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Design and Development of Hostel Building

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Abstract— The planning, research, and structural layout of a hostel buildings meant to offer students secure, cozy, and practical housing is the main focus of this project. This study's primary goal is to create a functional, affordable, and structurally sound hostel structure while taking into account the needs of residential accommodations, effective use of available space, accessibility, lighting, ventilation, sanitation, safety, along with future growth. Student rooms, hallways, stairwells, common spaces, dining facilities, restrooms, study areas, entertainment areas, and other necessary amenities will all be taken into consideration while designing the hostel's plan. Functional zoning and appropriate circulation will be taken into account to guaranty easy mobility and efficient use. To guaranty easy mobility and efficient use of the available space, functional zoning and proper circulation will be taken into account. For appropriate live loads, dead loads, normal wind loads, seismic load, and other pertinent design forces, a variety of structural elements, including foundations, beams, columns, slabs, staircases, as well as roof systems, will be examined. The suggested structural engineering design design structure will be carried out.In order to produce a safe and cost-effective solution while meeting the necessary architectural and functional requirements, the design will take into account appropriate structural systems including member dimensions. In order to produce a safe and cost-effective solution while meeting the necessary architectural and functional requirements, the design will take into account appropriate structural systems including member dimensions. The final proposal will include the building plan, structural layout, analysis results, design of major structural elements, reinforcement details, and relevant structural drawings. The overall aim of this project is to develop a practical, safe, comfortable, and economical hostel building that can serve as a basis for further detailed engineering and construction planning.

Keywords: Hostel Building, Structural Design, STAAD.Pro V8i, AutoCAD, Tekla Structures, Structural Analysis, Load Calculation, Reinforced Concrete, Building Planning, BIM.

I. INTRODUCTION

The planning and structural design of hostel buildings require careful consideration of functional requirements, structural safety, serviceability, comfort, and economy. A well-planned hostel should provide suitable accommodation along with adequate circulation spaces, staircases, common areas, sanitation facilities, and other essential services. At the same time, the structural system must be capable of safely resisting the various loads acting on the building while maintaining stability and durability.

This project focuses on the planning, analysis, and structural design of a G+3 hostel building intended to provide comfortable and efficient accommodation for students or residents. The planning process considers the effective utilization of available space by arranging rooms, corridors, staircases, common areas, and sanitation facilities in a suitable manner. The proposed structural system includes major components such as slabs, beams, columns, staircases, foundations, and roof systems, which are designed based on the results obtained from structural analysis and applicable Indian Standard Codes.



Computer-aided design and analysis tools are used to improve the accuracy and efficiency of the building design process. AutoCAD is used for preparing the architectural plans, elevations, sections, and column layout. STAAD.Pro V8i is used for structural modelling and analysis of the building by considering dead load, live load, wind load, and other relevant loading conditions. The analysis provides important structural parameters such as support reactions, member forces, bending moments, shear forces, and nodal displacements, which are used for the design of the structural members. Tekla Structures is also utilized for three-dimensional structural modelling and detailing of the building.

The main objective of the project is to develop a practical, safe, comfortable, and economical hostel building while making effective use of the available space. The design aims to achieve adequate strength, serviceability, structural stability, durability, and overall safety without compromising the functional requirements of the building. The proposed work provides a systematic approach for integrating buildingplanning, structural analysis, design, and detailing in the development of a multi-storey hostel structure.

II. LITERATURE REVIEW

The planning and structural design of hostel buildings require an integrated approach that considers structural safety, functional requirements, occupant comfort, and efficient utilization of space. Previous studies have examined the application of Building Information Modelling (BIM), structural modelling, environmental performance, and spatial planning in multi-storey residential and hostel buildings.

Recent developments in Building Information Modelling have improved the efficiency of building planning and structural design by integrating architectural, structural, and building-service information into a coordinated digital model. BIM-based approaches support three-dimensional modelling, structural detailing, quantity estimation, and coordination between different building components. The use of BIM can also help identify conflicts between structural and architectural elements at an early stage, thereby improving the accuracy and efficiency of the overall design process.

Studies on hostel and dormitory buildings have highlighted the importance of indoor environmental quality in addition to structural requirements. Factors such as thermal comfort, indoor air quality, natural lighting, ventilation, and acoustics significantly influence the usability and comfort of residential buildings. Proper planning of openings, room arrangements, circulation spaces, and ventilation paths can contribute to improved indoor conditions and reduce dependence on mechanical systems.

Research on student accommodation has also emphasized the relationship between spatial organization and occupant behaviour. The arrangement of rooms, furniture, common areas, and circulation spaces can influence privacy, social interaction, comfort, and the overall usability of hostel facilities. Appropriate planning of individual and shared spaces is therefore important for creating an environment that supports both residential and social activities.

Passive design principles have been considered in several studies as an effective approach for improving the environmental performance of buildings. Building orientation, natural ventilation, daylight availability, and appropriate spatial arrangements can contribute to improved thermal conditions and reduced energy consumption. These considerations are particularly relevant to hostel buildings because they accommodate a relatively large number of occupants for extended periods.

Previous research has further indicated that occupant behaviour and post-occupancy evaluation can provide useful information for improving the design and performance of residential buildings. The actual use of rooms, common spaces, ventilation openings, and furniture arrangements can influence the environmental performance of a building. Therefore,

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considering user requirements during the planning stage can improve the functional effectiveness of hostel buildings.

The reviewed literature indicates that modern hostel design should combine structural engineering principles with architectural planning, environmental considerations, and digital modelling technologies. BIM and structural analysis software can improve the accuracy and coordination of the design process, while proper spatial planning, ventilation, lighting, and common-area arrangements can enhance occupant comfort. Based on these findings, the present project integrates building planning using AutoCAD, structural analysis using STAAD.Pro V8i, and three-dimensional structural modelling and detailing using Tekla Structures to develop a safe, functional, and economical G+3 hostel building.

III. METHODOLOGY

The methodology adopted for the present project consists of building planning, structural modelling, load calculation, structural analysis, and design of structural members

A. Building Planning

- The architectural plan of the proposed G+3 hostel building is prepared by considering the functional requirements of the hostel
- The arrangement of hostel rooms, corridors, staircases, common areas, and sanitation facilities is considered during the planning stage
- The overall building dimensions and floor layout are defined based on the proposed building plan.
- AutoCAD is used for preparing the floor plans, elevations, sections, and column layout.

B. Structural Modelling Using STAAD.Pro

- The structural frame is modelled using STAAD.Pro V8i software. The model consists of nodes, beams, columns, slabs, and other structural elements required to represent the building.
- The building geometry is defined based on the selected structural grid arrangement and floor levels.
- Material properties and cross-sectional dimensions are assigned to the structural members based on the design requirements.
- The structural model is developed based on the architectural plan and proposed structural arrangement.

C. Load Calculation

The loads acting on the building are identified and calculated according to the applicable design requirements. The loads considered in the project include:

- Dead load due to the self-weight of structural members.
- Floor loads due to slabs and other permanent components.
- Live loads based on the occupancy and use of the hostel building.
- Wall loads, wherever applicable.
- Wind load and other relevant loads according to the project requirements and applicable Indian Standard Codes.

The calculated loads are assigned to the structural model using the appropriate STAAD.Pro loading procedures

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D. Structural Analysis

After defining the structural model and loading conditions, the analysis is performed using STAAD.Pro V8i.

The analytical results include:

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- Support reactions.
- Bending moments in beams and columns.
- Shear forces in structural members.
- Axial forces in columns.
- Displacements and deflections of the structural frame.

These results are examined to identify the critical structural members and the forces required for the design process.

E. Structural Design

- The structural members are designed based on the forces obtained from the STAAD.Pro analysis.
- The design process considers the relevant requirements of Indian Standard Codes for reinforced concrete structures.
- Beam and column reinforcement is determined based on the applicable design checks.
- Slab and foundation design is carried out using the relevant design information and project requirements.
- Staircases and other major structural components are designed based on the calculated loading and structural requirements.
- The final design is checked to satisfy the required strength, stability, serviceability, durability, and safety criteria.

F. Structural Modelling and Detailing Using Tekla Structures

- A three-dimensional structural model of the building is developed using Tekla Structures.
- Structural members and reinforcement details are represented in the 3D model.
- The model is used for structural detailing, quantity estimation, and preparation of construction-related documentation.
- The 3D modelling process helps improve coordination between the different structural elements and supports accurate structural detailing.

IV. EXISTING SYSTEM

The conventional approach to building planning and structural design mainly depends on manual calculations and traditional drafting methods. In multi-storey hostel buildings, the calculation of dead loads, live loads, wall loads, and other structural forces becomes complex due to the number of floors and structural members.

- Structural calculations are generally performed manually for beams, columns, slabs, staircases, and foundations.
- Repeated calculations increase the time required for structural analysis and design.
- Manual preparation of building plans and structural drawings makes modifications and coordination more difficult.
- Analysis of different load combinations and their effects on structural members requires considerable effort.
- Manual methods may make it difficult to coordinate architectural planning with structural detailing.
- Preparation of detailed structural drawings and quantity information is also time-consuming.
- The conventional approach provides limited integration between structural analysis, three-dimensional modelling, and detailing.

These limitations indicate the need for a computer-aided approach for efficient planning, analysis, design, and detailing of a multi-storey hostel building.

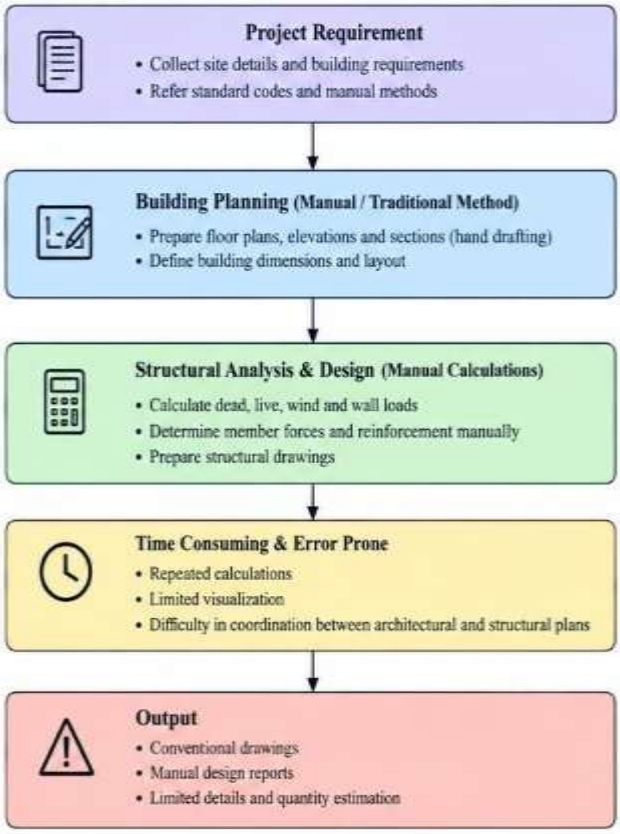


Fig.1. Existing System

V. PROPOSED SYSTEM

The proposed system adopts a computer-aided methodology for the planning, structural analysis, design, modelling, and detailing of the G+3 hostel building. AutoCAD 2026, STAAD.Pro V8i, and Tekla Structures are used at different stages of the project to improve accuracy and coordination.

- The architectural planning of the G+3 hostel building is prepared using **AutoCAD 2026**.
- The building layout includes hostel rooms, corridors, staircases, common areas, and sanitation facilities based on functional requirements.
- The structural model is developed using STAAD.Pro V8i with beams, columns, slabs, and other load-carrying elements.
- Dead loads, live loads, wall loads, wind loads, and other applicable loads are considered for structural analysis.
- STAAD.Pro V8i is used to determine support reactions, bending moments, shear forces, axial forces, and structural displacements.
- The analysis results are used for the design of structural members such as beams, columns, slabs, staircases, and foundations.
- **Tekla Structures** is used for three-dimensional structural modelling, reinforcement detailing, quantity estimation, and preparation of construction-related drawings.
- The integrated workflow improves coordination between architectural planning, structural analysis, design, and detailing.
- The proposed system aims to achieve a safe, functional, economical, and structurally sound hostel building.

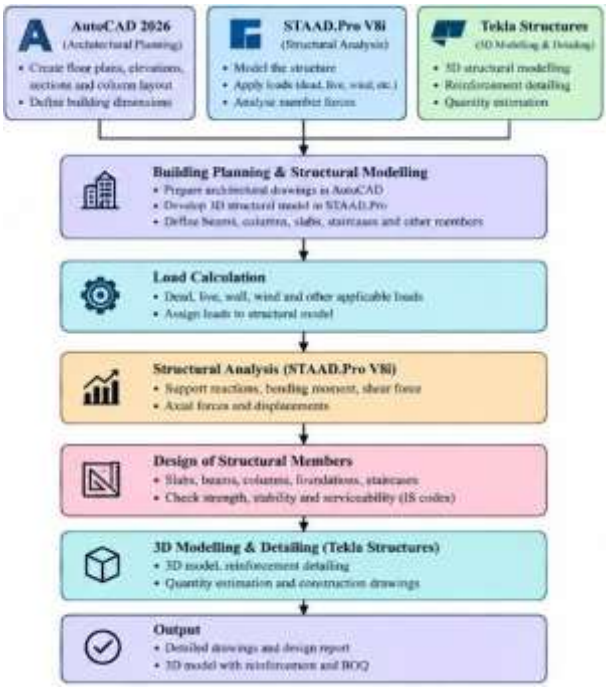


Fig.2. Proposed System

VI. RESULTS AND DISCUSSION

The proposed G+3 hostel building was planned and structurally analysed using AutoCAD, STAAD.Pro V8i and Tekla Structures. The architectural drawings included floor plans, sectional views, front elevation and column layout. The proposed building has an overall dimension of



200 ft × 160 ft, with a floor area of 32,000 sq.ft and a total built-up area of 128,000 sq.ft for the G+3 building.

The structural model was developed in STAAD.Pro V8i by considering beams, columns, slabs and other load-carrying members. Dead load, live load and other applicable loading conditions were considered for evaluating the structural response. The analysis generated support reactions, member forces, bending moments, shear forces, nodal displacements and deflections, which were used as a basis for the structural design.

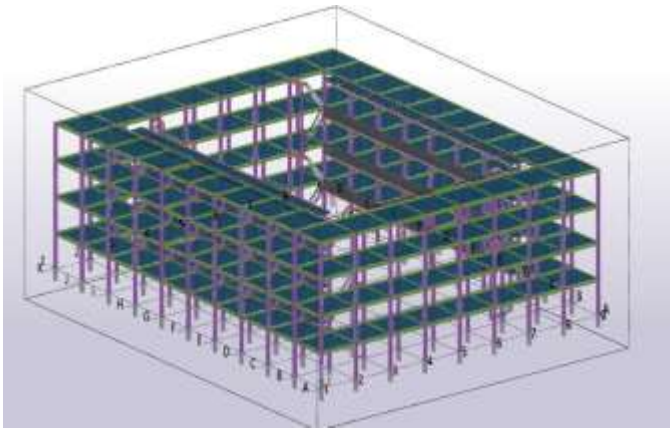


Fig.3. Structural Design

The design of the major structural components included slabs, beams, columns, footings and staircases. The design process considered self-weight, wall loads, floor finishes, imposed live loads and other applicable loads. The forces and moments obtained from the structural analysis were used to determine the required member dimensions and reinforcement or structural sections.

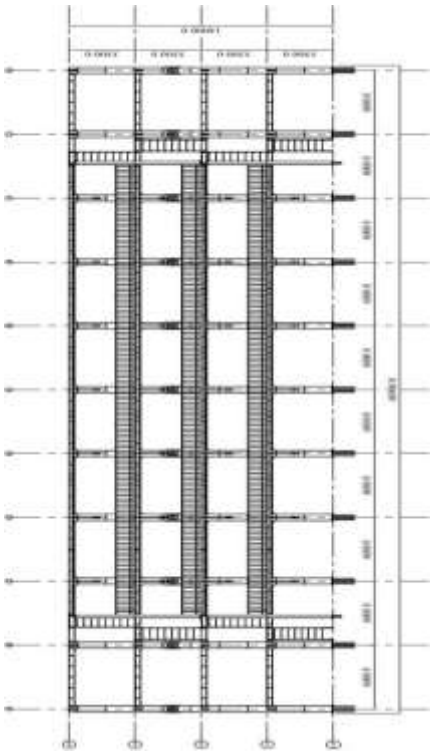


Fig.4. floor plan with staircase arrangement

The column design and load checks presented in the project report indicate a column capacity of approximately 3520 kN for the considered ISMB 600 section, while the maximum frame demand considered was 1134 kN. The corresponding estimated column reaction was approximately 284 kN per column for the four-column frame considered. The report also presents a footing size of 1.2 m × 1.2 m with a depth of 1.0 m for the stated soil bearing capacity assumption.

The beam design considered ISMB 400 as the primary beam and ISMB 200 as the secondary beam for the reported structural arrangement. The primary beam analysis considered a 6 m span with a total uniformly distributed load of 21 kN/m based on the stated dead and live load assumptions. The secondary beam calculation considered a total floor load of 7.0 kN/m².

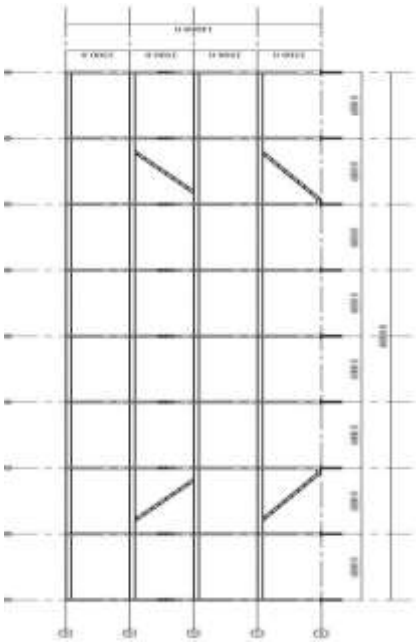


Fig.5. Beam-Column Layout

The results demonstrate the usefulness of computer-aided structural analysis for evaluating the behaviour of the proposed hostel building and identifying the forces required for member design. Tekla Structures further supports three-dimensional modelling, structural detailing, quantity estimation and preparation of construction-related drawings.

Overall, the integrated use of AutoCAD, STAAD.Pro V8i and Tekla Structures provides a coordinated workflow from architectural planning to structural analysis, design and detailing. The project therefore provides a basis for developing a practical, safe, comfortable and economical hostel building, subject to detailed engineering verification before construction.

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VII. CONCLUSION

The planning, analysis and structural design of the proposed G+3 hostel building were completed by integrating architectural planning, structural analysis and structural design. AutoCAD was used for preparing the floor plans, elevations, sectional views and column layout, while STAAD.Pro V8i was used to analyse the structural system under the considered loading conditions.

The structural analysis provided information regarding member forces, bending moments, shear forces, nodal displacements and beam deflections. These results were used as the basis for designing the major structural components, including slabs, beams, columns, footings and staircases.

The project focuses on efficient space utilization, functional accommodation, accessibility, ventilation and comfortable living conditions. The proposed structural system is developed with consideration of strength, serviceability, stability, durability and safety requirements.

The use of STAAD.Pro V8i and Tekla Structures improves the efficiency of structural analysis, modelling and detailing. The integrated computer-aided approach provides a suitable basis for further detailed engineering and construction planning of the proposed hostel building.

VII. FUTURE SCOPE

The following improvements may be considered in future work:

- Detailed geotechnical investigation can be carried out to obtain accurate soil properties and bearing capacity for foundation design.
- Detailed seismic and wind analysis can be performed using site-specific parameters and applicable design provisions.

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- Energy-efficient planning can be incorporated through improved building orientation, natural ventilation, daylighting and passive design strategies.
- The structural model can be further developed using an integrated BIM workflow for better coordination between architectural, structural and construction requirements.
- Tekla Structures can be utilized further for detailed reinforcement modelling, quantity estimation, fabrication information and construction documentation.
- Cost estimation and material optimization can be carried out to improve the economic efficiency of the proposed building.
- Clash detection and multidisciplinary coordination can be performed before construction to reduce errors and rework.
- Further studies can evaluate the hostel building's thermal comfort, indoor air quality, lighting, ventilation and occupant requirements, which are important aspects identified in the reviewed hostel-building literature.
- The proposed design can be further verified and refined using detailed engineering calculations and approved construction drawings before actual implementation.

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