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Construction and Analysis of a G+2 Commercial Building

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Abstract: This paper presents a comprehensive study on the planning, design, and constructionof a modern Ground plus 2 (G+2) storey commercial building. The project integrates sounder architectural design with principles of structural engineering, sustainability, and efficient construction methodology.

I. INTRODUCTION

Construction is one of the most essential industries in modern society. It encompasses the planning, design, and physical creation of buildings, infrastructure, and other built environments, serving abroad range of human needs, from providing shelter and housing to supporting commerce, transport, and public services [1]. Projects in this sector vary considerably in scale and complexity, ranging from small residential dwellings to large- scale public infrastructure such as bridges, highways, and water treatment facilities.

II. CONSTRUCTION METHODS

Building construction methods encompass a wide range of techniques and processes used to create structures. The selection of an appropriate method depends on factors such as the type of building, available budget, choice of materials, and local regulations. The following methods were considered for this project:

1) Flat Slab Construction: Flat slab construction is a type of reinforced concrete system in which floor slabs are supported directly by vertical columns, eliminating the need for conventional beams.
2) Precast Flat Panel System: In this approach, concrete wall panels and floor slabs are manufactured under controlled factory conditions before being transported and assembled on site.
3) Heavy Steel Framing: Heavy steel framing uses welded or bolted steel beams and columns to form the primary structural skeleton of a building.

III. METHODOLOGY

A. Auto CAD Drawing

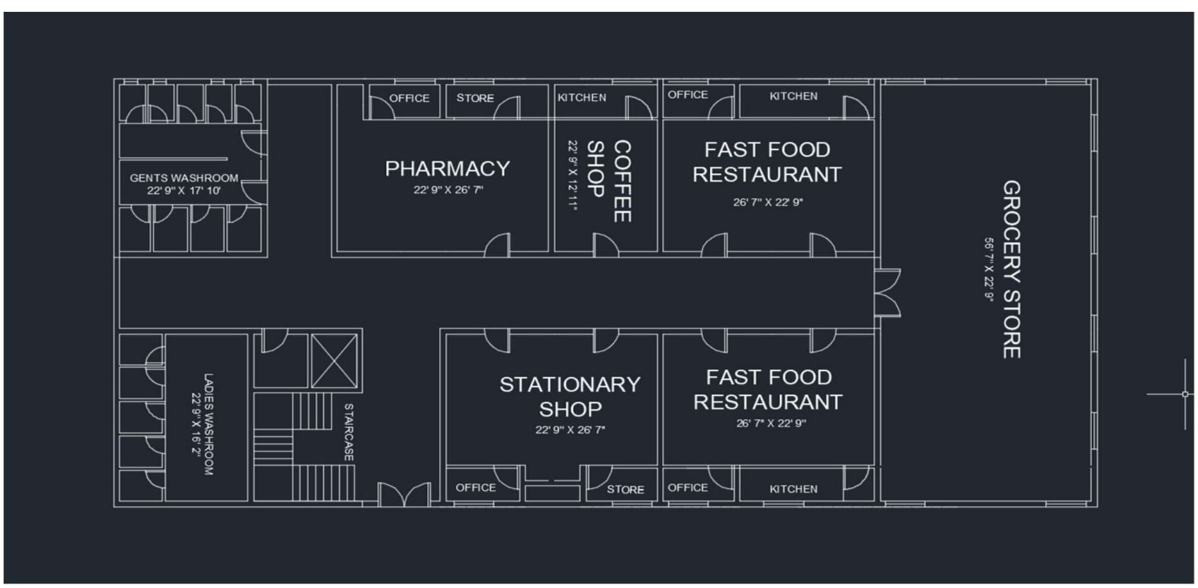

Figure 1: Floor Drawing

B. Earthwork Excavation
Excavation involves the controlled removal of earth, rock, or other material from the construction site to create the necessary space for foundation work and substructure elements. It is a critical early-stage activity that must be carefully planned with due consideration of soil conditions, groundwater levels, the presence of underground utilities and slope stability. Safety measures such as shoring, sloping and dewatering are implemented as required to prevent cave-ins and ensure safe working conditions.

C. Foundation
The foundation is the lowest structural element of a building, responsible for transferring all loads from the superstructure safely to the under lying ground.

D. Reinforcement Work
Reinforcement work involves the accurate placement and tying of steel bars or mesh with in concrete formwork prior to pouring. The reinforcement is positioned according to structural design drawings and is intended to provide tensile strength to the concrete elements, significantly enhancing their load-carrying capacity, ductility and resistance to cracking.

E. Formwork
Formwork is a temporary mould, typically constructed from timber, steel, or aluminium, used to contain freshly poured concrete and maintain its shape until sufficient strength is gained through curing.

F. Concrete Casting and Curing
Concrete casting refers to the process of pouring freshly mixed concrete into prepared form work and compacting it using mechanical vibrators to eliminate trapped air voids and prevent honeycombing. Curing typically spans7 to 28 days and is critical in preventing premature shrinkage cracks and ensuring long-term durability.

G. Masonry Work
Masonry work involves the construction of walls and partitions by laying bricks or concrete blocks in courses and binding them with mortar.

IV. STRUCTURAL ANALYSIS
Structural analysis is the process of evaluating the internal forces, stresses, displacements and deformations within a structure under various load conditions. Its primary objective is to verify that all structural elements satisfy safety, stability, serviceability and durability requirements. For this project, structural analysis was carried out using STAAD Pro software.

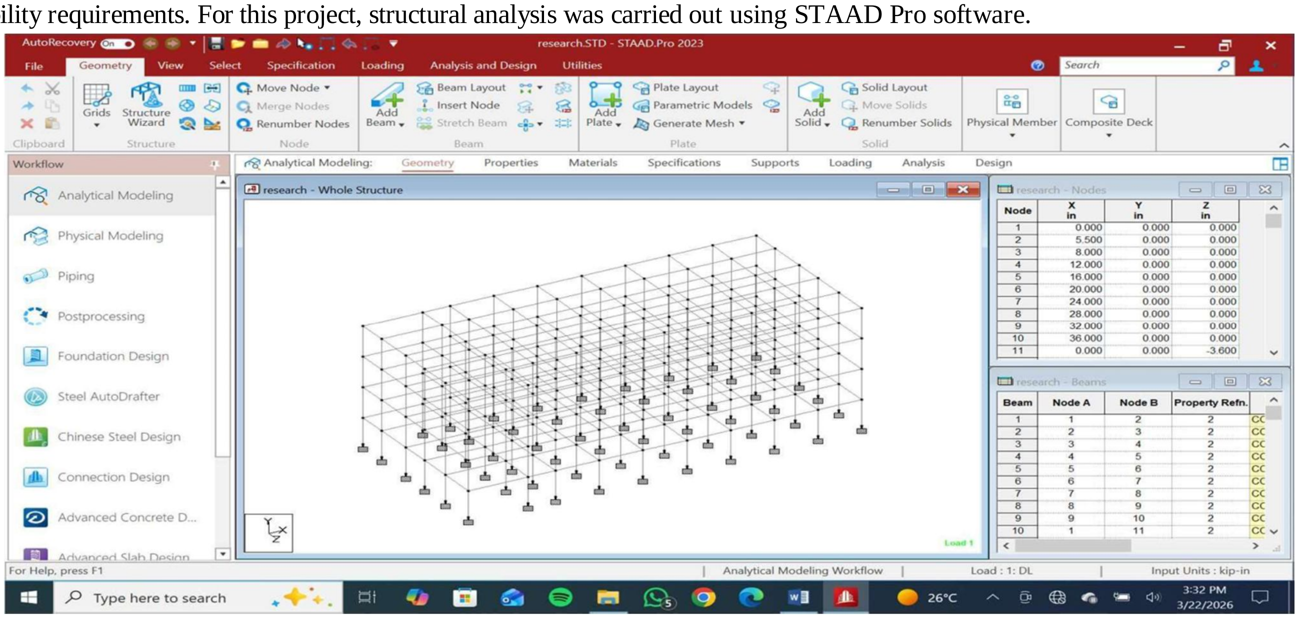

Figure 2: Isometric View of the Building

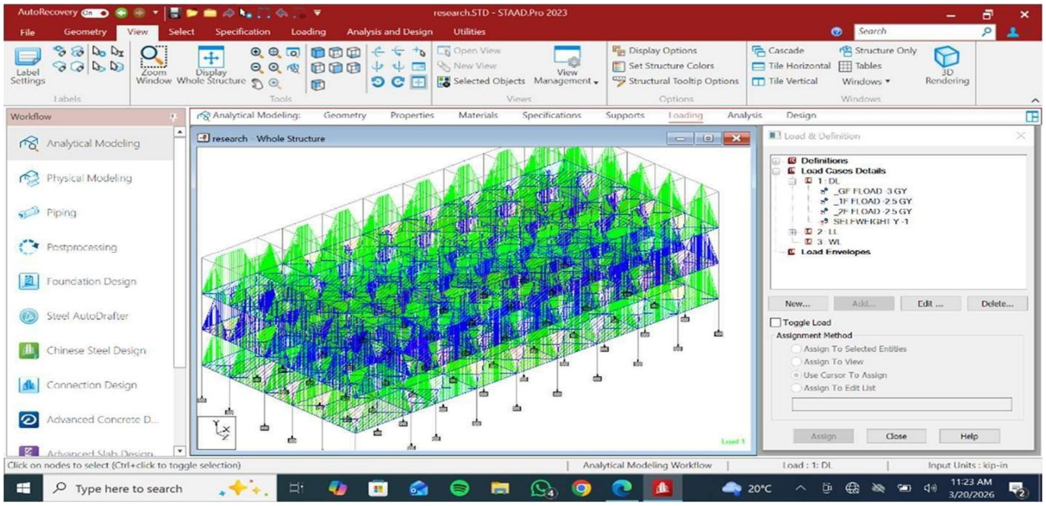

Figure 3: Dead Load: Self-weight of structural elements and permanent fixtures, As per IS875 Part1

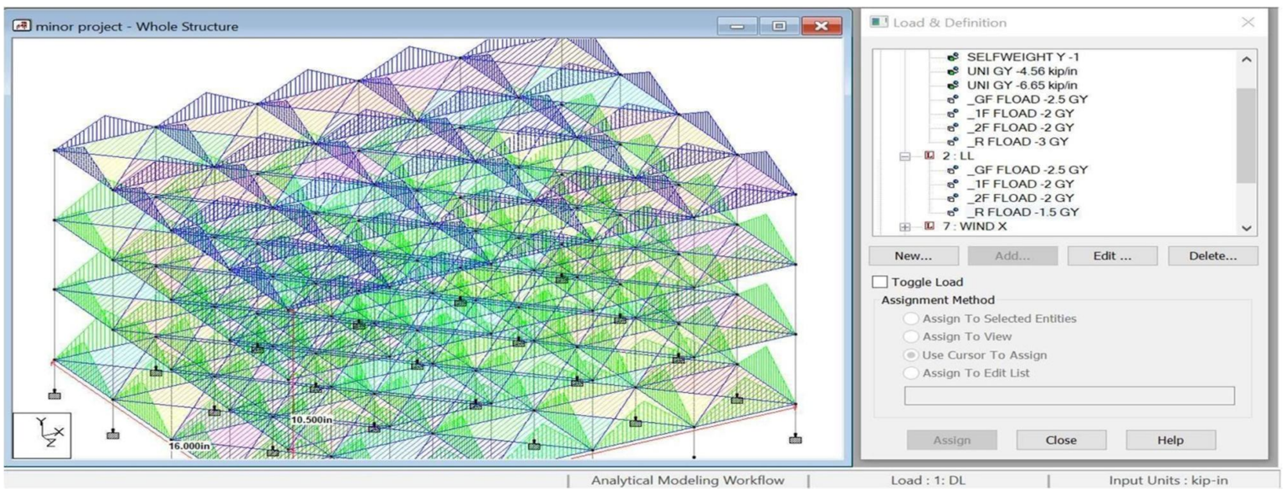

Figure 4: Live Load: Imposed loads from occupants and movable contents, As per IS875 Part 2

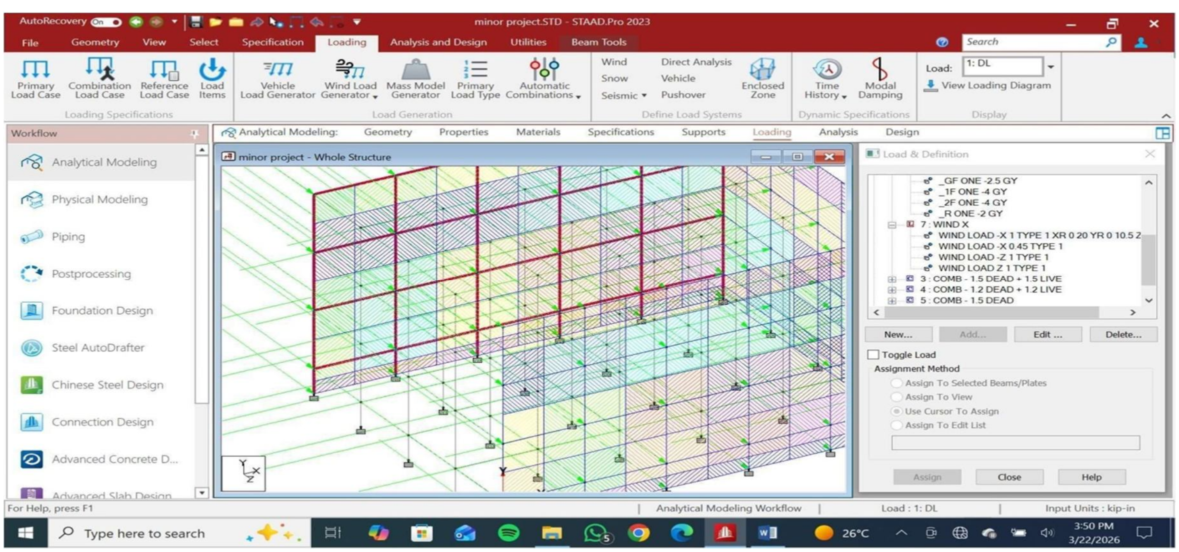

Figure 5: Wind Load: Lateral wind pressure based on the building's location and height, As per IS 875 Part 3

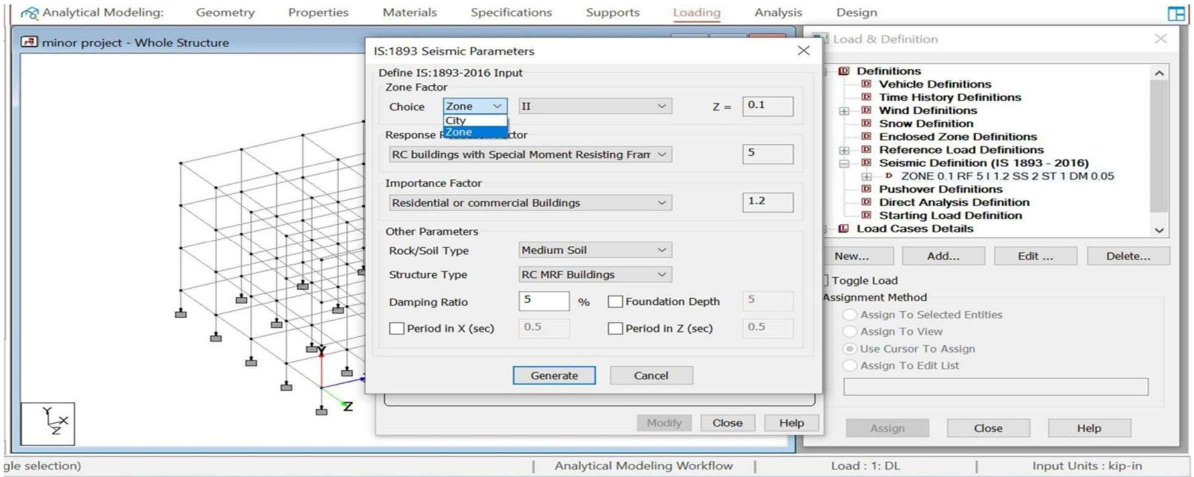

Figure 6: Seismic Load: Earthquake forces based on the seismic zone classification, As per IS 1893 Part

H. Static Analysis

Static structural analysis is a Finite Element Analysis (FEA) technique used to determine the displacement, stress, strain, and internal forces in structural members under constant or slowly varying loads. It is used to verify that beams, columns, slabs, and foundations remain within permissible stress and deflection limits under dead and live load combinations. The results of this analysis were used to finalise member sizes and reinforcement detailing as per IS 456-2000.

I. Dynamic Analysis

Dynamic analysis evaluates the response of the building to time-varying loads, particularly seismic and wind forces. The following methods were applied:

1) Modal Analysis: Identifies the natural frequencies and mode shapes of the structure to understand how it vibrates.
2) Response Spectrum Analysis: Determines the maximum structural response to a defined earthquake input spectrum, IS1893Part 1 (2016)[IS Code 1].
3) Time History Analysis: Simulates the structural response over time for a specific ground motion record to provide a more detailed assessment of seismic performance.

The STAAD Pro model confirmed that all members satisfy the code-prescribed safety factors and deflection criteria under the combined load cases considered.

V. CONCLUSION

The successful planning, design and construction of a G+2 commercial building requires the coordinated effort of architects, structural engineers, contractors, and skilled construction workers. This project has demonstrated how each phase of the construction process, from site preparation and foundation work to superstructure erection and finishing, must be carefully executed to meet design specifications, applicable IS codes, and safety standards. Structural analysis using STAAD Pro confirmed the adequacy of the proposed structural system under dead, live, wind, and seismic load combinations. The commercial building has been designed to accommodate a diverse range of uses including retail shops, a supermarket, a food court, office spaces, and ancillary facilities, all served by efficient water supply and sanitation systems. In conclusion, this paper reflects the integration of technical expertise, sound project management, and responsible construction practices. The resulting commercial facility stands as an example of how innovation, sustainability, and engineering rigour can be combined to deliver a structure that is safe, functional and environmentally responsible.

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