Section A-Research paper

ANALYSIS AND DESIGN OF G+8 RESIDENTIAL BUILDING IN MEERUT

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doi: 10.48047/ecb/2023.12.si6.135

Abstract:

This high-rise building analysis and design require a deep understanding of structural engineering principles and advanced computer-aided design tools. In this research paper. The design and analysis are presented. G+8 building located in Meerut, India. The process of designing building includes a comprehensive analysis of the building's structural components, such as columns, beams, slabs, and foundations, using finite element analysis software. Additionally, the IS Code of Practice for building construction is taken into consideration in the design. The analysis's findings indicate that the proposed building design is safe and structurally sound. This research paper intends to provide insights into a high-rise building analysis and design, as well as to function as a resource for future studies in this area. The planning along with analysis of a G+8 building in Meerut involve numerous factors and considerations, ranging from the site selection and structural design to the mechanical and electrical systems. The construction of high-rise buildings is becoming increasingly popular due to the scarcity of resources in metropolitan areas land and the need to accommodate a growing population. However, the design and construction of such buildings require careful planning and execution to ensure their safety and sustainability. The analysis and design process will involve a team of architects,

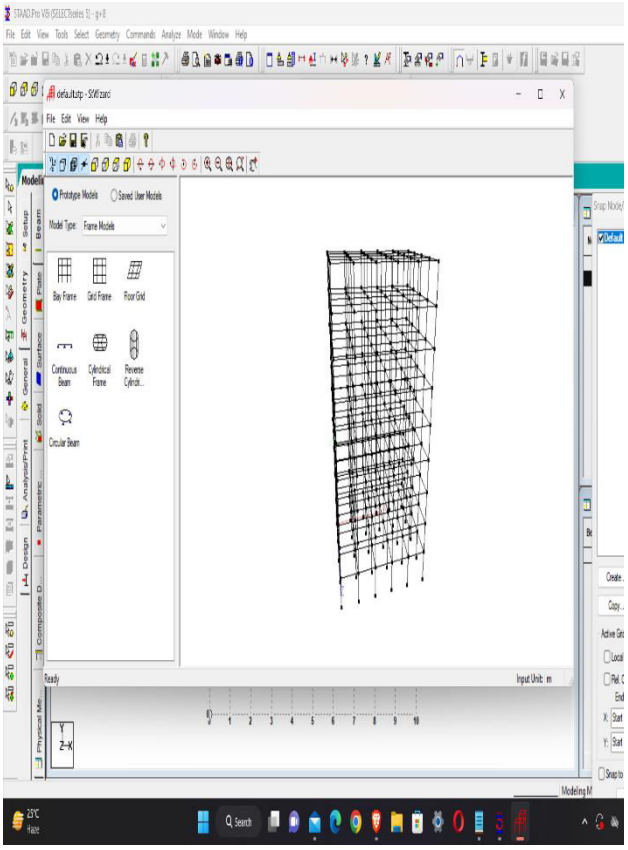
structural engineers, mechanical and electrical engineers, and other specialists who will collaborate to make certain that the building complies with all security and safety demands and code requirements. This will include conducting a detailed site analysis to identify any potential hazards or risks, such as seismic activity or soil instability, and developing a structural design that can withstand these forces. Overall, the analysis and design of a G+8building in Meerut requires a comprehensive understanding of the local building codes and criteria, as well as an in-depth comprehension of the latest construction techniques and materials. The successful completion of this project will require cooperation and the expertise of a highly skilled team of professionals who can work together to achieve a safe, sustainable, and aesthetically pleasing building that meets the needs of its occupants and the community as a whole... The content of this paper describes utilization of AutoCAD and STAAD. Pro software for analysing and developing a multi-story structure G+8. The project involves applying dead loads and live loads to the structure, and it uses STAAD Pro software to design the beams, columns, and footings This paper also emphasises, basic codes for design, including the Indian code for reinforced concrete design loading.

Overall, the project demonstrates the importance of a comprehensive analysis and design approach in ensuring the structural integrity and functionality of a residential building. The completed

design serves as a testament to the successful implementation of engineering principles and techniques in creating a safe and sustainable living space in Meerut. The research paper concludes by emphasizing the significance of the analysis and design process in meeting the specific requirements of a G+8 residential building in Meerut. It highlights the integration of earthquake resistance measures, consideration of wind loads, and adherence to relevant codes and standards. AutoCAD and StaadPro, are briefly described. The purpose of the design codes is to ensure. structural safety, render the task of the designer simple, ensure consistency among different designers and provide legal validity. The paper highlights the importance of planning. and design processes a thorough understanding of building sciences, practical applications underpinned by cutting-edge design codes, by-laws, integrated approach.

Introduction

The design and analysis of a G+8 residential building in Meerut is a complex task that involves multiple disciplines such as architecture, structural engineering, and construction management. The objective of this research paper is to present aa comprehensive study of the design and analysis of a G+8 residential building in Meerut, considering several factors such as site location, building codes and regulations, architectural design, structural analysis and design, and construction management. The study aims to develop a sustainable and cost-effective design that meets the needs of the residents, while ensuring the safety and the structural integrity of the building. The paper will discuss the design process, analysis techniques, and various considerations that must be taken into consideration when designing a G+8 residential building in Meerut. Furthermore, the paper will also highlight challenges faced during the design and construction process and how they were overcome to achieve the desired outcome. The G+8 residential building is a tall structure that demands a thorough analysis of its structural system to ensure that it can withstand the vertical and lateral loads. The analysis of the structural system is done by using various software tools and techniques that can predict the behaviour of the building under different load scenarios. The paper will discuss the use of such software tools and insights and decisions to carry out a precise analysis of the structure. The methodology used while working on the project was limit-state.The paper concludes that the analysis of multi-storey buildings is complex due to their statically indeterminate nature, but the use of software like AutoCAD and STADPRO make the process less lengthy and complex techniques to analyse the structural behaviour the building and ensure its safety. The study will also cover the architectural design of the building, which is an essential factor in figuring out the aesthetic appeal and functionality of the structure. The building's design depends on numerous factors such as the site location, climate, and cultural context. The paper will discuss the architectural design process and how it aligns with the needs of the residents. Construction management is another crucial the aspect of building design, which involves planning, coordination, and supervision of the construction process. The paper will discuss the construction management strategies used in the construction of the G+8 residential building in Meerut and how they ensure the quality and safety of the building. The study will provide valuable insights into the design and analysis of tall residential buildings, which can be beneficial to architects, engineers, and construction professionals. The research paper aims to contribute to the field's knowledge base of building design and analysis and to serve as a reference for future research in this area.



BASIC CODES FOR DESIGN

The Indian code for reinforced concrete design, published by the Bureau of Indian Standards, New Delhi, should be followed in the design of the G+8 residential structure. This code's goal is to guarantee adequate structural safety by defining the fundamental minimum standards for design. The use of code also makes the designer's job relatively simple by providing simple formulas or charts derived from sophisticated analyses. In addition to the code for reinforced concrete design, the building design should also, consider the loading standards specified in the following codes:

IS 875 (Part 1-5): 1987 – Code of Practice for design loads (other than earthquake) for buildings and structures.

- Part 1: Dead loads
- Part 2: Imposed (live) loads
- Part 3: Wind loads/Earthquake load
- Part 5: Special loads and load combinations

By following these codes, the design and construction of the G+8 residential building can ensure structural safety and consistency among different designers. Additionally, conformity to these regulations provides the structural designer with legal protection from any culpability resulting from structural failures brought on by insufficient monitoring and/or subpar materials and construction.

2. BASICS OF SOFTWARE USED

- **STADPRO**
- **AUTOCAD**

STADPRO

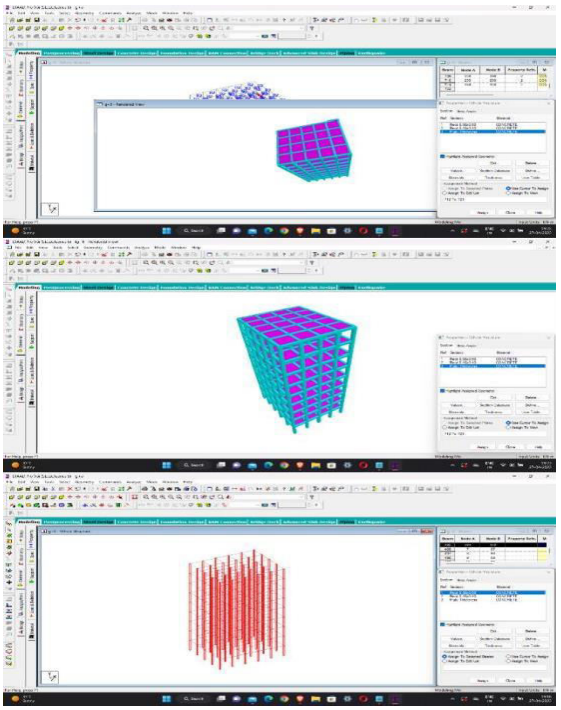
STADPRO is a structural analysis and design software used by engineers and architects forth analysis of diverse types of structures, including buildings, bridges, towers, and other types of structures. It can perform complex analysis and calculations related to structural behaviour and load distribution. The software uses finite element analysis (FEA) and other techniques to simulate the response of structures to different loads and forces. It can also help to design reinforced concrete, steel, and timber structures to meet the relevant building codes and standards. STADPRO is a powerful software application that helps structural engineers to analyse and design several types of structures. It is widely used in the construction industry for designing buildings, bridges, towers, and other types of structures. The software uses advanced techniques such as finite element analysis (FEA) to simulate the behaviour of structures under different loads and forces, allowing engineers to optimize designs for maxim efficiency and safety. STADPRO can perform arrange of analyses, including static, dynamic, and seismic analysis, as well as design reinforced concrete, steel, and timber structures to meet relevant building codes and standards. The software provides aa broad set of modelling and simulation colonializing structures, including beam and column elements, shells, plates, and solid elements. With STADPRO, engineers can quickly and accurately model complex structures, analyse them under different load conditions, and optimize their designs for optimal performance.

AUTOCAD

AutoCAD is a widely used CAD software. architects, engineers, and designers for creating 2D and 3D designs of buildings, products, and other objects. The software provides a variety of drafting and design tools.
detailing, including the creation of plans, sections, and elevations. It can also be used for
creating 3D models and generating photorealistic visualizations of the designs. AutoCAD is an essential tool for architects and
engineers, helping them to create precisely and
detailed drawings that are essential for communication with other professionals,

contractors, and clients. The software offers features such as precision drafting, annotation tools, and collaboration tools that help to increase productivity and efficiency in design projects. AutoCAD is compatible with a wide range of file formats, making it easy to share designs with others and collaborate on projects with colleagues and clients.

To produce 2D and 3D designs of buildings, products, and other objects, architects, engineers, and designers utilize the computer-aided design (CAD) programme AutoCAD. The software provides tools for drafting and detailing, including the creation of plans, sections, and elevations. It can also be used for creating 3D models and generating photorealistic visualizations of the designs. AutoCAD offers features such as precision drafting, 3D modeling, annotation tools, and collaboration tools that help to increase productivity and efficiency in design projects.



A BROADBAND CATEGORIZATION OF THE METHODOLOGY PROCEDURE CONSISTS OF 4 PARTS:

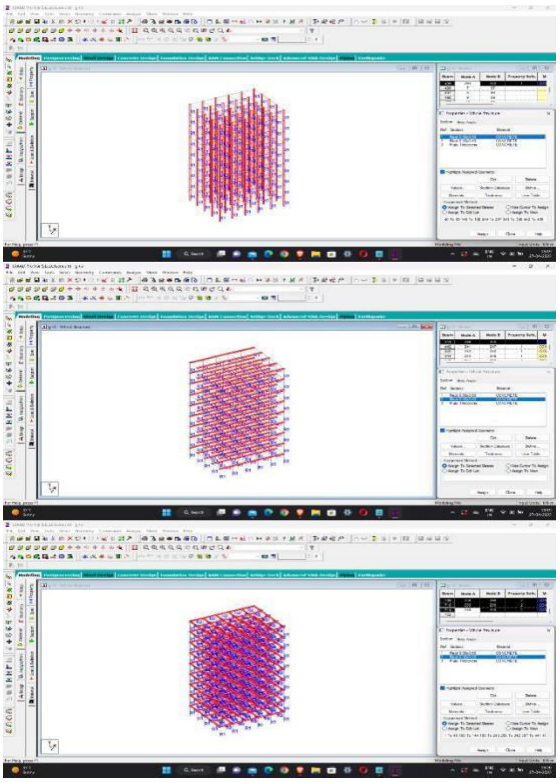
Part A: Creating the building's model.

The structure model has been created using AUTOCAD software, providing accurate dimensions and measurements for analysis and design purposes. The plan highlights a multi-storey structure with G+8 floors, comprising 1404 members and 810 joints in a framed structure. The modelling was carried out in StaadPro software, with beam size set to 500x500mm, and column size at 400x400mm. The plates applied to the structure have a thickness of 150mm, and diagrams below depict the fixed support type provided to the structure. There are 9 plates in the structure. The size of the beams and columns used in the model can greatly affect the overall stability and safety of the

building, especially in multi- storey structures. The selection of suitable materials and dimensions can help ensure that the building can withstand different environmental factors, such as earthquakes and fierce winds.

Furthermore, the provision of fixed supports to the structure in diagrams below helps to anchor the building firmly to the ground and prevent any excessive movement or collapse. This is a crucial aspect of building design, as any instability in the foundation can have profound consequences for the entire structure.

In conclusion, the use of software tools like AUTOCAD and StaadPro, combined with proper engineering and architectural principles, can result in the creation of safe and efficient building structures. The provision of suitable materials, dimensions, and support systems is critical to ensuring the stability and longevity of any building, particularly in multi- storey structures like the one depicted in this model.



Part B: Load and load combination

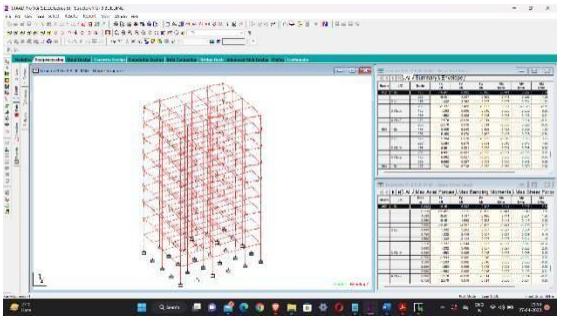
Dead loads, which refer to the weight of the structure itself, including the weight of walls, columns, beams, and floors, are permanent and always present. Live loads, which are variable and include the weight of people, furniture, and other moveable items, must be accounted for in the design to ensure that the structure can withstand the expected amount of load. Wind loads, which are dependent on factors such as building height, shape, and location, can cause significant stresses on a building's exterior and foundation.

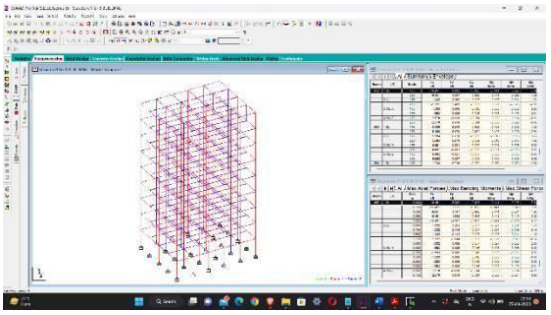
Many other sorts of loads, including dead loads, live loads, wind loads, and seismic loads, were taken into account when the building was being designed. Using different coordinate systems, these loads were applied to the structure in accordance with the guidelines established by IS 456:2000. The structure's member weight, which was applied to the structure was determined.

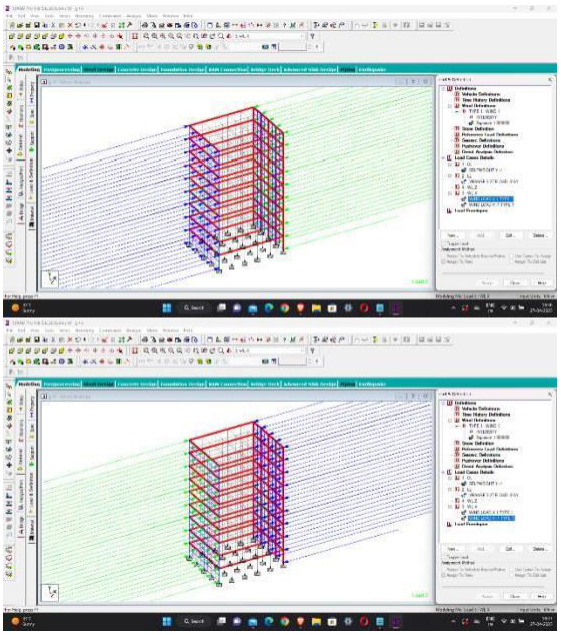
to be 2.25KN/m. Following the guidelines of IS1893:2002, the seismic load was applied to the building in both the X and Z axes.

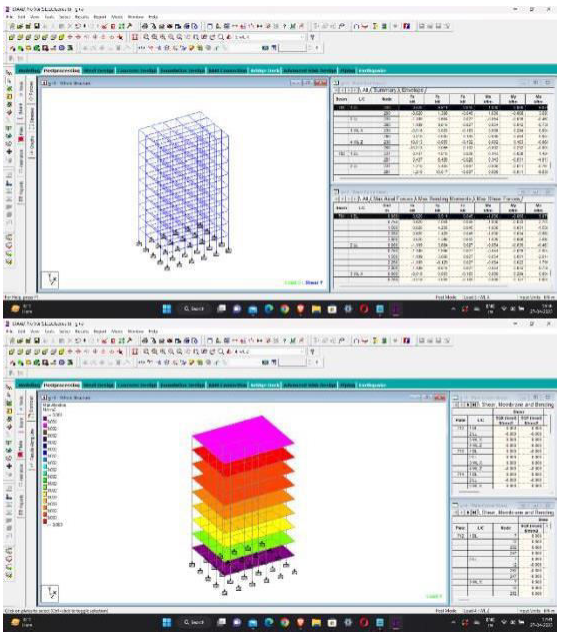
All dead load was represented in red in diagram below, while the live load was shown below, applied to the structure at a rate of 3KN/m2, as per IS456:2000. The blue image showed the location of the floor load placed on the building.

Overall, the consideration of distinct types of loads during the design process is crucial to ensure the safety and stability of the structure. Adhering to established standards and guidelines, such as IS 456:2000 and IS1893:2002, can help engineers and architects design structures that can withstand distinct types of loads and environmental factors.





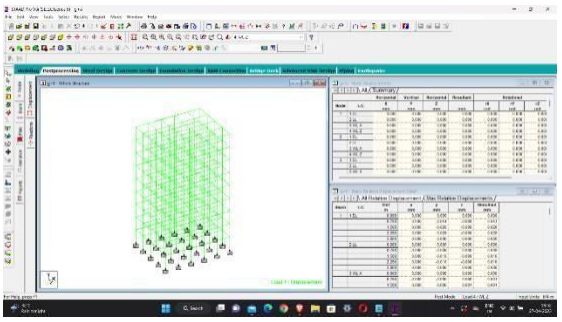


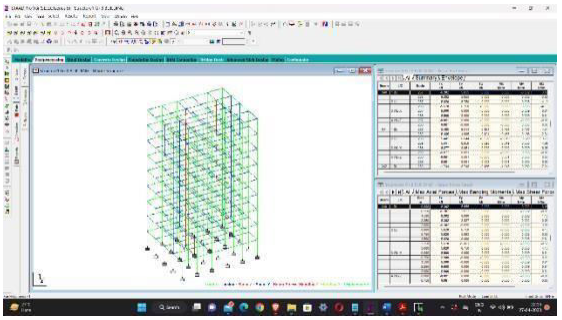


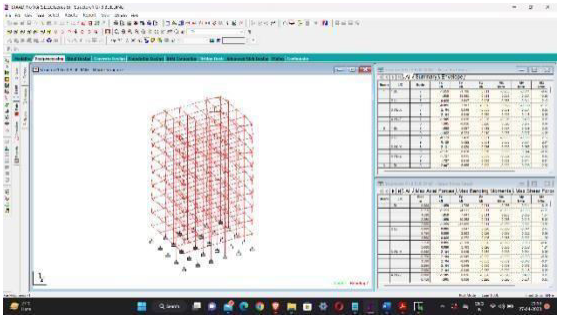
Part C: Analysis

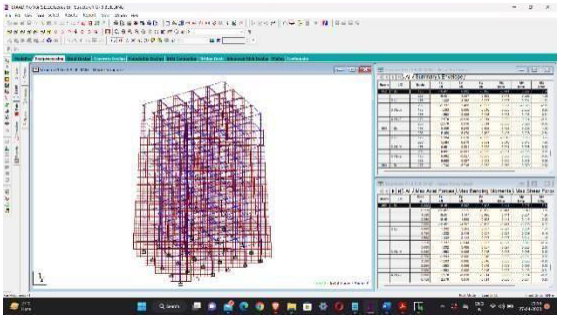
The Staad Pro software was used to analyze the building, which provided crucial information about the structure's maximum loads, including reaction forces, bending moments, shear forces, and other forces. By analyzing the structure, engineers can ensure that the building is designed and constructed safely and economically. The displacement of the structure is represented by the green color in the figure below,

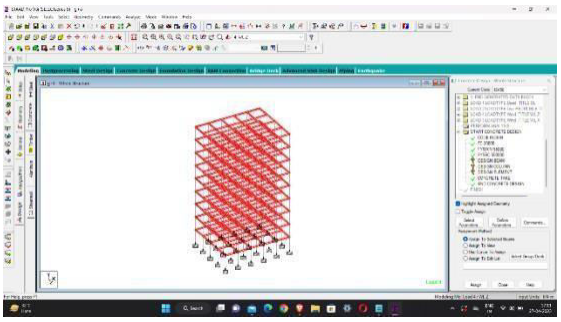
Additionally, the matching table in figure below gives the structure's maximum axial forces, maximum shear forces, and maximum bending moments show the behavior of a randomly selected member of the structure are given in the figures.

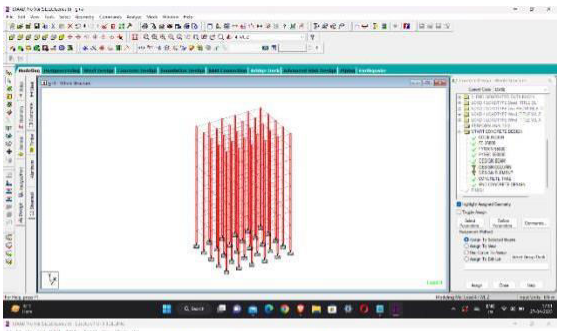


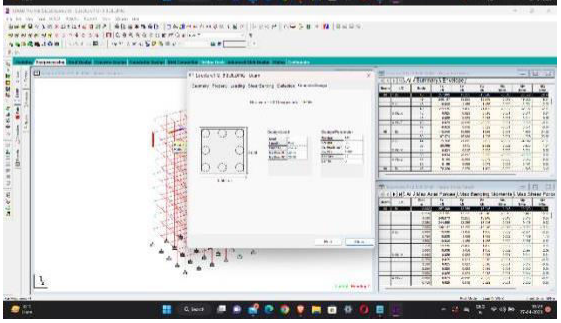


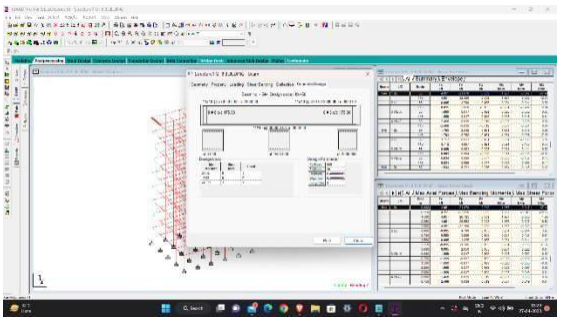












Concrete design

Part D: Design and Detailing

The Staad Pro software was used to design and detail the building in accordance with the IS456:2000 code. The major goal of the design process was to calculate the maximum requirement of concrete and steel reinforcement needed to complete the project. Fe550 was used to design the construction, and secondary bars with a diameter of 12 mm were used weighing 819089KN, while 16mm bars were used as main bars, whose weight was calculated to be 360951KN. The structure was designed with M30 grade concrete.

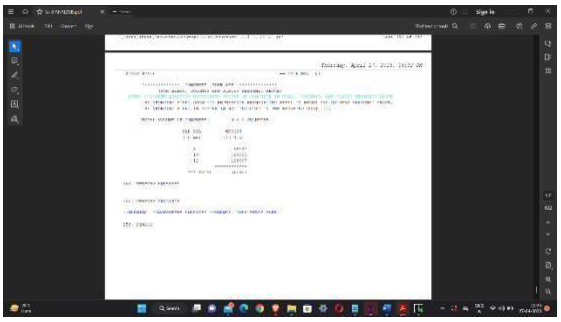


Figure above, presents the final result obtained after the successful completion of the design process. The use of advanced software tools and high-quality construction materials enables engineers to design and construct sturdy and durable structures that can withstand diverse types of loads and environmental factors. The detailed analysis and accurate calculations conducted during the design process provide critical information that helps ensure the safety and reliability of the structure.

3. Results and Conclusions

Upon completion of the work, the actual weight of the structure was found to be 29861.369 KN, while the number of joints, members, and supports were recorded as 810, 1404, and 72, respectively. The total volume of concrete used in the structure was.414.2 cum, and the total area of steel reinforcement was 643708 KN. During the analytical phase, it was discovered that the seismic load applied in the x direction resulted in the largest bending moment, with a value of 53.284KNm. The greatest bending moment, on the other hand, was 2.486 KNm when the

identical earthquake force was applied in the z-direction. Similar to this, when the earthquake load was applied in the x direction, the greatest value of shear force was measured at 117.388KN. However, the value of shear force was discovered when the same seismic stress was applied in the z-direction, that is 108.764KN. These outcomes demonstrate how important it is to take distinct types of loads into account during the design and analysis phase to ensure the safety and durability of the structure.

CONCLUSIONS

We worked on the study and design of a G+8 residential block in Meerut as part of our project. Through this project, we were able to have hands-on experience with a variety of field practices related to the study and design of residential buildings as well as contemporary construction methods. We used Staad Pro software for the analysis, and obtained bending moment and shear force diagrams which enabled us to create the most effective and cost-effective structure for the stresses placed on it. The application, such as AutoCAD and Staad Pro, made the work relatively simple, which would have been quite tedious if done manually.

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