

PARAMETRIC STUDY OF BRACED MEGA FRAMES CORE TUBE STRUCTURAL SYSTEM WITH DIFFERENT MATERIALS

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Abstract - The seismic performance of braced mega-frame core tube structural systems constructed using RCC, structural steel, and composite material with seismic behaviour of 30-storey and 50-storey buildings. The effect of plan irregularity L-shaped, T-shaped, Plus-shaped and response parameters such as Storey displacement, Storey drift, Storey stiffness, Fundamental natural time period, Base shear and base moment. The findings of this study provide useful guidance for the efficient seismic design of tall, irregular buildings employing braced mega-frame-core tube structural systems. The results demonstrate that material selection and plan configuration significantly influence seismic response, with composite and steel systems showing superior stiffness, reduced lateral deformations, and improved energy dissipation compared to RCC systems. All structural models are developed and analysed using ETABS version 22 (CSI Ltd.), enabling accurate assessment of material nonlinearity and dynamic characteristics.

Key Words: Braced Mega-Frame; Core Tube System; Plan Irregularity; RCC; Steel; Composite Structures; Non-Linear Time History Analysis; Seismic Performance; ETABS.

1. INTRODUCTION

1.1 General

Composite construction combines the better properties of the both i.e. concrete and steel and results in speedy construction. In the present work included Comparative study of R.C.C., STEEL and COMPOSITE. The present study investigates 30-storey and 50-storey buildings designed for gravity and seismic loads, employing nonlinear time-history analysis in ETABS v22. the seismic behavior of such systems becomes

more complex when plan irregularities - such as L-shaped, T-shaped, and plus-shaped configurations are introduced.

1.2 Need for Study

There is still a lack of detailed comparative research on braced mega-frame core tube systems made with RCC, steel, and composite materials. The influence of plan irregularities such as L-shaped, T-shaped, and Plus-shaped buildings, along with height variations of 30-storey and 50-storey structures, has not been studied sufficiently in a single framework. This study will compare seismic performance under nonlinear time history analysis using key parameters such as storey displacement, drift, base shear, natural period, and stiffness to support better seismic design decisions.

1.3 Objectives of the Study

- To evaluate the seismic performance of braced mega-frame core tube structural systems constructed using RCC, structural steel, and composite materials.
- To study the effect of plan irregularity (L-shaped, T-shaped, and Plus-shaped configurations) on the seismic response of tall buildings.
- To compare the seismic behavior of 30-storey and 50-storey buildings to assess the influence of building height on structural response. To perform non-linear time history analysis in accordance with IS 1893 (Part 1) for realistic assessment of inelastic seismic behavior.
- To analyse and compare key response parameters such as: Storey displacement, Storey drift, Base shear, Fundamental natural time period, and Storey stiffness.

2. LITERATURE REVIEW

2.1 General

As building heights increase, lateral loads due to earthquakes and wind become the governing design criteria, necessitating the use of advanced lateral load-resisting structural systems. Conventional moment-resisting frames and shear wall systems often become inefficient or uneconomical for tall structures, prompting researchers and designers to explore innovative systems such as mega-frame structures, core tube systems, and braced configurations.

2.2 Overview

Brunesi.et.al (2025): It developed a detailed fibre-based finite element modelling approach for the nonlinear dynamic analysis of high-rise mega-braced frame-core building systems, with the objective of accurately capturing inelastic behaviour and seismic response characteristics of super-tall structures. The study employed fibre-section elements to represent beams, columns, braces, and core components, allowing the spread of plasticity along member lengths rather than concentrating damage at discrete hinge locations.

Katsimpini.et.al (2025): It presented a comprehensive review of the seismic performance and recent advancements in steel-concrete composite structural systems, with particular emphasis on their application in earthquake-resistant design. The study systematically examined existing research on composite frames, composite shear walls, and hybrid lateral load-resisting systems, focusing on design methodologies, material behavior, and analytical modeling techniques used for seismic assessment.

Shehzad.et.al (2025): It conducted a systematic review on seismic resilience strategies for high-rise buildings, synthesizing recent advancements in materials, structural systems, and performance-based design approaches. The study reviewed a wide range of lateral load-resisting systems, including braced frames, core tube systems, outrigger and belt truss arrangements, and hybrid configurations, with an emphasis on their effectiveness in mitigating seismic demand and enhancing post-earthquake functionality.

2. METHODOLOGY

2.1 General

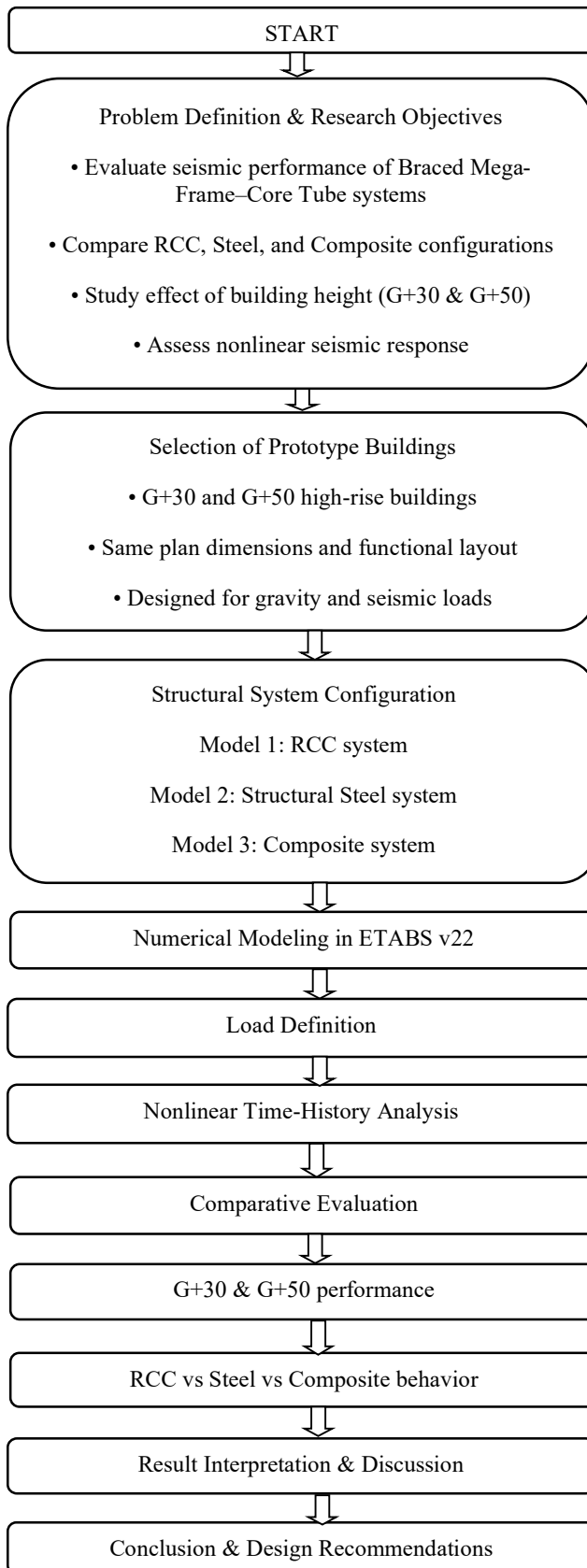


Table -1: Sample Table format

Parameter	RCC Structure	Structural Steel Structure	Composite Structure
Structural System	Braced Mega-Frame-Core Tube	Braced Mega-Frame-Core Tube	Braced Mega-Frame-Core Tube
Building Heights	G+30 & G+50	G+30 & G+50	G+30 & G+50
Type of Analysis	Nonlinear Time History Analysis (NLTHA)	Nonlinear Time History Analysis (NLTHA)	Nonlinear Time History Analysis (NLTHA)
Software Used	ETABS v22	ETABS v22	ETABS v22
Number of Bays (X-direction)	6	6	6
Number of Bays (Y-direction)	6	6	6
Bay Spacing	9.0 m	9.0 m	9.0 m
Plan Area	1944 m ²	1620 m ²	1620 m ²
Typical Storey Height	3.5 m	3.5 m	3.5 m
Ground Floor Height	4.5 m	4.5 m	4.5 m
Floor System	RCC Slab	Composite Metal Deck Slab	Composite Slab
Lateral Load Resisting System	RCC Core + RCC Mega Frame	RC Core + Steel Mega Frame	RC Core + Composite Mega Frame
Bracing Configuration	X-Bracing	X-Bracing	X-Bracing
Core Tube	Reinforced Concrete	Reinforced Concrete	Reinforced Concrete
Beam Sections	RCC Beams	Steel I Sections	Composite Beams
Column Sections	RCC Columns	Steel Box/I Columns	Composite Columns
Slab Thickness	150 mm	Composite Deck Slab	Composite Slab (150 mm)
Core Wall Thickness	300 mm	300 mm	300 mm
Concrete Grade	M50 (Beams & Columns), M30 (Slab)	M50 (Core)	M50 (Core & Composite Members)

Reinforcement Grade	Fe500	Fe500	Fe500
Density of Concrete	25 kN/m ³	25 kN/m ³	25 kN/m ³
Unit Weight of Steel	—	78.5 kN/m ³	78.5 kN/m ³
Infill Wall	AAC Blocks	AAC Blocks	AAC Blocks
Structural Steel Grade	Fe500 Reinforcement	E350 Structural Steel	E350 + Fe500
Soil Type	Medium Soil	Medium Soil	Medium Soil
Damping Ratio	5%	5%	5%
Seismic Zone	Zone IV	Zone IV	Zone IV
Importance Factor (I)	1.5	1.5	1.5
Response Reduction Factor (R)	5	5	5
Seismic Code	IS 1893 (Part 1):2016	IS 1893 (Part 1):2016	IS 1893 (Part 1):2016
Wind Code	IS 875 (Part 3):2015	IS 875 (Part 3):2015	IS 875 (Part 3):2015
Design Code	IS 456:2000	IS 800:2007	IS 11384 & IS 800:2007

Table 2: Member Sizes Adopted for RCC Braced Mega-Frame-Core Tube Buildings

Storey Level	Column Size (mm × mm)	Beam Size (mm × mm)
1–20	1200 × 1200	450 × 750
21–30	1000 × 1000	450 × 750
31–50	800 × 800	450 × 750

Table 3: Member Sizes Adopted for Structural Steel Braced Mega-Frame-Core Tube Buildings

Storey Level	Steel Box Column Section	Steel Beam Section
1–20	700 × 700 × 40 mm	ISWB 700
21–30	600 × 600 × 35 mm	ISWB 700
31–50	500 × 500 × 30 mm	ISWB 700

Table 4: Member Sizes Adopted for Composite Braced Mega-Frame–Core Tube Buildings

Storey Level	Composite Column Section	Composite Beam Section
1–20	CFST Box $700 \times 700 \times 25$ mm filled with M50 Concrete	ISWB 700 with 150 mm RCC Slab
21–30	CFST Box $600 \times 600 \times 20$ mm filled with M50 Concrete	ISWB 700 with 150 mm RCC Slab
31–50	CFST Box $500 \times 500 \times 20$ mm filled with M50 Concrete	ISWB 700 with 150 mm RCC Slab

2.2 Load Definition

All structural models are subjected to gravity and seismic loads in accordance with the applicable Indian Standards. Gravity loading includes dead load, live load, floor finish load, wall load, and other permanent structural loads acting throughout the building.

Table 5: Loading Details

Load Type	Value
Dead Load (Self-weight)	Calculated automatically by ETABS
Floor Finish Load	1.25 kN/m ²
Live Load	3.0 kN/m ²
Roof Live Load	1.5 kN/m ²
Wall Load	10 kN/m
Earthquake Load	IS 1893 (Part 1):2016
Wind Load	IS 875 (Part 3):2015
Criteria for Designing of tall buildings	IS 16700:2017

Table 6: Gravity Load Combinations

S. No	Load Combination
1	DL + LL
2	1.5(DL + LL)

Table 7: Seismic Load Combinations

S. No	Load Combination
3	1.2(DL + LL ± EQX)
4	1.2(DL + LL ± EQY)
5	1.5(DL ± EQX)
6	1.5(DL ± EQY)
7	0.9DL ± 1.5EQX
8	0.9DL ± 1.5EQY
9	1.5(DL + LL ± EQX)
10	1.5(DL + LL ± EQY)

Table 8: Wind Load Combinations

S. No	Load Combination
11	1.2(DL + LL ± WX)
12	1.2(DL + LL ± WY)
13	1.5(DL ± WX)
14	1.5(DL ± WY)
15	0.9DL ± 1.5WX
16	0.9DL ± 1.5WY
17	1.5(DL + LL ± WX)
18	1.5(DL + LL ± WY)

Seismic loading is defined based on the seismic parameters specified in IS 1893 (Part 1): 2016, considering the appropriate seismic zone, importance factor, response reduction factor, damping ratio, and soil conditions. The load combinations are generated as per the relevant design codes to ensure that the structures are evaluated under realistic loading scenarios representing both serviceability and ultimate limit states.

2.3 Nonlinear Time-History Analysis

The nonlinear dynamic analyses are performed for all structural models using ETABS to obtain detailed response histories. Important engineering response parameters such as storey displacement, inter-storey drift, base shear, storey stiffness, overturning moment, and time period are extracted for subsequent evaluation.

L - TYPE

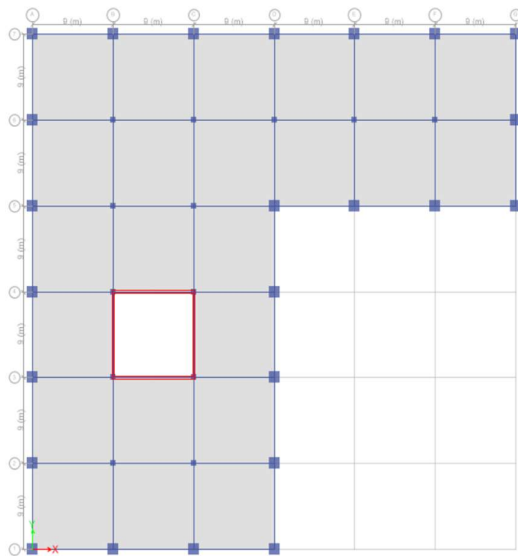


Figure 1: Typical plan configuration of the L-type prototype Braced Mega-Frame-Core Tube building model

T - TYPE

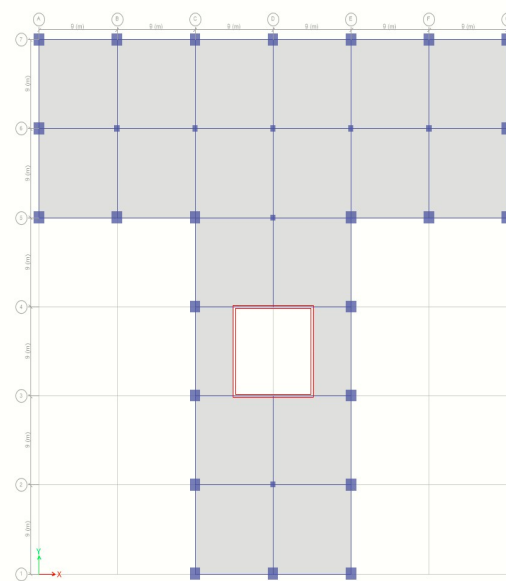


Figure 3: Typical plan configuration of the T-type prototype Braced Mega-Frame-Core Tube building model

3 -D MODEL (L-TYPE)

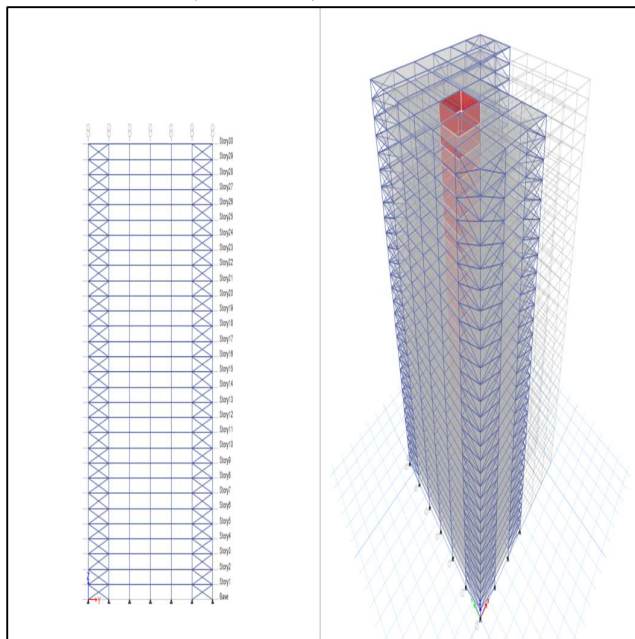


Figure 2: Elevation view and 3-Dimensional ETABS analytical model of the prototype Braced Mega-Frame-Core Tube building showing the exterior X-braced mega-frame and the centrally located core tube used for nonlinear seismic analysis

3-D MODEL (T-TYPE)

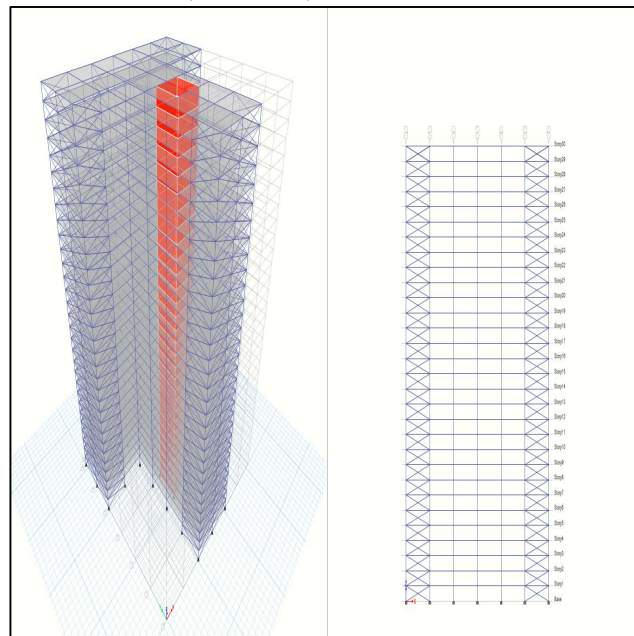


Figure 4: Elevation view and 3-Dimensional ETABS analytical model of the prototype Braced Mega-Frame-Core Tube building showing the exterior X-braced mega-frame and the centrally located core tube used for nonlinear seismic analysis.

PLUS - TYPE

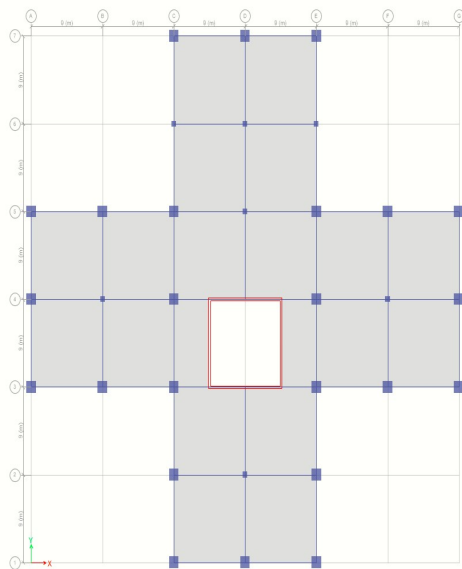


Figure 5: Typical plan configuration of the PLUS-type prototype Braced Mega-Frame-Core Tube building model

3-D MODEL (PLUS-TYPE)

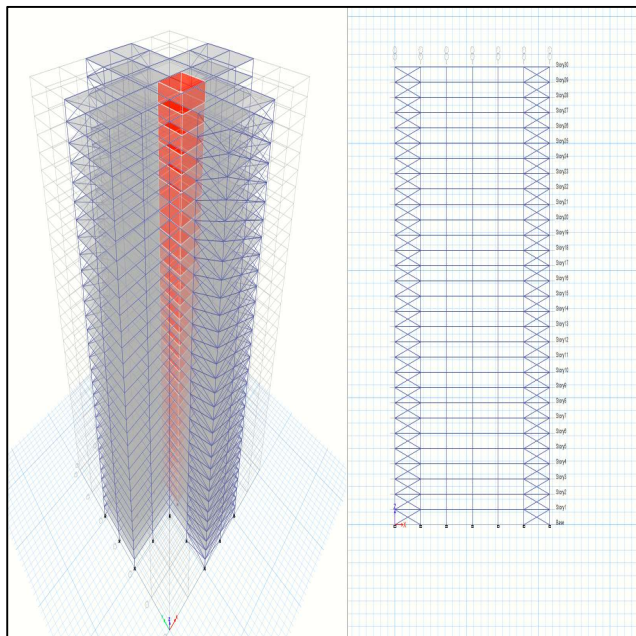


Figure 6: Elevation view and 3-Dimensional ETABS analytical model of the prototype Braced Mega-Frame-Core Tube building showing the exterior X-braced mega-frame and the centrally located core tube used for nonlinear seismic analysis.

The performance of the two selected prototype buildings, namely G+30 and G+50, is analysed to investigate the influence of building height on seismic behaviour. Increasing building height generally leads to higher flexibility, longer natural periods, and greater lateral displacement. Therefore, comparing these two building heights provides valuable insights into the effectiveness of Braced Mega-Frame-Core Tube systems for medium-rise and tall buildings. The study examines how each structural system responds to increasing height and evaluates whether Composite and Structural Steel systems continue to provide superior performance over RCC as the building height increases.

3. RESULTS & DISCUSSION

3.1 Results for G+30 L-Type Building

3.1.1 Storey Displacement

According to IS 16700:2017 Cl 5.4.1, the displacement must not exceed the height of the building/250. This is the relative sway of the building from its original position. When a structure has a lesser displacement, it is most likely due to the increase in its lateral stiffness. The higher its lateral stiffness, the less damage it will sustain from lateral loads. The displacement in the present considered model should not exceed 384 mm. Storey displacement is the total horizontal movement of each floor due to seismic loading and is an important indicator of the overall flexibility of the structure. According to IS 1893 (Part 1): 2016, lower lateral displacement indicates better seismic performance because it reduces the likelihood of structural and non-structural damage.

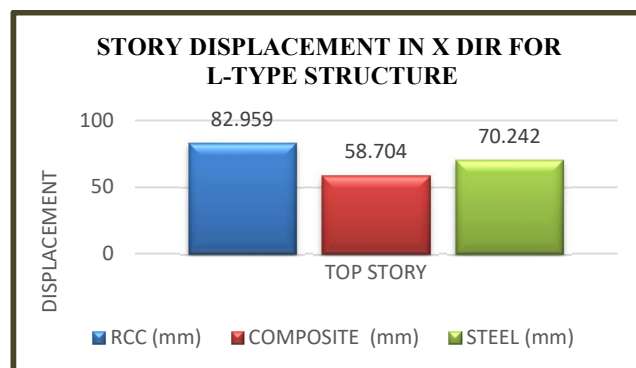


Figure 7: Displacements of all models for L-type in X direction

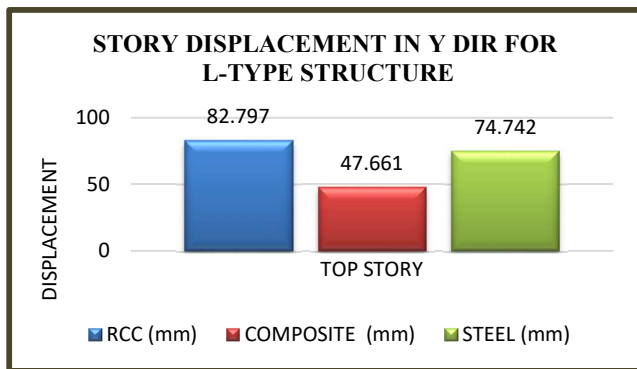


Figure 8: Displacements of all models for L –type in Y direction

X-direction: Compared with RCC, the Composite system reduces roof displacement by 29.2%, while the Steel system reduces it by 15.3%.

Y-direction: Compared with RCC, the Composite system reduces roof displacement by 42.0%, while the Steel system reduces it by 9.7%.

3.1.2 Story Drift Results for L-Type Structure

Storey drift is the relative lateral displacement between two consecutive floors during an earthquake and is one of the most important seismic performance parameters. As per IS 1893 (Part 1): 2016, the maximum permissible storey drift under design seismic load is 0.004 times the storey height, ensuring structural safety and serviceability. Higher the lateral stiffness, the less likely the damage will be. It can be observed that the limit for Storey drift is $0.004 \times 3000\text{mm}$, which equals 12mm. Furthermore, we can say all of the structures are within the permitted limits.

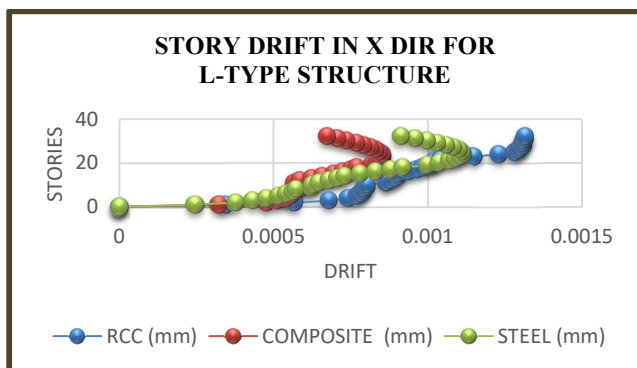


Figure 9: Drift of all models for L –type in X direction

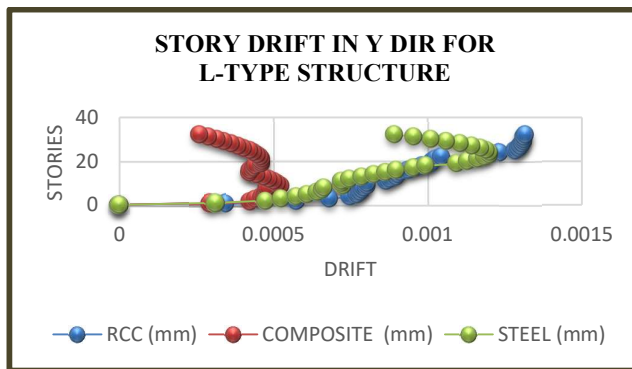


Figure 10: Drift of all models for L –type in Y direction

X-direction: Compared with RCC, the Steel system reduces inter-storey drift by 30.6%, while the Composite system reduces it by 48.6%.

Y-direction: Compared with RCC, the Steel system reduces inter-storey drift by 8.9%, while the Composite system reduces it by 80.1%.

3.1.3 Story Stiffness Results for L-Type

Storey stiffness is the ability of a storey to resist lateral deformation under earthquake loading and directly influences displacement and drift. Higher storey stiffness results in lower lateral displacement, reduced inter-storey drift, and improved seismic stability. The diagonal mega-braces transfer seismic forces efficiently to the mega-columns and core tube, thereby increasing the overall stiffness of the structure. The increase in stiffness is mainly attributed to the higher elastic modulus of structural steel and the composite action developed between steel and concrete.

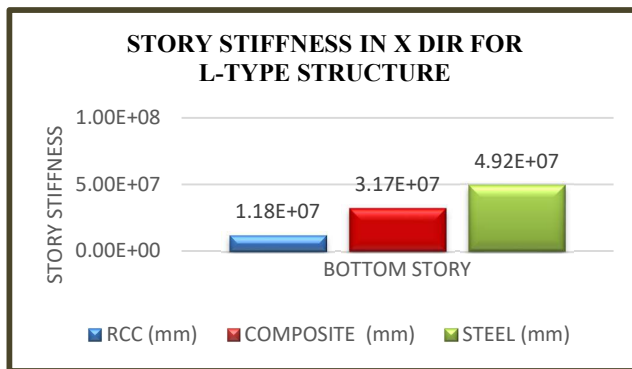


Figure 11: Story stiffness of all models for L –type in X direction

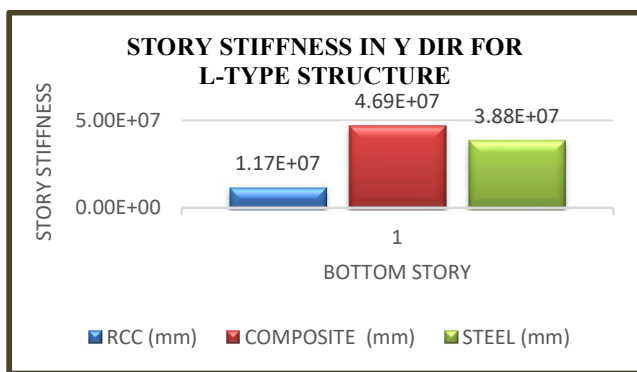


Figure 12: Story stiffness of all models for L –type in Y direction

X-direction: Compared with RCC, the Composite system increases storey stiffness by 16.9%, while the Steel system increases it by 31.7%.

Y-direction: Compared with RCC, the Composite system increases storey stiffness by 30.1%, while the Steel system increases it by 23.2%.

3.1.4 Time Period Results for L-Type

The fundamental natural time period is the time required by a structure to complete one cycle of free vibration and reflects its dynamic characteristics. A lower natural period indicates improved lateral rigidity and reduced dynamic response during earthquake excitation.

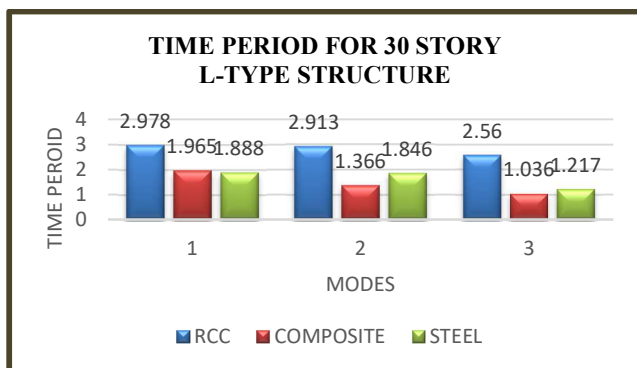


Figure 13: Time period of all models for L –type

Mode 1: Composite reduces the time period by 34.0%, while the Steel system reduces it by 36.6%.

Mode 2: Composite reduces the time period by 53.1%, while the Steel system reduces it by 36.6%.

Mode 3: Composite reduces the time period by 59.5%, while the Steel system reduces it by 52.5%.

3.1.5 Base Shear and Base Moment Results for L-Type

Base shear is the total horizontal seismic force acting at the foundation level of the building due to earthquake excitation. Base moment is the overturning moment developed at the base of the structure due to lateral earthquake forces acting over the building height. It is a critical parameter for the design of foundations, mega-columns, and core structural elements.

Table 10: Base Shear and Base Moment Results for L-Type

BASE SHEAR AND MOMENT FOR 30 STORY L TYPE STRUCTURE			
	RCC	Composite	Steel
BASE FX (KN)	5600	6812	5238
BASE FY (KN)	6128	7026	5384
BASE MOMENT (KN-M)	198960	235340	165820

Base Shear (FX): The Composite system increases base shear by 21.64%, while the Steel system decreases it by 6.46%.

Base Shear (FY): The Composite system increases base shear by 14.65%, while the Steel system decreases it by 12.14%.

Base Moment: The Composite system increases the base moment by 18.28%, while the Steel system decreases it by 16.65%.

3.2 Comparative Seismic Response Summary–30 Storey Buildings

Table 11: Top Story Displacement Comparison – 30 Storey Buildings (X-Dir)

Building Type	RCC (mm)	Composite (mm)	% Diff	Steel (mm)	% Diff
L-Type	82.959	58.704	-29.2%	70.242	-15.3%
T-Type	76.989	51.702	-32.9%	62.544	-18.8%
Plus-Type	70.875	61.686	-13%	59.691	-15.8%

Table 12: Top Story Displacement Comparison – 30 Storey Buildings (Y-Dir)

Building Type	RCC (mm)	Composite (mm)	% Diff	Steel (mm)	% Diff
L-Type	82.797	47.661	-42%	74.742	-9.7%
T-Type	76.161	51.276	-32.7%	61.524	-19.2%
Plus-Type	71.646	28.527	-60.2%	59.526	-16.9%

Table 13: Maximum Story Drift Comparison – 30 Storey Buildings (X-Dir)

Buildin g Type	RCC (mm)	Composit e (mm)	% Diff	Steel (mm)	% Diff
L-Type	0.00131 4	0.000675	- 48.6 %	0.00091 2	- 30.6 %
T-Type	0.00158 7	0.000651	- 59.0 %	0.00088 5	- 44.2 %
Plus- Type	0.00139 2	0.000804	-42%	0.00072 3	-48%

Table 14: Maximum Story Drift Comparison – 30 Storey Buildings (Y-Dir)

Buildin g Type	RCC (mm)	Composit e (mm)	% Diff	Steel (mm)	% Diff
L-Type	0.00131 4	0.000261	- 80.1 %	0.00089 1	-8.9%
T-Type	0.00156 6	0.000645	- 58.8 %	0.00078 6	- 49.8 %
Plus- Type	0.00139 2	0.000303	- 78.2 %	0.00085 8	- 38.3 %

Table 15: Maximum Story Stiffness Comparison – 30 Storey Buildings (X-Dir)

Buildin g Type	RCC (mm)	Composit e (mm)	% Diff	Steel (mm)	% Diff
L-Type	1.18E+0 7	3.17E+07	- 168 %	4.92E+0 7	- 317 %
T-Type	1.76E+0 7	3.23E+07	-83%	5.27E+0 7	- 199 %
Plus- Type	1.11E+0 7	1.43E+07	-29%	1.88E+0 7	-69%

Table 16: Maximum Story Stiffness Comparison – 30 Storey Buildings (Y-Dir)

Buildin g Type	RCC (mm)	Composit e (mm)	% Diff	Steel (mm)	% Diff
L-Type	1.17E+0 7	4.69E+07	- 300 %	3.88E+0 7	- 231 %
T-Type	1.71E+0 7	3.69E+07	- 115 %	5.16E+0 7	- 201 %
Plus- Type	1.11E+0 7	5.40E+07	- 386 %	4.27E+0 7	- 284 %

Table 17: Fundamental Time Period – 30 Storey Buildings

Building Type	RCC (mm)	Composite (mm)	% Diff	Steel (mm)	% Diff
L-Type	2.978	1.965	-34%	1.888	- 36.6%
T-Type	2.594	2.201	- 15.15%	1.879	- 27.5%
Plus- Type	2.716	2.642	- 2.724%	2.545	- 6.29%

Table 18: Base Shear Comparison – 30 Storey Buildings (X-Dir)

Buildin g Type	RCC (mm)	Composit e (mm)	% Diff	Steel (mm)	% Diff
L-Type	5600	6812	+21.64 %	5238	- 6.46 %
T-Type	5474.1 9	6735.8	+23.04 %	5038. 6	- 7.95 %
Plus- Type	3070.0 2	3568.4	+16.23 %	2835. 6	- 7.63 %

Table 19: Base Shear Comparison – 30 Storey Buildings (Y-Dir)

Buildin g Type	RCC (mm)	Composit e (mm)	% Diff	Steel (mm)	% Diff
L-Type	6128	7026	+14.65 %	5384	- 12.14 %
T-Type	5808.7 5	7248.4	+24.78 %	5346. 3	-7.96%
Plus- Type	3339.3 1	3896.8	+16.69 %	3098. 4	-7.21%

Table 20: Base Moment Comparison – 30 Storey Buildings

Buildin g Type	RCC (mm)	Composit e (mm)	% Diff	Steel (mm)	% Diff
L-Type	198960	235340	+18.28 %	16582 0	- 16.65 %
T-Type	30441.3 6	37265.9	+22.41 %	26854. 8	- 11.78 %
Plus- Type	86240	101980	+18.25 %	74860	- 13.19 %

3.3 Comparative Results for G+50

Table 21: Top Story Displacement Comparison 50 Storey Buildings (X-Dir)

Buildin g Type	RCC (mm)	Composit e (mm)	% Diff	Steel (mm)	% Diff
L-Type	165.29 4	104.223	-36.95 %	121.29 6	-26.62 %
T-Type	192.52 5	127.851	-33.60 %	101.32 8	-47.40 %
Plus- Type	210.10 8	182.169	-13.30 %	193.77 9	-7.80%

Table 22: Top Story Displacement Comparison 50 Storey Buildings (Y-Dir)

Buildin g Type	RCC (mm)	Composit e (mm)	% Diff	Steel (mm)	% Diff
L-Type	163.77 9	75.204	-54.08 %	124.67 4	-23.88 %
T-Type	194.07 0	139.236	-28.30 %	103.14 0	-46.90 %
Plus- Type	170.36 4	93.759	-44.90 %	103.72 5	-39.10 %

Table 23: Maximum Story Drift Comparison 50 Storey Buildings (X-Dir)

Buildin g Type	RCC (mm)	Composit e (mm)	% Diff	Steel (mm)	% Diff
L-Type	0.00160 8	0.000835	-48 %	0.00110 5	-31 %
T-Type	0.00187 0	0.001028	-45 %	0.00087 7	-53 %
Plus- Type	0.00167 9	0.001641	-2%	0.00162 3	-3%

Table 24: Maximum Story Drift Comparison 50 Storey Buildings (Y-Dir)

Buildin g Type	RCC (mm)	Composit e (mm)	% Diff	Steel (mm)	% Diff
L-Type	0.00162 1	0.000603	-63 %	0.00105 3	-35 %
T-Type	0.00193 7	0.001258	-35 %	0.00084 1	-57 %
Plus- Type	0.00165 8	0.000896	-46 %	0.00085 2	-49 %

Table 25: Maximum Story Stiffness Comparison 50 Storey Buildings (X-Dir)

Buildin g Type	RCC (mm)	Composit e (mm)	% Diff	Steel (mm)	% Diff
L-Type	1.42E+0 7	3.86E+07	-171 %	3.48E+0 7	-145 %
T-Type	2.08E+0 7	3.96E+07	-90%	3.18E+0 7	-52%
Plus- Type	1.38E+0 7	2.86E+07	-107 %	2.42E+0 7	-75%

Table 26: Maximum Story Stiffness Comparison 50 Storey Buildings (Y-Dir)

Buildin g Type	RCC (mm)	Composit e (mm)	% Diff	Steel (mm)	% Diff
L-Type	1.39E+0 7	5.24E+07	-276 %	4.35E+0 7	-212 %
T-Type	2.02E+0 7	6.48E+07	-220 %	6.04E+0 7	-199 %
Plus- Type	1.36E+0 7	6.12E+07	-350 %	5.08E+0 7	-273 %

Table 27: Fundamental Time Period 50 Storey Buildings

Building Type	RCC (mm)	Composite (mm)	% Diff	Steel (mm)	% Diff
L-Type	4.932	3.802	-22.9%	3.678	-25.4%
T-Type	4.762	4.330	-9%	3.804	-20%
Plus- Type	4.943	5.059	+2.3%	4.976	+0.7%

Table 28: Base Shear Comparison 50 Storey Buildings (X-Dir)

Buildin g Type	RCC (mm)	Composit e (mm)	% Diff	Steel (mm)	% Diff
L-Type	8125	9875	+21.53 %	7580	-6.7%
T-Type	7965. 4	9802.6	+23.06 %	7335. 8	-7.9%
Plus- Type	4485. 6	5215.8	+16.27 %	4142. 4	-7.65 %

Table 29: Base Shear Comparison 50 Storey Buildings (Y-Dir)

Buildin g Type	RCC (mm)	Composit e (mm)	% Diff	Steel (mm)	% Diff
L-Type	8870	10190	+14.88 %	7795	-12.11 %
T-Type	8542. 1	10545.3	+23.45 %	7778. 4	-8.94%

Plus-Type	4879.3	5695.4	+16.72%	4526.7	-7.22%
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Table 30: Base Moment Comparison 50 Storey Buildings

Building Type	RCC (mm)	Composite (mm)	% Diff	Steel (mm)	% Diff
L-Type	462580	548920	+18.66%	386740	-16.39%
T-Type	71285.4	87462.8	+22.69%	62984.6	-11.64%
Plus-Type	206980	244750	+18.24%	179650	-13.2%

4. CONCLUSION

- Composite and Structural Steel Braced Mega-Frame Core Tube systems exhibited superior seismic performance compared to RCC buildings for both G+30 and G+50 structures. The Composite system showed the best overall performance with higher lateral stiffness and lower displacement.
- Plan irregularity significantly influenced seismic behaviour. L-shaped and T-shaped buildings showed higher storey displacement, storey drift, and torsional effects, whereas the Plus-shaped configuration performed better due to its balanced structural layout. These effects became more significant from G+30 to G+50.
- With increasing building height, seismic response became more critical. However, Composite and Structural Steel systems reduced storey displacement by 8–61% in G+30 and up to 55% in G+50, while storey drift was reduced by 8–81% in G+30 and up to 63% in G+50, demonstrating better nonlinear seismic performance and energy dissipation.
- Composite and Structural Steel systems also achieved a 6–35% reduction in the fundamental natural time period and higher storey stiffness. Although base shear increased by about 25% in G+30 and 6–24% in G+50, and base moments increased by more than 23% in several irregular G+50 models, these systems provided superior seismic performance and structural efficiency compared to conventional RCC buildings.

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