STABILITY AND STRUCTURAL BEHAVIOR OF SINGLE COLUMN SUPPORTED STRUCTURES

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ABSTRACT

The structural design and analysis of a reinforced-concrete building supported entirely on a single central column represent a challenging and architecturally distinctive engineering problem. This paper investigates the feasibility, structural behaviour, and comparative economics of a **G+7 storey single-column RCC building** modelled and analysed in **STAAD Pro** against a conventional multi-column framed building of identical floor area and loading. The analysis encompasses dead load, live load, floor load, wind load (in ±X and ±Z directions), and seismic load (Zone II, IS 1893:2002) applied as per Indian Standard codes. Support reactions, nodal displacements, member forces (shear force, bending moment, axial force, and torsional moment), and stress distributions are extracted and compared for both configurations. Results indicate that while the single-column structure successfully sustains all applied loads, it demands substantially higher support reactions, shear forces, and bending moments compared to a representative column in the multi-column building. A concrete volume-based cost comparison reveals that the single-column building requires approximately **27.26%** more concrete than the multi-column alternative, establishing that the single-column form is economically less efficient despite its superior architectural spatial utility.

Keywords—RCC Structure, Single Column Building, STAAD Pro, Structural Analysis, Seismic Load, Wind Load, Support Reactions, Bending Moment, Shear Force, Cost Comparison

I. INTRODUCTION

A. Background

Reinforced concrete has become the dominant structural material in Indian construction practice owing to its versatility, inherent fire resistance, and the wide availability of constituent materials. In a reinforced concrete composite system, the relatively low tensile capacity and limited ductility of plain concrete are compensated by the embedded steel reinforcement, which carries tensile forces and imparts ductility to the composite section. This synergy makes RC framing suitable for a wide spectrum of structural configurations, from simple single-storey utility sheds to complex high-rise towers.

Among the more unconventional configurations attracting attention in contemporary urban design is the structure supported on a single vertical element — commonly called a mono-column or single-column building. Such arrangements offer compelling architectural advantages: the ground level is freed almost entirely for parking, circulation, or landscaping; the visual mass of the building appears to float above the cleared podium; and the structural system becomes a bold architectural expression in its own right. However, these visual and functional benefits come at a steep structural price. Every gram of building weight, every kilonewton of wind pressure, and every quantum of seismic inertia must be channelled through a single foundation point, demanding a column and foundation of extraordinary proportions and reinforcement intensity [1].

This paper documents the complete modelling, analysis, and comparison study of such a building. A G+7 storey structure occupying a 12 m × 12 m floor plate is modelled in STAAD Pro under the full suite of loads prescribed by IS codes. A conventional multi-column building of identical geometry and loading is modelled alongside it. Results for support reactions, displacements, member forces, and concrete volume are extracted and compared to quantify the structural and economic penalties associated with the single-column configuration [2].

B. Single-Column Building Concept

A single-column structure routes all gravity and lateral loads through one central vertical element to a single foundation. Structurally, every beam framing into the central column functions as a cantilever or as a member of a ring-beam system designed to convert cantilever action into something approaching simply-supported behaviour. The principal mechanisms employed to achieve this are: (a) a massive ground-level ring beam that redistributes load from the cantilevering floor beams into the single column; (b) inclined strut members or V-shaped framing at intermediate levels that reduce effective cantilever spans; and (c) a highly reinforced central column of large

cross-section, typically square or circular, capable of carrying the combined axial force, biaxial bending, and shear generated by eccentric and lateral loading [3].



Fig. 1. Typical configurations for supporting a multi-storey structure on a single central column — cantilever, ring-beam, and inclined-strut approaches.

C. Objectives of the Study

- To model a G+7 storey RCC single-column building and a conventional multi-column building of identical plan dimensions in STAAD Pro and analyse them under self-weight, dead, live, floor, wind (IS 875 Part 3), and seismic loads (IS 1893:2002, Zone II).
- To extract and compare support reactions, nodal displacements in all three orthogonal directions, and member forces (shear force, bending moment, axial force, stress) for the critical load combination 1.2DL + 1.2LL + 1.2EL.
- To draw shear force, bending moment, and deflection diagrams for the central single column and a representative column in the multi-column building and compare their magnitudes and distributions.
- To perform a concrete-volume-based cost comparison and quantify the economic premium associated with the single-column structural form.
- To draw evidence-based conclusions regarding the structural viability, performance characteristics, and economic trade-offs of single-column construction relative to conventional multi-column framing.

II. LITERATURE REVIEW

The body of published work directly addressing single-column or mono-column multi-storey structures is limited, reflecting the niche but growing interest in this architectural typology. The literature that does exist spans structural analysis, detailing innovation, and comparative studies, and is supplemented by the broader corpus of work on high-rise RC framing, seismic response, and software-based structural evaluation.

Ambati Venu Babu and Dumpa Venkateswarlu (2016)

Ambati Venu Babu and Dumpa Venkateswarlu investigated the design of an office building supported on a mono-column, explicitly addressing the cantilever problem inherent in such configurations. They demonstrated that by converting two-thirds of each cantilevering beam's length to an effectively simply-supported condition through the provision of two concentric ring beams at intermediate heights and inclined connecting members, the bending moment envelope could be substantially reduced relative to a pure cantilever. STAAD Pro analysis confirmed that the resulting structure satisfied all serviceability and ultimate limit state requirements under code-prescribed loading. Their conclusion — that mono-column buildings are structurally achievable with appropriate detailing and that maximum space utilisation is obtainable at grade level — is directly relevant to the present investigation [4].

Madireddy Satyanarayana (2016)

Satyanarayana presented a multi-storey residential building resting on a single column, combining manual design calculations based on IS 456:2000 limit-state provisions with STAAD Pro verification. The building comprised a ground floor plus five upper floors, each accommodating one residential unit per floor. The study highlighted the role of IS code references SP 16 (design aids for concrete) and SP 34 (detailing) in ensuring that the extreme reinforcement demands of the single column were constructable. Results confirmed that while design is feasible, the reinforcement quantity and formwork complexity for the single column substantially exceed those of comparable multi-column framing [5].

Research Gap

The above studies, while validating the structural feasibility of single-column buildings, do not present a direct quantitative comparison of support reactions, displacements, and member forces between the single-column and multi-column configurations under identical loading within the same software environment, nor do they compute and compare concrete volumes as a cost proxy. The present study addresses both of these gaps by modelling both configurations in STAAD Pro under a common loading protocol and extracting comparative data from the post-processing output.

TABLE I. SUMMARY OF KEY PRIOR STUDIES

Author(s)	Year	Key Finding	Relevance
Ambati Venu Babu & Venkateswarlu	2016	Ring beam + inclined strut reduces cantilever BM; structure meets code limits	Validates structural feasibility; detailing strategy adopted here
Madireddy Satyanarayana	2016	Limit-state design + STAAD Pro verification for G+5 mono-column residential building	Confirms IS 456 applicability; reinforcement intensity reference

IS 456:2000	2000	Code of practice for plain and reinforced concrete design	Governs all section design and detailing in this study
IS 1893 Part 1	2002	Seismic load provisions for Zone II buildings	Seismic load definition and zone factor applied here

III. STAAD PRO ANALYTICAL ENVIRONMENT

A. Software Overview

STAAD Pro (Structural Analysis and Design Program) is a general-purpose finite-element analysis package widely used for the static and dynamic analysis of two- and three-dimensional linear and nonlinear structures. Its integrated workflow encompasses pre-processing (geometry definition, property assignment, and load specification), processing (matrix assembly and solution), and post-processing (result extraction and presentation). The three-module structure makes it particularly suited to multi-load-case building analysis where results from dozens of load combinations must be organised and filtered efficiently [6].

B. Workflow in STAAD Pro

The STAAD Pro analytical workflow follows a standardised sequence. Basic geometry is defined by specifying node coordinates and connecting members as beams or columns. Cross-sectional shapes — rectangular, circular, T-section, I-section, channel, angle, and wide-flange profiles — are assigned from built-in section libraries or user-defined dimensions. Material constants (modulus of elasticity, Poisson's ratio, density, coefficient of thermal expansion) are either drawn from the built-in concrete or steel databases or specified manually. Support conditions (fixed, pinned, roller, spring) are assigned to boundary nodes. Load cases are created for each load type and assigned to the corresponding members and nodes. Finally, an analysis instruction specifies the solution type (linear static, P-delta, dynamic), and post-processing commands extract deflected shapes, bending-moment diagrams, shear-force diagrams, and reaction tables.

C. Cross-Sectional Shapes for Finite Elements

STAAD Pro supports a comprehensive library of cross-sectional profiles for structural elements. For building structures the principal shapes employed are rectangular and square sections for RC beams and columns, and circular sections for mono-columns. The software also provides American Standard Steel sections including wide-flange (W), standard channel (C), and equal-leg angle (L) profiles with full tabulated geometric and sectional properties. In the present study, all beams and columns are modelled as rectangular RC sections; the single column is modelled as a 3 m × 3 m square section consistent with the problem statement.

TABLE II. SELECTED AMERICAN STANDARD EQUAL-LEG ANGLE PROPERTIES (REFERENCE)

Size (in×in)	Depth h (in)	Thick. s (in)	Area (in²)	Wt (lbf/ft)	Ix (in⁴)	Note
12 × 12	12	1⅜	30.9	105	410.0	Heaviest
12 × 12	12	1¼	28.3	96.4	377.5	
10 × 10	10	1⅜	25.6	87.1	232.1	
8 × 8	8	1¼	16.7	56.9	98.0	
6 × 6	6	1	11.0	37.4	35.5	Lightest shown

TABLE III. SELECTED AMERICAN STANDARD CHANNEL (C) SECTION PROPERTIES (REFERENCE)

Desig.	h (in)	w (in)	tw (in)	A (in²)	Ix (in⁴)	Sx (in³)	Iy (in⁴)
C15×50	15	3.716	0.716	14.7	404	53.8	11.0
C15×40	15	3.520	0.520	11.8	349	46.5	9.23
C12×30	12	3.170	0.510	8.82	162	27.0	5.14
C10×30	10	3.033	0.673	8.82	103	20.7	3.94
C9×20	9	2.648	0.448	5.88	60.9	13.5	2.42
C8×18.75	8	2.527	0.487	5.51	44.0	11.0	1.98

D. Modulus of Elasticity of Concrete

The modulus of elasticity of concrete E_n governs stiffness-based computations including deflection, lateral drift, and fundamental period. The ACI Code expression is:

$$E_n = W_n^{1.5} \times 33 \times \sqrt{f'_n} \qquad (1)$$

where W_n is the unit weight of concrete in lb/ft³ and f'_n is the 28-day compressive strength in lb/in². For normal-weight concrete (W_n = 145 pcf) the expression simplifies to:

$$E_n = 57{,}000 \times \sqrt{f'_n} \quad (psi) \qquad (2)$$

For M25 concrete (f'_n = 25 MPa) adopted in this study, the Indian Standard equivalent $E_n = 5000\sqrt{f_n}^{y}$ yields E_n = 25,000 MPa, consistent with the default STAAD Pro material constant assigned to the concrete material.

IV. STRUCTURAL MODELLING

A. Problem Statement

A G+7 storey reinforced concrete building is modelled in STAAD Pro. The building occupies a square plan of 12 m × 12 m, subdivided into a 4×4 bay arrangement with equal bay widths of 3.0 m in both orthogonal directions. The total building height is 24.5 m, comprising a raised ground storey of 3.5 m height and seven typical storeys of 3.0 m each. The building site is classified in Seismic Zone II with a seismic zone coefficient Z = 0.06 as per IS 1893:2002. Two configurations are modelled: a single-column building in which all gravity and lateral loads are channelled through one central 3 m × 3 m column; and a conventional multi-column building in which a 5×5 grid of 0.6 m × 0.6 m columns supports the structure.

TABLE IV. STRUCTURAL DIMENSIONS AND DESIGN PARAMETERS

Parameter	Value
Plan dimension	12 m × 12 m (4 bays @ 3.0 m each direction)
Total building height	3.5 + 3.0 × 7 = 24.5 m
Number of storeys	G + 7 (ground storey height = 3.5 m)
Single column size	3.0 m × 3.0 m (square RC section)
Multi-column size (all)	0.6 m × 0.6 m (square RC section)
Beam cross-section	0.4 m × 0.4 m (square RC section)
Slab thickness	0.12 m (120 mm)
Live load (floor)	3.5 kN/m² (IS 875 Part 2)
Floor finish load	1.0 kN/m²
Material grade	M25 concrete, Fe 415 steel
Seismic zone	Zone II (Z = 0.06, IS 1893:2002)
Wind zone	As per IS 875 Part 3 (applied in ±X and ±Z)

B. Plan and Elevation

The plan of the single-column building places the central 3 m × 3 m column at the geometric centroid of the 12 m × 12 m floor plate. All floor beams radiate outward from the central column to the perimeter ring beam, forming a symmetric radial-plus-orthogonal framing pattern. The large column cross-section ensures that its centroidal axis coincides with the resultant of all symmetric gravity loads, minimising biaxial bending under gravity alone and limiting torsion to that induced by wind and seismic asymmetry.

C. Three-Dimensional STAAD Pro Model

The three-dimensional model is generated in STAAD Pro using the graphical user interface snap-node/beam method. Node coordinates are first defined at every beam-column intersection across all eight floor levels. Beam elements connect adjacent nodes within each floor, and column elements connect corresponding nodes between successive floors. The central column of the single-column model is a single vertical member spanning the full building height, constrained at its base with a fixed support that restrains all six degrees of freedom.

D. Material and Section Property Assignment

Concrete material (E_n = 25,000 MPa, ν = 0.17, γ = 25 kN/m³) is assigned globally to all beam and column members. Section properties are defined as rectangular profiles: 0.4 m × 0.4 m for all beams; 0.6 m × 0.6 m for multi-column columns; and 3.0 m × 3.0 m for the single column. The slab is modelled as a plate element of 120 mm thickness with the appropriate in-plane and out-of-plane stiffness, contributing to load distribution and dead-load computation.

assigned to beams and columns throughout the structure.

E. Support Conditions

The base of the single central column and all base nodes of the multi-column grid are assigned fixed supports, restraining translation in X, Y, and Z and rotation about all three global axes. Fixed supports are appropriate for the deep foundations required by both building types, particularly the single-column building where the foundation must resist the full building overturning moment and axial load concentrated at one point.

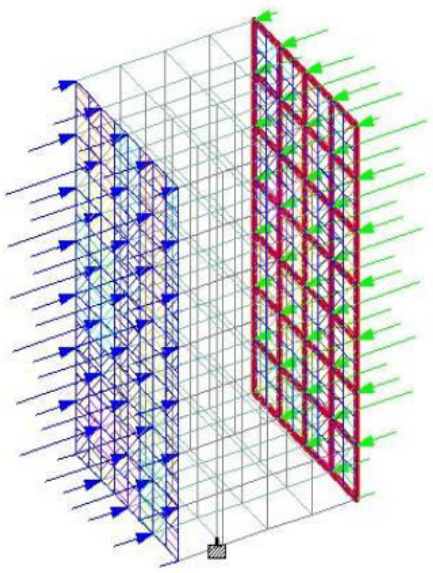


Fig. 12. STAAD Pro model with fixed supports assigned at the base of the single column, visible as triangular support symbols at the foundation node.

V. LOADS ACTING ON THE STRUCTURE

A. Dead Load

Dead loads comprise the self-weight of all structural members (beams, columns, slab) computed automatically by STAAD Pro from the assigned section dimensions and material density (25 kN/m³ for concrete), plus superimposed dead loads from floor finishes and partitions applied as uniform loads on beam elements. The self-weight generation command applies a factor of −1.0 in the global Y direction, consistent with gravity acting downward.

B. Live Load

Live loads represent the variable occupancy loads imposed on floors by furniture, occupants, and moveable equipment. A uniformly distributed live load of 3.5 kN/m² is applied to all floor beams of both the single-column and multi-column models as a member load in the local Y direction, consistent with IS 875 Part 2 provisions for residential buildings. Roof live load follows IS 875 Part 2 Table 2 values for accessible roofs.

beams of the building.

C. Floor Load

A supplementary floor finish load of 1.0 kN/m² is applied separately from the structural self-weight to account for tile, screed, and waterproofing layers. This load is applied as a uniform member load on the same beam elements as the live load and is categorised as a dead-load case for load combination purposes.

D. Seismic Load

Seismic loads are defined in STAAD Pro using the IS 1893:2002 seismic definition wizard. Zone II is selected with a zone factor Z = 0.06, importance factor I = 1.0, response reduction factor R = 5.0, and rock/hard soil site classification. STAAD Pro computes the design base shear V_2 using:

$$V_2 = Ah \times W \qquad (3)$$

where $Ah = (Z/2) \times (I/R) \times (S_a/g)$ and W is the seismic weight. The base shear is distributed vertically using the IS 1893 parabolic distribution. Loads are applied in both the positive X and positive Z horizontal directions as separate load cases.

E. Wind Load

Wind loads are computed in accordance with IS 875 Part 3 and applied as equivalent static pressures in ±X and ±Z directions. The design wind speed for the site is taken from the IS 875 wind zone map, and pressure coefficients are assigned based on building height and plan aspect ratio. STAAD Pro applies the resulting pressure as nodal or member loads at each floor level.

VI. RESULTS AND ANALYSIS

A. Single Column Building Results

A.1 Single Column Properties

The single central column is modelled as a square RC section of 3.0 m × 3.0 m with M25 concrete and Fe 415 steel. This exceptionally large cross-section is required to carry the combined axial force, biaxial bending moment, and shear generated by the full gravity load of the entire seven-storey building plus the overturning moments from wind and seismic loading — all transferred through a single node at the base.

A.2 Support Reactions — Single Column Building

Table V presents the maximum and minimum support reactions at the base of the single column for the critical load combination. The governing combination is 1.2DL + 1.2LL + 1.2EL as per IS 1893:2002 load combination requirements for seismic design.

TABLE V. MAXIMUM SUPPORT REACTIONS — SINGLE COLUMN BUILDING

Reaction Component	Maximum Value	Unit
Shear Force FX	1061.69	kN
Vertical Reaction FY	18109.44	kN
Shear Force FZ	1061.69	kN
Moment MX	20230.76	kN·m
Moment MY (torsion)	0.00	kN·m
Moment MZ	20230.77	kN·m

The vertical reaction FY = 18,109.44 kN reflects the total weight of the seven-storey building channelled through one point. The moments MX = MZ = 20,230.76 kN·m are the overturning moments generated by wind and seismic horizontal forces acting at height. The torsional moment MY = 0 confirms that the symmetric plan produces no net torque under symmetric loading patterns.

A.3 Displacements — Single Column Building

Table VI presents the maximum nodal displacements in all three global directions for the single-column building under the critical load combination. The vertical displacement (Y direction) is negative (downward deflection), while lateral displacements in X and Z reflect sway under wind and seismic loading.

TABLE VI. MAXIMUM AND MINIMUM NODAL DISPLACEMENTS — SINGLE COLUMN BUILDING

Direction	Maximum Displacement (mm)	Observation
X (lateral sway)	+24.75	Wind/seismic induced
Y (vertical deflection)	−50.97	Gravity-dominated
Z (lateral sway)	+24.75	Equal to X (symmetric plan)

A.4 Member Forces — Single Column Building

The maximum member forces in the central column for the critical load combination are reported in Table VII. These represent the most extreme demands on any single element in the structure and govern the design of the column cross-section and reinforcement.

TABLE VII. MAXIMUM MEMBER FORCES — SINGLE COLUMN BUILDING (COLUMN 179)

Force / Moment Component	Maximum Value	Unit
Axial Force FX	18109.44	kN
Shear Force FY	1304.85	kN
Shear Force FZ	1304.85	kN
Torsional Moment MX	20.04	kN·m
Bending Moment MY	20230.77	kN·m
Bending Moment MZ	20230.77	kN·m

Total concrete volume required for the single-column building = 514.3 m³ (from STAAD Pro output file).

B. Multi-Column Building Results

B.1 Column No. 37 Properties

For the multi-column building, a representative interior column (column no. 37) is selected for detailed comparison. This column carries a tributary area representative of a typical interior bay and thus experiences approximately the average load intensity per column in the grid.

B.2 Support Reactions — Multi-Column Building

TABLE VIII. MAXIMUM SUPPORT REACTIONS — MULTI-COLUMN BUILDING (COLUMN 37)

Reaction Component	Maximum Value	Unit
Shear Force FX	37.056	kN
Vertical Reaction FY	961.066	kN
Shear Force FZ	37.056	kN
Moment MX	102.138	kN·m
Moment MY (torsion)	0.067	kN·m
Moment MZ	102.138	kN·m

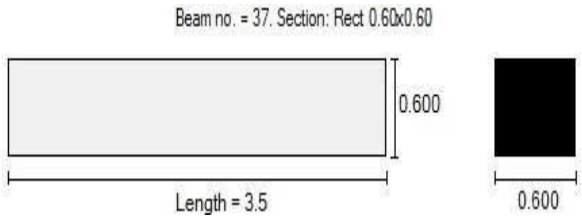


Fig. 28. Graph showing maximum support reaction moments (MX, MY, MZ) for column no. 37 in the multi-column building — MX and MZ are approximately equal; MY is near-zero.

B.3 Displacements — Multi-Column Building

TABLE IX. MAXIMUM AND MINIMUM NODAL DISPLACEMENTS — MULTI-COLUMN BUILDING

B.4 Member Forces — Multi-Column Building

TABLE X. MAXIMUM MEMBER FORCES — MULTI-COLUMN BUILDING (COLUMN 37)

Force / Moment Component	Maximum Value	Unit
Axial Force FX	961.07	kN
Shear Force FY	49.25	kN
Shear Force FZ	41.35	kN
Torsional Moment MX	0.27	kN·m
Bending Moment MY	102.14	kN·m
Bending Moment MZ	102.14	kN·m

Total concrete volume required for the multi-column building = 374.1 m³ (from STAAD Pro output file).

C. Comparative Analysis: Single Column vs. Multi-Column

TABLE XI. HEAD-TO-HEAD COMPARISON — SINGLE COLUMN (COL. 179) vs. GENERAL COLUMN (COL. 37)

Parameter	Single Column (3m×3m)	General Column (0.6m×0.6m)	Ratio (SC/GC)
Shear Force (kN)	849.36	24.503	×34.7
BM max. (kN·m)	16184.61	75.55	×214.2
BM min. (kN·m)	13211.86	−10.203	N/A
Deflection max. (mm)	0.677	1.257	SC less
Stress (N/mm²)	7.645	−3.598	Tension vs. Comp.
Support FX (kN)	−849.36	−24.503	×34.7
Support FY (kN)	14487.55	648.27	×22.3
Support MZ (kN·m)	16184.61	75.56	×214.2
Steel required (mm²)	72000	2880	×25.0
Bar configuration	148 bars × 25mm φ	28 bars × 12mm φ	Highly reinforced

D. Shear Force Comparison

The shear force diagrams for column no. 179 (single column) and column no. 37 (multi-column building) are extracted from STAAD Pro under the critical load combination 1.2DL + 1.2LL + 1.2EL. In both cases the shear force is constant along the column height, which is characteristic of columns subject to point loads at each floor level rather than distributed loading along the member length. The shear force in the single column (849.36 kN) is approximately 34.7 times that of the general column (24.503 kN), a direct consequence of the load concentration effect.

E. Bending Moment Comparison

The bending moment diagrams reveal important qualitative differences between the two column types. The single column displays a purely sagging bending moment profile with no point of contra-flexure throughout its height, indicating that it acts as a fully fixed-base cantilever with no reversal of curvature. The multi-column building column, by contrast, exhibits a linearly varying bending moment with a small hogging region near one end and a point of contra-flexure at approximately 3.08 m from the base — characteristic of a column in a continuous frame where adjacent beams provide rotational restraint at intermediate levels.

F. Deflection Comparison

The deflected shapes of both columns are extracted from STAAD Pro post-processing. The single column deflects in a second-order curve profile consistent with its cantilever boundary condition, with maximum deflection

of 0.677 mm occurring at the top node. The general column in the multi-column building deflects by a maximum of 1.257 mm — paradoxically larger than the single column in local deflection, because the surrounding frame provides significantly less lateral restraint to any individual column than the massive stiffness of the 3 m × 3 m single-column section provides to itself.

G. Cost Comparison

The total concrete volume is used as the primary cost proxy since concrete constitutes the dominant material cost in both structural systems. Reinforcement costs are not included in this comparison because the heavily reinforced single column requires non-standard bar diameters and complex placement operations that would further widen the cost gap.

$$\text{Concrete volume (single-column building)} = 514.3\ m^3 \quad (4)$$

$$\text{Concrete volume (multi-column building)} = 374.1\ m^3 \quad (5)$$

$$\%\ \text{cost saving of multi-column} = (514.3 - 374.1) / 514.3 \times 100 = 27.26\% \quad (6)$$

The single-column building therefore requires 27.26% more concrete than the multi-column building of identical floor area and loading, primarily because of the enormous cross-section of the central column and its associated heavily reinforced ring-beam system.

VII. CONCLUSION

A complete structural analysis of a G+7 storey RCC single-column building has been carried out in STAAD Pro under dead, live, floor, wind, and seismic loads, and the results have been compared systematically with a conventional multi-column building of identical geometry and loading. The following conclusions are drawn from the study:

- The single-column structure was designed and found to withstand all applied loads including earthquake (Zone II) and wind loads without violating any IS code strength or serviceability limit, demonstrating that single-column construction is structurally feasible with appropriate section sizing and reinforcement.
- The single-column building is 27.26% more costly in concrete volume than the multi-column building, and this economic penalty is compounded by the reinforcement premium — 148 bars of 25 mm diameter (72,000 mm² of steel area) for the single column versus 28 bars of 12 mm diameter (2,880 mm²) for a representative multi-column section — making single-column construction significantly more expensive per unit of floor area.
- Shear forces and bending moments in the single column (849.36 kN and up to 16,184.61 kN·m respectively) are dramatically larger than in a typical column of the multi-column building (24.503 kN and 75.55 kN·m), by factors of approximately 35 and 214 respectively, reflecting the complete concentration of load-path at one element.
- Deflection of the individual single column (0.677 mm) is less than that of a general column in the multi-column building (1.257 mm), despite the vastly larger load it carries, because the massive 3 m × 3 m cross-section provides enormous flexural stiffness (EI proportional to d^4) that overcomes the larger bending moment demand.
- Support reactions at the base of the single column — vertical reaction FY = 18,109.44 kN and overturning moments MX = MZ = 20,230.76 kN·m — are exceptional and necessitate a deep, heavily reinforced pile cap or raft foundation, adding further to the overall project cost relative to the conventional multi-column foundation system.
- STAAD Pro provided complete member-level results including bending moment, shear force, axial force, torsional moment, stress, and deflection diagrams for every member, confirming its suitability as the analysis platform for structurally complex configurations such as single-column buildings.
- Despite its economic and structural-intensity disadvantages, the single-column building offers compelling functional benefits: maximum ground-level space utilisation for parking and circulation, a distinctive architectural form, and enhanced spatial flexibility at all floor levels — benefits that may justify the cost premium in premium urban or commercial contexts where land value per square metre of parking is extremely high.

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