International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435 (Online) Volume 15, Issue 08, August 2026)

Analysis and Design of G+4 Residential Building using STAAD.PRO

Subba Rao G[1], G. Mounikeshwari[2], N. Preethi Laxmi[3]

[1]*Professor,* [2,3]*B Tech IV year students, Department of Civil Engineering, NNRG, Nalla Narasimha Reddy Education Society's Group of Institutions, Hyderabad, Telangana, India*

***Abstract*—This paper presents the structural analysis and design of a G+3 residential building using STAAD.PRO V8i. The building is considered as a reinforced concrete framed structure and is studied under the loading conditions identified in the project, including dead load, live load, and seismic load in accordance with relevant Indian Standard provisions. The study integrates building planning, structural modeling, load assignment, structural analysis, and reinforced-concrete member design. The STAAD.RO workflow consists of creating nodal points from the column layout, connecting beams and columns, generating the three-dimensional model, assigning fixed base supports and member properties, applying dead and live loads, and carrying out analysis with error checking. The resulting shear-force, bending-moment, and deflection outputs are used to interpret structural response. Concrete design is then performed with IS 456:2000 commands for the structural components considered in the project. Column and beam design concepts are discussed in relation to axial force, bending, slenderness, longitudinal reinforcement, transverse reinforcement, and flanged action. The study demonstrates the application of software-based structural analysis to an efficient and systematic structural-design workflow while retaining the need for code-based engineering judgment and verification.**

***Keywords*—Foundations, Indian Standard Codes, structural load analysis, Reinforced Concrete Structure, Seismic Load, STAAD.PRO, Structural Analysis, Structural Design.**

I. Introduction

The increasing demand for residential accommodation in densely populated areas has contributed to the development of multi-storey residential buildings. The structural planning of such buildings requires a coordinated consideration of functional requirements, structural configuration, safety, economy, durability, and serviceability. In multi-storey reinforced-concrete construction, the structural system must provide a continuous and reliable load-transfer path from slabs and other floor components to beams, columns, and foundations. Consequently, structural analysis and design constitute an essential stage in establishing the adequacy of the proposed building system.

Previous studies have demonstrated the application of computer-aided techniques to the planning, analysis, and design of residential buildings.

A G+3 residential building was analyzed and designed using STAAD-Pro, with the study addressing structural planning and the use of software for the analysis and design process [1]. Another study on residential building design emphasized that structural planning and design require consideration of safety, economy, durability, serviceability, and practical engineering judgment[2]. These studies indicate the relevance of systematic structural planning before the execution of detailed analysis and member design.

The application of STAAD.PRO to multi-storey residential structures has also been reported for different building configurations. A G+3 residential building was Analysed using STAAD-Pro, with the study describing the influence of increasing population and the resulting demand for high-rise residential construction. It further emphasized that structural design should satisfy requirements associated with durability, economy, serviceability, and safety [3]. A separate study on a G+5 residential building considered the planning, analysis, and design of structural components using STAAD.PRO and the Limit State Method in accordance with IS 456:2000 and SP-16 design charts [4]. These investigations demonstrate the applicability of software-assisted structural analysis to multi-storey reinforced-concrete residential structures.

The literature also indicates the use of STAAD.PRO for the analysis of multi-storey framed buildings under specified loading conditions. The reported G+6 study employed structural analysis and design procedures for a multi-storey residential building using STAAD.PRO [5]. Such work illustrates the use of numerical structural analysis to evaluate the response of building frames and to support the design of structural members. The application of computer-based analysis is particularly useful where the structural system contains several interconnected members and the distribution of forces must be evaluated systematically.

For reinforced-concrete residential buildings, the evaluation of structural actions is fundamental to the design process. Permanent actions include the self-weight of structural and other permanent components, while imposed actions arise from occupancy and use of the building. Appropriate load assessment is required before structural analysis because the calculated design actions govern the sizing and reinforcement requirements of structural members.

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435 (Online) Volume 15, Issue 08, August 2026)

The studies considered in the literature demonstrate the use of standard design provisions and software-based procedures for the analysis and design of multi-storey residential structures [1]–[5].

In the present study, a G+4 residential building is considered for structural analysis and design using STAAD.PRO. The proposed work extends the application of software-assisted analysis to a four-storey-above-ground residential configuration. The structural model is developed to represent the building geometry, member connectivity, material properties, support conditions, and specified loading. The analysis is intended to determine the structural response required for the subsequent design and verification of the reinforced-concrete members.

The methodology involves the systematic development of the structural model followed by assignment of member properties, supports, and relevant loads. The resulting analytical model is used to obtain structural response quantities such as member forces, reactions, and displacements. These results form the basis for assessing critical design actions in the structural members. The design procedure is then carried out with reference to the applicable Indian Standard provisions and the requirements adopted for the building. The use of STAAD.PRO provides an organized computational framework for carrying out these stages and for interpreting the resulting structural response.

The objective of the present work is to analyze and design the G+4 residential building by integrating structural planning, numerical modeling, load assessment, analysis, and member design. Particular emphasis is placed on establishing a structurally consistent model and evaluating the response of the reinforced-concrete frame under the prescribed design actions. The study is intended to demonstrate a systematic approach to software-based structural engineering in which the numerical results are interpreted with reference to structural behavior and applicable design provisions.

The preceding studies provide the technical background for the present investigation while also indicating a progression in the application of STAAD.PRO to residential buildings of different storey configurations [1]–[5]. The present G+4 model is therefore considered within this established context, with the analysis and design procedure focused on the structural requirements of the proposed residential building. The work emphasizes that software output should be interpreted as part of an engineering design procedure, with the final structural configuration governed by the adopted design criteria, loading requirements, and verification of member adequacy.

II. Literature Review

A. Studies On multistory Residential Buildings

Ranjan and Jaiswal reported the design and analysis of a G+3 multistory residential building using AutoCAD and STAAD.PRO. Their study considered dead, live, seismic, and wind loads and compared software-generated base shear with manual calculations, emphasizing the usefulness of software for seismic analysis[1].

Sravan Kumar discussed G+1 residential buildings from the perspective of safety, functionality, aesthetics, cost efficiency, and code compliance. The work emphasized the importance of considering dead, live, wind, and seismic forces, while noting that finite-element modeling and manual verification are complementary activities[2].

Kaur et al. studied a G+3 residential building using STAAD.PRO with dead, live, wind, and seismic loads. The study described AutoCAD planning followed by STAAD.PRO analysis and reported agreement between software and manual calculations. It concluded that software-based analysis can reduce calculation time and manual errors [3].

Anuja et al. presented the planning, analysis, and design of a G+5 residential building using STAAD.PRO. Frame analysis was performed using the software, while slabs, beams, columns, footings, and staircases were designed using IS 456:2000 and the limit-state method. The study also discussed checks related to shear, deflection, torsion, development length, and load-carrying capacity [4].

Chaitanya described the analysis and design of a G+2 building and emphasized the time-saving value of structural software. The study discussed the consideration of possible loads, frame-analysis approaches, and the design of beams, columns, and footings, illustrating the continuing role of software in practical structural engineering [5].

B. Research Motivation

The reviewed studies show a consistent use of computer-aided structural analysis for multistory buildings and a continued emphasis on code compliance, safety, economy, and verification. The present project applies these principles to a G+3 residential building and focuses on the complete workflow from plan interpretation and structural modelling to load application, analysis-output interpretation, and concrete design.

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435 (Online) Volume 15, Issue 08, August 2026)

III. Building Planning And Structural Configuration

A. Building Plan and Site Considerations

Building plans are graphical representations used to communicate the intended arrangement of a building and to support construction, estimation, and budgeting. The submitted project describes plot selection as an important planning activity and identifies access, public utilities, drainage, adjacent land use, educational and public facilities, transportation, and future development as factors that influence site selection. For the structural study, the architectural plan provides the geometric basis for locating the structural grid and defining the column positions.

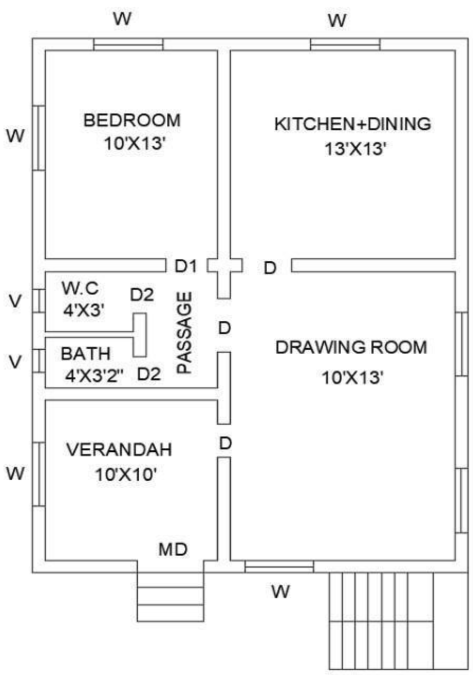

Fig. 1. Shows Ground Floor Plan

B. Structural Parameters

Table I Selected Structural Parameters

Parameter	Project Value
Plan size	25 ft × 40 ft
Number of stories	4
Ground-floor height	10 ft
Typical storey height	10 ft
Total stated building height	44 ft
Primary structural system	Reinforced-concrete frame
Analysis software	STAAD.PRO V8i
Drafting software	AutoCAD 2014

The submitted report specifies a plan size of 25ft×40ft and four stories. The ground-floor height is stated as 10 ft, the height of each storey as 10 ft, and the total building height as 44ft. These dimensions form the basic geometric input for the structural model. The project identifies AutoCAD 2014 for drafting and STAAD.PRO V8i for analysis and design.

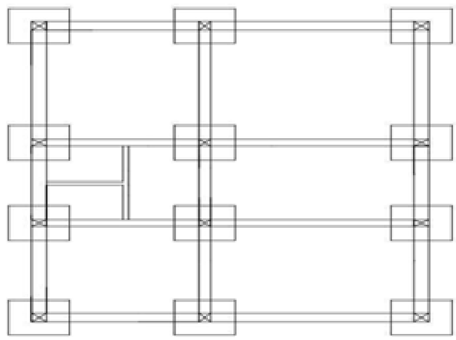

Fig. 2. Shows Typical Upper-Floor Plan

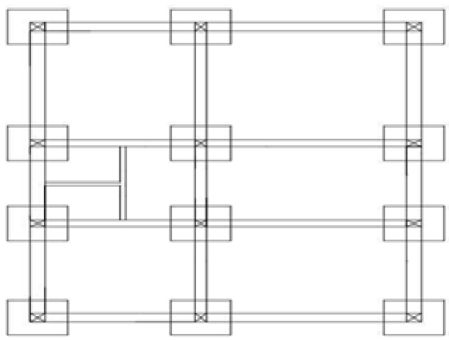

Fig. 3. Shows Column Plan

C. Codes and Software

Table I reveals the selected structural parameters

Item	Application
IS 875 (Part 1)	Dead loads
IS 875 (Part 2)	Imposed/live loads
IS 1893	Seismic loading identified in project scope
IS 456:2000	Reinforced-concrete design
AutoCAD 2014	Building-plan drafting
STAAD.PRO V8i	Structural modelling, analysis, and design

The project explicitly identifies IS 875 (Part 1) for dead loads and IS 875 (Part 2) for live loads, with IS 1893 identified in the project scope for seismic loading and IS 456:2000 used for concrete design. AutoCAD 2014 and STAAD.PRO V8i are the software tools identified in the source report.

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435 (Online) Volume 15, Issue 08, August 2026)

IV. Structural Analysis Using STAAD.Pro V8i

A. Model Generation

The structural system is idealized as a three-dimensional reinforced-concrete frame consisting of beams, columns, and floor systems. The submitted project follows a stepwise modeling procedure. First, nodal points are created according to the column positioning shown in the plan. The beams and columns are then drawn between corresponding nodes. The translational repeat command in the Y direction is used to obtain the three-dimensional building representation. After the geometry is created, the base supports are specified as fixed and material properties and member cross-sections are assigned.

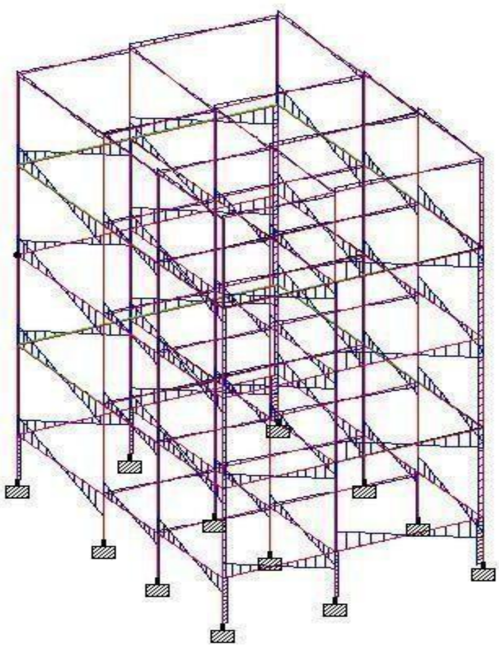

Fig. 4. Shows the Three-Dimensional STAAD.PRO Structural Model

B. Load Assignment and Analysis

Dead loads are assigned after the structural properties are defined. Live loads for the floors are calculated manually using IS 875 Part 2 and then assigned to the corresponding floor levels. The submitted report describes the final step as running the structural analysis and checking the model for errors. This sequence is important because an analysis result is meaningful only when the structural model, supports, member properties, and loading have been defined consistently.

The analysis generates graphical outputs that facilitate interpretation of the structural response. Shear-force diagrams identify the distribution of transverse internal forces, bending-moment diagrams show the flexural response, and deflection diagrams indicate the displacement pattern of the model. The submitted report presents these outputs as part of the STAAD.PRO analysis stage.

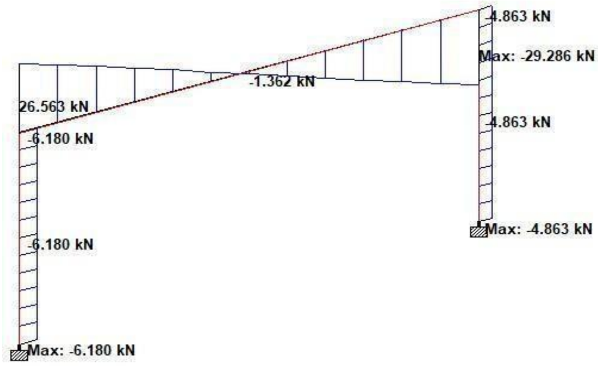

Fig. 5. Shows Shear-Force Diagram

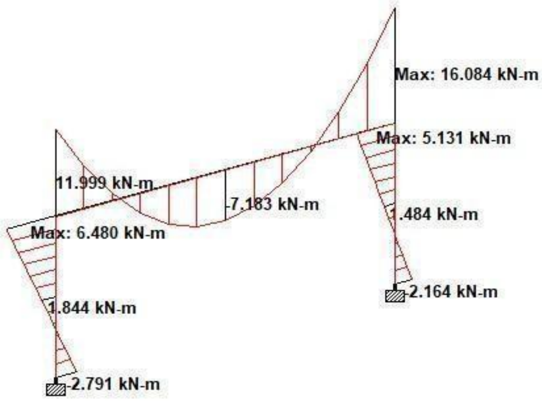

Fig. 6. Shows Bending-Moment Diagram

C. Interpretation of Structural Response

The shear-force and bending-moment outputs provide a direct visual representation of how the frame responds to the applied loading. The deflection plots provide a complementary serviceability view. In engineering practice, these outputs are interpreted together with the member design results and the applicable code provisions. The submitted project does not provide a consolidated numerical table of governing design forces in the report text; therefore, the present paper retains the graphical outputs without introducing additional numerical values.

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435 (Online) Volume 15, Issue 08, August 2026)

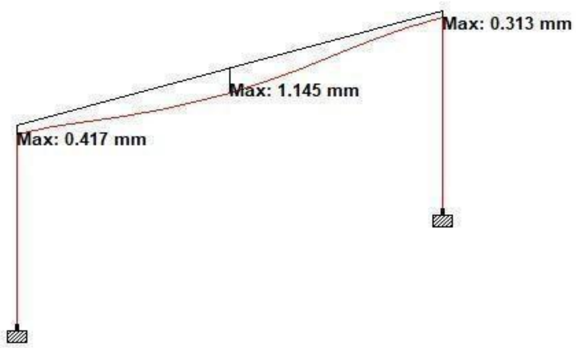

Fig. 7.Shows Deflected Shape of the Building Model

IV. REINFORCED-CONCRETE DESIGN

A. Concrete Design Procedure

After structural analysis, the project performs concrete design using IS 456:2000 by defining suitable design commands for the structural components. The design commands are followed by another analysis/checking stage to identify possible errors. The submitted report states that the design considers the strength and deflection requirements of the reinforced-concrete system and uses the analysis results as the basis for member design.

B. Column Design and Reinforcement

A column is defined in the source report as a vertical compression member whose effective length is greater than three times its least lateral dimension. Columns transfer loads from beams or slabs to footings and foundations. Although concrete has high compressive strength, longitudinal reinforcement is required to enhance load-carrying capacity and to resist tensile stresses that may develop due to bending and lateral actions. Transverse reinforcement in the form of lateral ties or spiral reinforcement helps resist longitudinal splitting and prevents buckling of longitudinal bars.

Columns are classified in the project according to loading and slenderness. An axially loaded column is one in which the resultant compressive force passes through the centroid of the cross-section. An eccentrically loaded column has the resultant compressive force away from the centroid and must be designed for combined axial force and bending moment. Based on slenderness ratio, the report identifies short columns as having an effective-length-to-least-lateral-dimension ratio below 12 and long columns as having a ratio above 12.

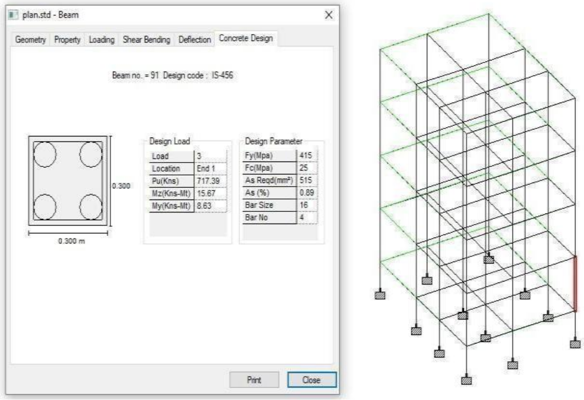

Fig. 8. Shows STAAD.PRO Column-Design Output

C. Beam Design

In reinforced-concrete structures, beams and slabs are commonly cast monolithically. Formwork is erected for the beam and slab together and concrete is placed in one operation. A portion of the slab acts with the beam in compression, so the resulting structural section behaves as a flanged beam. The project includes beam design within the STAAD.PRO concrete-design workflow.

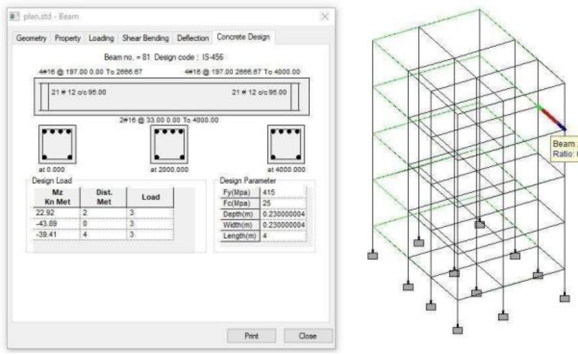

Fig. 9. Shows STAAD.PRO Beam-Design Output

D. Design Verification and Serviceability

The project adopts the limit-state design approach and states that slabs, beams, and columns were designed to satisfy strength and deflection criteria. In a software-based workflow, verification includes checking the structural model for errors after load assignment and after design commands are applied. The design process should therefore be viewed as an iterative sequence of modeling, analysis, output review, design, and verification rather than as a single software execution.

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435 (Online) Volume 15, Issue 08, August 2026)

V. Results And Discussion

A. Analysis Outputs

The principal results available from the source project are the STAAD.PRO graphical outputs for shear force, bending moment, and deflection, together with column and beam design outputs. The figures demonstrate that the structural model was successfully generated as a three-dimensional frame and that the software produced member-force and displacement representations for subsequent design interpretation.

B. Engineering Significance

The analysis workflow provides a systematic means of relating the architectural plan to a structural model and then to design actions. The use of fixed base supports, assigned member properties, and manually determined floor live loads makes the modelling assumptions explicit. The output diagrams can be used to identify critical members and locations for further design checks. The project also demonstrates the practical value of integrating AutoCAD drafting with STAAD.PRO structural analysis.

C. Limitations of the reported results

The submitted project report does not provide a consolidated numerical results table containing all governing axial forces, shear forces, bending moments, reinforcement areas, or code-check ratios. Accordingly, this journal manuscript does not invent or infer such values. The discussion is restricted to the structural configuration, analysis procedure, graphical outputs, and design statements explicitly reported in the project. For a final research submission, the authors should add a numerical results table directly exported or verified from the final STAAD.PRO model if available.

D. Load considerations and verification

The submitted project identifies dead load, live load, and seismic load as important actions for the building. In the detailed STAAD.PRO procedure, dead loads are assigned after member properties are defined, while live loads for each floor are calculated manually using IS 875 Part 2 and assigned to the corresponding floor levels. The project scope also identifies IS 1893 for seismic loading. Because the submitted report does not provide a separate numerical seismic load case or a consolidated seismic-response table, the present manuscript does not add numerical seismic results that are not available in the source.

For reliable software-based design, the model should be checked at each stage: geometry and connectivity, support conditions, material and section properties, load definition, analysis warnings, and design-code parameters.

The submitted project explicitly reports an error-checking step after analysis and another analysis/checking step after concrete design commands. These checks are important because software output is dependent on the assumptions and input data supplied by the engineer.

E. Practical Implications

The project demonstrates a practical sequence that can be repeated for similar low- to medium-rise reinforced-concrete residential structures. Architectural plans are translated into a structural grid, the frame is modelled in three dimensions, loads are applied according to the selected code provisions, and member forces and displacements are examined before design. The same workflow can support comparison of alternative member sizes and can reduce repetitive manual calculations, while final engineering decisions remain subject to code compliance and independent verification.

VI. Conclusion

The project presents the planning, structural modeling, analysis, and reinforced-concrete design of a G+3 residential building using AutoCAD and STAAD.PRO. The building is represented as a three-dimensional reinforced-concrete frame, with the model generated from the column layout, member properties assigned, fixed supports specified, and dead and live loads applied according to the identified Indian Standard provisions. The analysis produces shear-force, bending-moment, and deflection outputs that support interpretation of structural behavior and subsequent design.

The reinforced-concrete design stage uses the IS 456:2000 design provisions and addresses the structural design of the components included in the project. Column design is discussed in terms of axial and eccentric loading, slenderness, longitudinal reinforcement, and transverse reinforcement, while beam design considers the monolithic action of beams and slabs. The submitted report concludes that the design satisfies the stated strength and serviceability objectives and that the project successfully provided practical experience in planning, drafting, structural analysis, and design.

Overall, the study demonstrates the usefulness of computer-aided structural analysis for a multistory residential building while reinforcing the importance of correct modeling assumptions, appropriate Indian Standard provisions, and engineering verification of software outputs. The project also identifies construction-cost factors including steel, cement, aggregates, bricks, composite materials, equipment, electrical installations, plumbing, sanitary works, and Labor as relevant considerations in the broader building-development process.

Future Scope

The present project establishes a software-based workflow for a G+3 reinforced-concrete residential building. A natural extension of the work would be to document the complete set of numerical outputs generated by the final STAAD.PRO model, including governing axial forces, shear forces, bending moments, displacements, member sizes, reinforcement requirements, and code-check results. Presenting these values in compact tables would make the analysis easier to reproduce and would allow direct comparison between critical members and design limits.

The submitted report identifies seismic loading within the project scope, while the detailed modeling procedure reproduced in the report mainly describes dead-load and live-load assignment. Future work can therefore present the seismic definition, load combinations, governing seismic response, and relevant IS 1893 parameters explicitly. This would strengthen the traceability between the stated design scope and the reported numerical results without changing the underlying modeling approach.

The study can also be extended by comparing alternative structural configurations or member sizes. Such a comparison could evaluate changes in bending moments, shear forces, deflections, reinforcement quantities, and construction economy while maintaining the same code requirements. The project already identifies economy and appropriate member sizing as objectives, so a documented optimization study would provide a useful next step.

Further verification can be carried out by independently checking selected critical beams and columns using manual calculations. This would complement the software results and provide an additional check on load paths, member actions, reinforcement requirements, and serviceability. The literature reviewed in the source project similarly emphasizes the value of combining software analysis with manual verification [6], [8], [12].

Finally, the planning and structural-analysis workflow can be integrated with more detailed quantity estimation and construction planning. The submitted report identifies steel, cement, aggregates, bricks, composite materials, equipment, electrical installations, plumbing, sanitary works, and labor as cost-related factors. A future study could connect the structural design outputs to these construction-cost components and evaluate alternative designs on both structural and economic criteria.

Acknowledgment

The authors acknowledge the support provided by one of the authors Dr Gangisetty Subba Rao, HoD, Department of Civil Engineering, Nalla Narasimha Reddy Education Society's Group of Institutions.

REFERENCES

[1] A. K. Ranjan and D. Jaiswal, "Design and analysis of a G+3 multistory residential building using AutoCAD and STAAD.PRO software," International Journal of Research (IJR), vol. 11, no. 3, pp. 162–170, 2024.

[2] B. S. Kumar, D. Kalyan, D. Prudvi Raj, K. Yogesh, R. Archana" Design considerations of G+1 residential buildings," International Research Journal of Education and Technology (IRJEDT), Vol. 6, Issue. 12, pp. 648-652, 2024.

[3] M. Kaur, J. Pema, S. Tshering, R. Jha, and F. Sohtun, "Design and analysis of G+3 residential building using STAAD.PRO," Journal of Emerging Technologies and Innovative Research (JETIR), vol. 8, no. 5, pp. 701–707, 2021.

[4] D. L. Anuja, V.S. Nagasai, "Planning, analysis and design of G+5 residential building using STAAD.PRO," International Journal of Engineering Research, Vol.7, Issue 3, pp.788-793, 2019.

[5] D. K. Chaitanya, "Analysis and design of G+2 building using STAAD.PRO," International Journal of Civil Engineering Research, vol. 5, no. 2, pp. 45–50, 2017.

[6] Bureau of Indian Standards, IS 875 (Part 1): Code of Practice for Design Loads—Dead Loads, New Delhi, India, 1987.

[7] Bureau of Indian Standards, IS 875 (Part 2): Code of Practice for Design Loads—Imposed Loads, New Delhi, India, 1987.