-53.417	-41.088
Max Mz	556	20 GENERAT	377	60.773	-92.417	-3.112	5.389	-6.264	87.456
Min Mz	556	20 GENERAT	376	60.773	-0.961	-3.112	5.389	3.070	-52.612

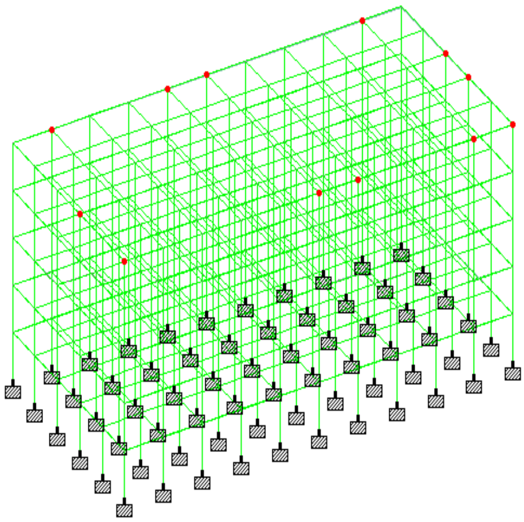


Beam End forces summary for RCC

RCC 1 - Node Displacements:

All | Summary

			Horizontal	Vertical	Horizontal	Resultant	Rotational		
	Node	L/C	X mm	Y mm	Z mm	mm	rX rad	rY rad	rZ rad
Max X	255	22 GENERAT	1.374	-3.055	0.004	3.350	0.000	-0.000	-0.001
Min X	199	20 GENERAT	-1.369	-3.055	0.008	3.348	-0.000	-0.000	0.001
Max Y	392	2 RSA2	-0.000	0.049	-3.342	3.342	-0.000	0.000	0.000
Min Y	397	7 GENERATE	0.020	-6.470	0.002	6.470	0.000	0.000	-0.000
Max Z	62	23 GENERAT	0.003	-2.980	5.037	5.852	0.001	0.000	-0.000
Min Z	392	21 GENERAT	0.004	-2.980	-5.031	5.847	-0.001	0.000	-0.000
Max rX	61	7 GENERATE	-0.003	-3.466	0.029	3.466	0.001	0.000	-0.000
Min rX	393	7 GENERATE	0.010	-3.466	-0.023	3.467	-0.001	0.000	0.000
Max rY	58	21 GENERAT	-0.118	-3.710	1.389	3.963	0.001	0.001	0.000
Min rY	66	21 GENERAT	0.125	-3.717	1.387	3.969	0.001	-0.001	-0.000
Max rZ	265	7 GENERATE	-0.105	-3.555	0.005	3.557	0.000	0.000	0.001
Min rZ	255	7 GENERATE	0.109	-3.555	0.008	3.557	0.000	-0.000	-0.001
Max Rs	387	21 GENERAT	0.059	-6.388	4.598	7.871	0.000	0.000	0.000



Node Displacement summary for RCC

Parameter	Steel Beams	Steel Columns	Concrete Beams	Concrete Columns
Max Fx (kN)	2924.939	3327.586	3327.586	3327.586 KN
Min Fx (kN)	-51.015	-90.033	-90.033	-90.033 KN
Max Fy (kN)	130.1	92.389	92.389	92.389 KN
Min Fy (kN)	-130.1	-92.417	-92.417	-92.417 KN
Max Fz (kN)	558.925	53.905	53.905	53.905 KN
Min Fz (kN)	-26.396	-29.532	-29.532	-29.532 KN
Max Mx (kNm)	115.668	7.118	29.111	29.111 KN-m
Min Mx (kNm)	-115.668	-12.517	-29.119	-29.119 KN-m
Max My (kNm)	47.852	53.377	53.377	53.377 KN-m
Min My (kNm)	-47.852	-53.417	-53.417	-53.417 KN-m

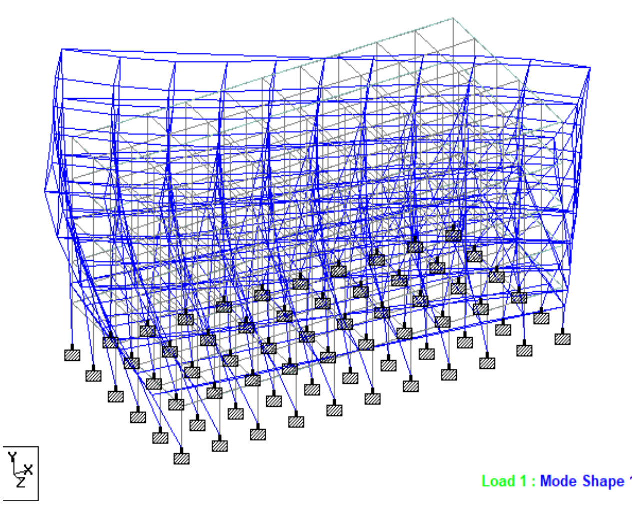
Max Mz (kNm)	153.589	87.456	87.456	87.456 KN-m
Min Mz (kNm)	-116.385	-52.612	-52.612	-52.612 KN-m

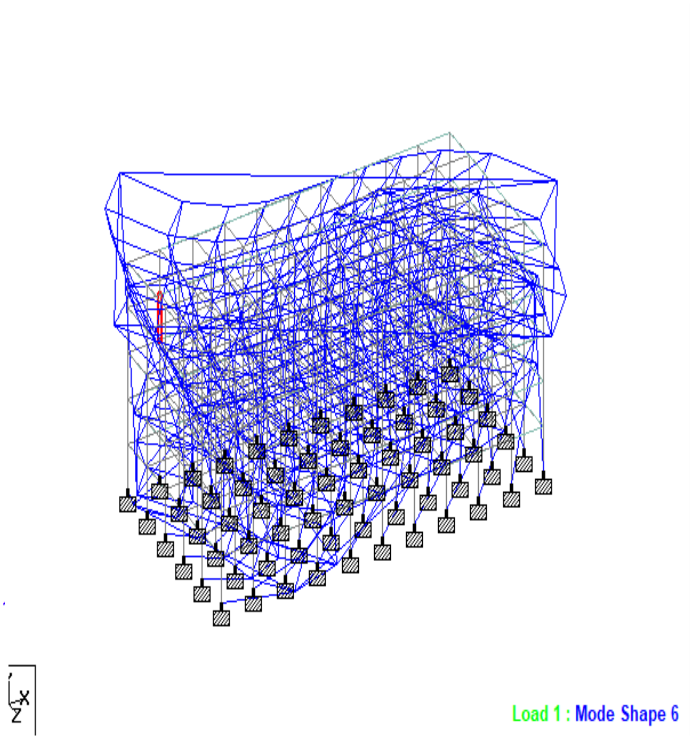
Force and Moment Analysis

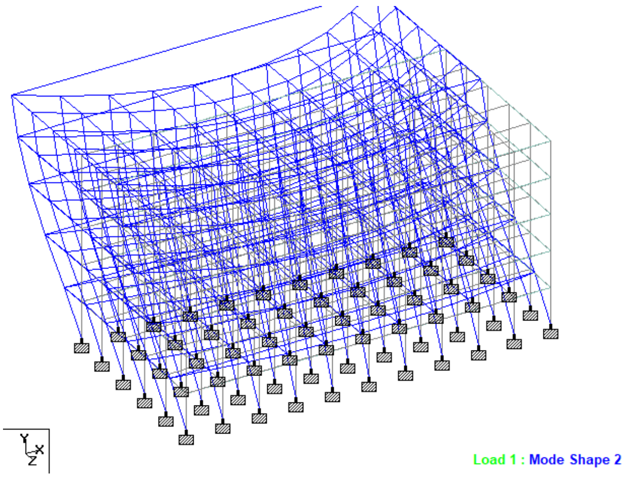
Parameter	**Steel Structure**	**Concrete Structure**
Max X (mm)	1.82	1.374 mm
Min X (mm)	-1.82	-1.369 mm
Max Y (mm)	0.052	0.049 mm
Min Y (mm)	-7.808	-6.47 mm
Max Z (mm)	5.675	5.037 mm
Min Z (mm)	-5.675	-5.031 mm
Max rX (rad)	0.024	0.029 rad
Min rX (rad)	-0.024	-0.023rad
Max rY (rad)	0.11	0.125 rad
Min rY (rad)	-0.11	-0.118 rad
Max rZ (rad)	0.001	0.001 rad
Min rZ (rad)	-0.001	-0.001 rad

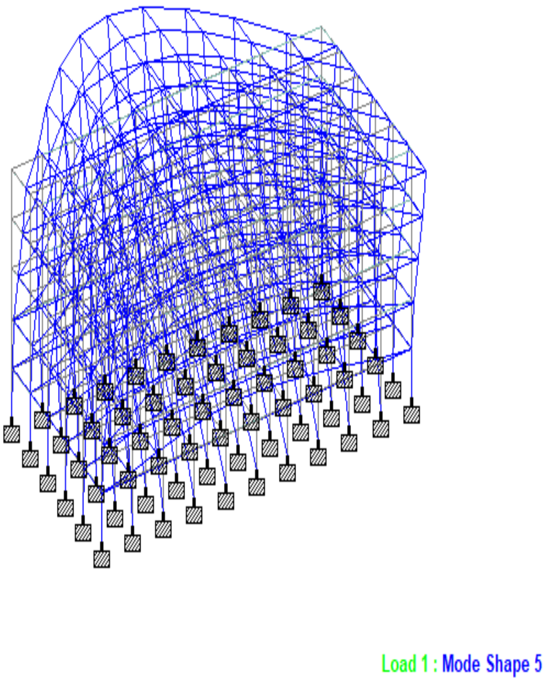
In this project, we conducted a comprehensive comparison of steel and concrete columns and beams based on force, moment, displacement, and rotation parameters. For the force analysis, the steel beams exhibited a maximum axial force (Fx) of 2924.939 kN, while the steel columns had a slightly higher maximum axial force of 3327.586 kN. The minimum axial forces for steel beams and columns were -51.015 kN and -90.033 kN, respectively. Concrete beams and columns both experienced maximum and minimum axial forces of 3327.586 kN and -90.033 kN, respectively. In terms of shear force (Fy), steel beams recorded a maximum of 130.1 kN and a minimum of -130.1 kN, whereas steel columns showed values of 92.389 kN (maximum) and -92.417 kN (minimum). Concrete beams and columns had similar shear force values as the steel columns. Vertical force (Fz) measurements indicated a maximum of 558.925 kN and a minimum of -26.396 kN for steel beams, while steel columns recorded 53.905 kN (maximum) and -29.532 kN (minimum). Concrete structures showed comparable vertical force values to their steel counterparts. In the moment analysis, steel beams experienced maximum and minimum moments (Mx) of 115.668 kNm and -115.668 kNm, respectively, while steel columns had maximum and minimum moments of 7.118 kNm and -12.517 kNm, respectively. For the moments (My), steel beams reached a maximum of 47.852 kNm and a minimum of -47.852 kNm, while steel columns showed 53.377 kNm (maximum) and -53.417 kNm (minimum). Concrete beams and columns had maximum moments (Mx) of 29.111 kNm and -29.119 kNm and moments (My) of 53.377 kNm (maximum) and -53.417 kNm (minimum). The moment (Mz) values for steel beams were 153.589 kNm (maximum) and -116.385 kNm (minimum), while steel columns recorded 87.456 kNm (maximum) and -52.612 kNm (minimum). Concrete beams and columns exhibited similar moment values (Mz) to the steel columns.Regarding displacement and rotation, the steel structure's maximum and minimum horizontal displacements (X) were 1.82 mm and -1.82 mm, respectively, while the concrete structure recorded 1.374 mm (maximum) and -1.369 mm (minimum). The vertical displacements (Y) for the steel structure were 0.052 mm (maximum) and -7.808 mm (minimum), whereas the concrete structure exhibited values of 0.049 mm (maximum) and -6.47 mm (minimum). The steel structure showed maximum and minimum displacements (Z) of 5.675 mm and -5.675 mm, respectively, compared to 5.037 mm (maximum) and -5.031 mm (minimum) for the concrete structure. The steel structure's maximum and minimum rotations (rX) were 0.024 rad and - NARAYANA ENGINEERING COLLEGE, GUDUR 112 0.024 rad, respectively, while the concrete structure recorded 0.029 rad (maximum) and - 0.023 rad (minimum). Similarly, the rotations (rY) for the steel structure were 0.11 rad (maximum) and -0.11 rad (minimum), compared to 0.125 rad (maximum) and -0.118 rad (minimum) for the concrete structure. Both structures showed maximum and minimum rotations (rZ) of 0.001 rad and -0.001 rad, respectively.

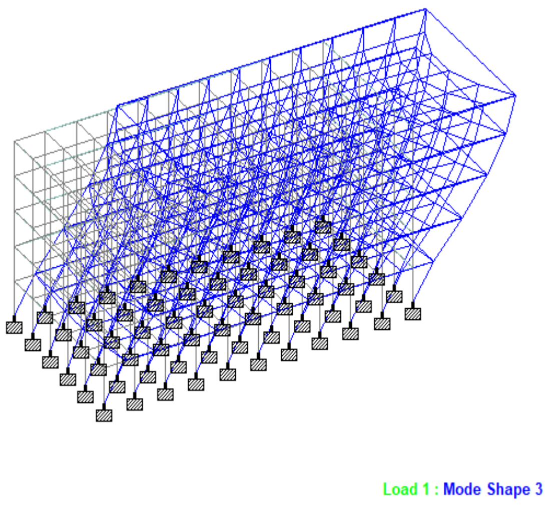
Figures andTables

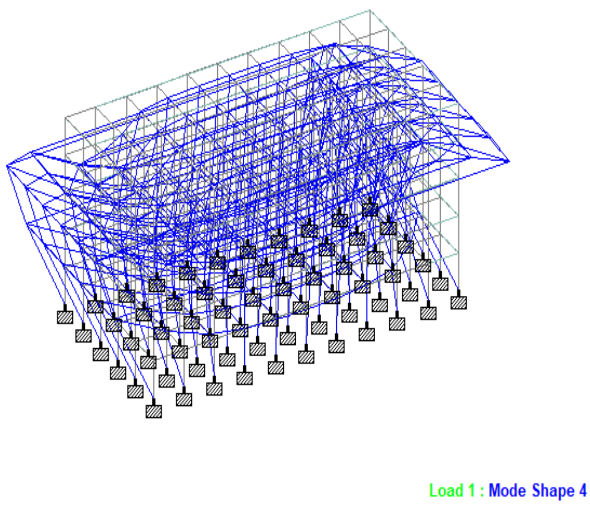












V.CONCLUSION

In conclusion, both steel and concrete structures demonstrated robust performance under the specified loads. Steel beams and columns showed higher axial and shear forces, while concrete beams and columns had comparable moment and displacement characteristics. This detailed comparison provides valuable insights for selecting appropriate materials for structural design, balancing performance requirements with material properties and construction considerations.

While concrete structures are robust and cost-effective, especially for certain types of buildings and loads, steel structures offer superior performance in terms of strength, flexibility, speed of construction, and sustainability. For a multi-story building that demands high load-bearing capacity, flexibility under dynamic loads, and efficient construction processes, steel is the recommended choice. This choice ensures not only the structural integrity and longevity of the building but also meets modern construction standards and sustainability goals.

VI. REFERENCES

1. Parag P. Limbare, Prof. P. A. Dode “Comparative study of Reinforced Concrete frame structure & Steel Concrete composite structure subjected to static and dynamic loading”, International Journal of Engineering and Applied Sciences (IJEAS) ISSN: 2394-3661, Volume-5, Issue-3, March 2018
2. V.Preetha1 M.C. Arun Prasad2, “Comparative Study On Behaviour Of Rcc And Steel - Concrete Composite Multistorey Building”, International Research Journal of Engineering and Technology (IRJET)Volume: 04 Issue: 02 | Feb -2017. 3. [5]. Bhavin H. Zaveri 1, Jasmin A. Gadhiya 2, Hitesh K. Dhameliya
3. “A Review on the Comparative Study of Steel, RCC and Composite Building”, International Journal of Innovative Research in Science, Engineering and Technology (A High Impact Factor, Monthly Peer Reviewed Journal)Vol. 5, Issue 1, Januray 2016.
4. . Nileshkumar. V. Ganwani1 S .S. Jamkar2“Comparative Study on RCC and SteelConcrete Composite Building using Linear Static Analysis ”, IJSRD - International Journal for Scientific Research & Development| Vol. 4, Issue 02, 2016 | ISSN (online): 2321-0613.
5. Anish N. Shah , Dr. P.S. Pajgade “Comparision Of R.C.C. And ComositeMultistoried Buildings” International Journal of Scientific and Research Publications, ISSN 2250- 3153, Volume 5, Issue 10, p- 1-6, October 2015.
6. Mr. Nitish A. Mohite1, Mr. P.K. Joshi2, Dr. W. N. Deulkar3 “Comparative Analysis of RCC and Steel ConcreteComposite (B+G+ 11 Storey) Building”, International Journal of Scientific and Research Publications, Volume 5, Issue 10, October 2015.
7. Yogesh R. Suryavanshi , Prashant S. Patil ―Comparative Study on Analysis, Design and Cost of r.c.c. and steel-composite structure‖ International Journal of Engineering Research-Online 2015.
8. Anamika Tedia ,Dr.Savita Maru ―Cost, Analysis and Design of Steel-Concrete Composite Structure RCC Structure‖ IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) Jan. 2014.
9. Anish N. Shah, Dr. P.S. Pajgade ―ComparisionOf R.C.C. And ComositeMultistoried Buildings‖ International Journal of Engineering Research and Applications (IJERA) April 2013.
10. Josef Hegger, Professor Dr.-Ing ―High Performance Steel and High Performance Concrete in Composite Structures‖ American Society For Civil Engineers.