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COMPARISON OF SEISMIC BEHAVIOR OF A STRUCTURE WITH COMPOSITE COLUMNS AND STEEL COLUMNS BY USING E-TABS SOFTWARE

[1] Arava Pavan, [2] Mr. A Vishnu
[1]Student, [2]Assistant Professor
Department of Civil Engineering
Bheema Institute of Technology and Science, Adoni, A.P

ABSTRACT

Most building structures are made of reinforced concrete, which is mostly determined by the accessibility of the component materials, the degree of construction expertise needed, and the applicability of design regulations. Due to its dangerous formwork and high dead load, R.C.C. is no longer cost-effective. Nonetheless, composite construction is a novel idea in the building sector. Delaying the building of each floor while concrete columns are cast may be economically prohibitive due to the usage of contemporary composite technologies, which enable the creation of multi-story structural frames to continue at a rapid rate. However, composite beam-columns' greater earthquake resistance has long been acknowledged in Japan, where they are now often used in building. Therefore, in order to promote the adoption of this effective kind of mixed construction, seismic design standards for commonly used Indian structural systems have to be developed. This project compares different building characteristics.

This research uses ETABS to study a residential G+15 multi-story building for pushover analysis, assuming that linear, static, and dynamic analysis of material properties is carried out. Several metrics, including displacement, storey drift, performance point, and base shear, are shown as part of these non-linear analyses. These days, it is essential that all structures be examined and built to withstand lateral pressures like wind and earthquakes. However, in the construction of multistory buildings, it is often seen that the cross sectional area of RCC structural members comes out quite heavy with a big quantity of component material, such as steel & concrete, which takes up a lot of space. One of the greatest solutions in these situations is a composite construction, which not only protects against seismic stresses but also reduces the cross sectional area of structural members and offers a lot of space for economical use.

KEY WORDS: non-linear, performance point, pushover, and ETABS.

I. INTRODUCTION

1.1 General

Fire is not often regarded by structural engineers as a burden on the structural structure. This contrasts with other loads they need to take into account. Modelling, risk assessments, and adjustments to structural stiffness are all necessary for seismic design. Additional structural components and wind tunnel testing are necessary for wind design. Adding insulating material to the frame and doing very basic single element tests are key components of fire design. In most cases, thermally generated forces are neither computed or planned.

Natural catastrophes cannot be completely controlled and are unavoidable. The history of human civilisation shows that although man has fought natural disasters since the beginning of time, events such as earthquakes, cyclones, floods, and volcanic eruptions have occasionally disrupted the normal course of life, caused significant losses in terms of both life and property, and stopped the advancement of civilisation. As technology advanced, man

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attempted to counteract these natural catastrophes in a number of ways, such as creating early warning systems, implementing new preventative strategies, and implementing appropriate relief and rescue operations. Unfortunately, this isn't always the case with natural calamities. One kind of catastrophe that is linked to an ongoing tectonic process is an earthquake, which may occur at any time and result in significant damage and human casualties. Therefore, preventing and reducing earthquake disasters is a worldwide issue nowadays. The seismic code's hazard maps that show seismic zones are periodically updated, which increases the base shear demand on already-existing structures.

Building construction is the technical solution that allows for the formation of structures similar to residential houses in a very simple way. The building will likely be outlined as an enclosed space with a roof, food, cloth, and other elements that correspond to the fundamental needs of contributors. To protect themselves from wild animals, the heat, rain, and other elements, humans in the early period lived in caves, over bushes, or under bushes. because as time went on, people began to live in huts made out of tree branches. These former shelters have now been transformed into magnificent homes. People who are wealthy live in fancy homes.

The main measure of the county's social development is its structures. Everyone has dreamed of owning a comfortable home, and on average, people spend two-thirds of their lives in such homes. These are the few factors that make a person put forth their best effort and spend hard-earned money on a home. They include the sense of civic duty and protection.

These days, the construction of condominiums is a necessary component of the county's socioeconomic advancement. Every day, new methods are created to build homes quickly, cheaply, and to the group's specifications. Engineers and designers handle the construction's seam work, planning, layout, and other aspects. As for the engineers' and designers' paths, skilled workers are trustworthy when it comes to constructing drawings. According to the requirements, the skilled worker must understand his task, be able to follow the engineer's instructions, and be able to create the appropriate building, website, and layout plans, among many other things.

A building body is made up of different bays and stories. A complex statically intermediate structure would be a multi-story, multi-paneled body. Preoccupied is the design of the G+20 flooring body work for a R.C. building. The 40x28 structure is made up of monolithically constructed columns that create a community. The building measures 40 by 28 meters in size. Eighty-five columns are present. It is a sophisticated residential area.

The ETABS program is used to construct the design. The structure was subjected to both horizontal masses and vertical hundreds. The vertical load is made up of both live and dead loads from structural components like beams, columns, slabs, etc. According to IS 875, the building is designed for lifeless load, dwell load, and wind load because the horizontal load includes wind forces. The structure is intended to be a two-dimensional vertical body, and IS 456-2000 is used for analysis. The assistance is obtained via the institute's program, which is why the calculations of hundreds, moments, and shear forces are obtained from it.

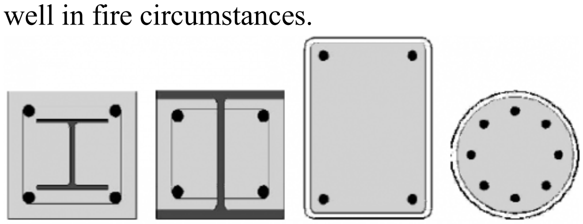
Composite columns are often employed in buildings because they are quick and simple to install and function well in fire situations. Steel tubes filled with reinforced concrete are known as concrete-filled tubes. In a typical scenario, the column functions as composite, but in a fire, the reinforced concrete core bears the bulk of the weight. Although there are many publications on this kind of column, they all use really basic techniques. particularly in relation to the computation of the circular columns' neutral axis. Additionally, the column's shear resistance is often overlooked.

1.2 Composite slabs

1. Consist of in-situ reinforced concrete on top of profiled steel decking.
2. In addition to serving as permanent formwork for the concrete, the decking (profiled steel sheeting) also creates a strong enough shear connection with the concrete such that, after the concrete has strengthened, the two materials work as a composite.
   Project 3 to 4.5 meters onto walls or beams for stability.
3. The decking alone can withstand the self-weight of the wet concrete and construction stresses if the slab is left unsupported during construction. The composite part takes on additional stress.
4. The composite portion must withstand all loads if the slab is supported.
5. In normal circumstances, they are often made to be merely supported members.

1.3 Composite columns

The image below illustrates the variety of shapes that composite columns may take. They are appealing because they capitalise on the relative advantages of concrete and steel, as is the case with all composite components. This may maximise usable floor space by producing a high resistance for a comparatively small cross sectional area. Additionally, they function very well in fire circumstances.



Typical composite column cross sections

1.4 Advantages of Composite Columns

For durability and fire resistance, concrete or another protective layer is often needed around steel columns in design. Therefore, it would seem reasonable to create a composite action between the steel and the concrete in order to benefit from the concrete's inherent compressive strength, increase the section's compressive resistance, and significantly reduce the cost of the steelwork. The slenderness of the steel column in lateral buckling is decreased, enhancing the compressive stress that the steel section can withstand, even if this composite effect is ignored.

The behaviour of tubular sections filled with concrete has been extensively studied.

Concrete infill has little aesthetic impact on the architecturally pleasing qualities of tubular columns. The triaxial placement of the concrete inside the section and the column's fire resistance, which is mostly dependent on the concrete core's residual capacity, are the benefits from a structural standpoint.

1.5 Uses for Composite Columns

- Large unbraced lengths in tall open spaces;
- Lower stories in high-rise buildings, such as convention centres and airport terminals;
- Corrosion and fireproof protection in steel buildings;
- Composite frame in high-rise construction; transition columns between steel and concrete systems;
- Toughness and redundancy as for blast, impact

1.6 Composite Construction

When comparing these two approaches, the most cost-effective approach is to combine the two.

- Greater rigidity,
- Increased bearing capacity, and
- Plastic redistribution

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Millennium Tower (Vienna – Austria) – Composite Construction of Buildings

1.7 Objective of the project

1. To examine the G+15-story building in accordance with IS1893:2002's requirements employing various columns, such as composite, steel, and RCC columns.
2. To use push over analysis to examine the buildings in the ETABS program.
3. Pushover analysis is used to determine outcomes such as storey bending, storey drift, storey shear force, and building torsion of structures.
4. According to IS 13920, ductility-based earthquake-resistant design

1.8 Summary

The goal of this study is to analyse the main design concerns and look into the seismic behaviour of a typical ordinary moment-resisting framed structure with composite and conventional steel columns. The current research uses the ETABS software tool to evaluate the seismic behaviour of a typical (G+10) storey framed building utilising the equivalent static technique of analysis as per IS: 1893-2002 for moderate seismic zone V. Two different kinds of conventional moment-resisting framed 3D space models with steel columns are used for the studies, and the comparison of steel and composite building columns is examined. Critical earthquake response characteristics, including foundation shear, storey drifts, roof displacements, and storey overturning moments, are analysed and the findings compared.

II. LITERATURE REVIEW

Yogesh N. Sonawane and Mahesh N. Patil

This document offers comprehensive guidelines for both software and manual seismic coefficient analysis. Effectively designing and building earthquake-resistant buildings is of utmost significance everywhere in the globe. This study uses ETABS 9.7.1 software in conjunction with human calculations to examine the seismic response of symmetric multistory buildings. As advised by IS 1893:2002, the seismic coefficient approach is included into the procedure. A comparison is made between the results of soft computing and manual analysis.

The study comes to the conclusion that, in both manual and computerised analysis, the value of lateral forces gradually increases from the lowest level to the top floor. The results of calculating seismic weight using software and manual analysis are same. Both digital and manual analyses show a little difference in the base shear values. Compared to automated analysis, base shear values derived from hand analysis are somewhat greater. Results are compared, and for an eight-story structure, about the same mathematical values are found. This document provides comprehensive guidelines for using ETABS 7.1 for seismic coefficient analysis. A thorough design with several factors has been completed in order to produce the earthquake, and a 3D perspective is shown for convenience and comprehension.

J.P. Annie Sweetlin and M. Jeevanathan

The current situation is marked by a number of natural disasters, such as floods, tsunamis, and earthquakes. Earthquakes are the most destructive and frequent of them. Around the globe, the necessity of designing and building earthquake-resistant structures has increased. This study uses E-TABS 9.7.4 software to analyse the earthquake resistance of a G+20 multi-story structure using the Equivalent Static

Method. As advised by IS 1893:2002, the seismic coefficient approach is included into the procedure. Storey shears, storey drift, and displacement were the characteristics that were examined.

The displacement value increases from the lowest level to the top floor. In this kind of model, earthquake displacement is more than the building's allowable limitations (h/500 = 135mm), but wind displacement is within those limits. Drift is 0.004 times the storey height (0.004x3.2 = 12.8mm), which is within the building's bounds. Wind base shear is less than earthquake base shear. This document provides comprehensive guidelines for using E-TABS 9.7.4 for seismic coefficient analysis.

Guleria Abhay

The study of a multi-story RCC structure for various plan configurations was presented. The study has been completed for the seismic loads. The IS 1893 (Part 1)-2002 standard for lateral loads was used. ETABS, a program based on finite elements, was used for the modelling and analysis. They draw the conclusion that form has a significant impact based on the study and findings. Additionally, they compare the outcomes of various plan configuration structures, including mode forms, story shear, overturning moment, story drift, and story displacement. Furthermore, this analysis indicates that the responses of L-shape and I-shape structures to overturning moments, tale drift, and story displacement are almost identical.

Sandip A. Tupa, Dr. K. R. C. Reddy, and others (2014)

The current work uses IS 1893 to analyse the earthquake loads in different zones of a multistory structure, and IS 875 to analyse the wind loads. With a 20% variance, the wind loads are calculated using the zone's design wind speed. The building's wind loads as determined by this method have been compared to earthquake loads. Ultimately, it is discovered that in the majority of situations, wind loads are more significant than earthquake loads.

An RC-framed construction of twelve stories is anticipated to be subject to earthquake and wind stresses. The following inferences are drawn from the findings. The higher the building, the greater the wind and seismic stresses. For towering buildings, wind loads are more important than earthquake loads. For major earthquake or wind forces, structures should be constructed to support loads acquired in both directions independently.

D. R. Panchal, Baldev D. Prajapati, et al. (2013)

The analysis and design process used to assess symmetric high-rise multi-story buildings (G+30) under the influence of wind and equalisation pressures is covered in this study. The shear wall of these R.C.C., steel, and composite buildings is thought to be a mechanism that resists lateral forces. This research uses ETABS to analyse and design a G+30 story structure under the effects of earthquakes and wind. A total of 21 different models are examined and developed, demonstrating the superiority of steel-concrete composite buildings. To choose the best economic structure and resisting system against the lateral pressures, analytical findings are compared.

In the Indian context, composite steel-concrete design is a relatively new idea, and there are currently no suitable updated rules for its design. In addition to removing the need for expensive experimentation, the current work makes design easier by offering a variety of alternatives for the steel sections and shear connections with adequacy checks. Compared to non-composite construction, composite building necessitates fewer structural steel sections while maintaining span and loading unchanged. Because the composite construction weighs less overall than traditional structures, the cost of the base and structure is lower.

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III. METHODOLOGY AND TYPES OF LOADS CONSIDERED

3.1 PUSHOVER ANALYSIS – AN OVERVIEW

Although pushover analysis, also known as nonlinear static analysis, was first used in the 1970s, its potential has been acknowledged over the last 20 years. This process is primarily used to determine the current structure's strength, drift capacity, and seismic demand under certain earthquake conditions. This process may also be used to verify if a new structural design is adequate. In recent years, pushover analysis has been included into a number of seismic recommendations (ATC 40 and FEMA 356) and design codes (Euro code 8 and PCM 3274) due to its efficacy and computational simplicity.

3.2 PUSHOVER ANALYSIS PROCEDURE

Depending on the physical characteristics of the load and the anticipated behaviour from the structure, pushover analysis may be carried out as either force-controlled or displacement-controlled. When the load is known (as in gravity loading) and the structure is anticipated to be able to handle it, the force-controlled option is helpful. When specific drifts are desired (as in seismic 2 1 loading), when the imposed load's size is unknown beforehand, or when the structure is likely to deteriorate or become unstable, displacement controlled technique should be utilised.

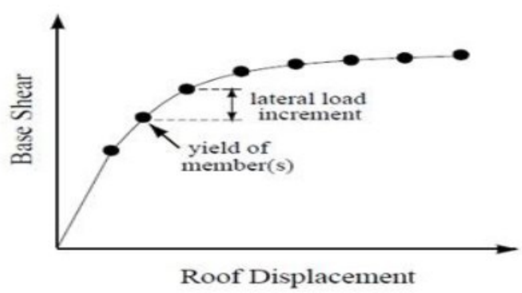

Figure 3.1: Global Capacity (Pushover) Curve of Structure

3.4 Use of Pushover Results

Due to its conceptual and computational simplicity, pushover analysis has been the technique of choice for seismic performance assessment of structures by the main rehabilitation standards and codes. Pushover analysis makes it possible to track the progression of the structure's overall capacity curve as well as the sequence of yielding and failure at the member and structural levels.

Estimating critical response parameters imposed on the structural system and its constituent parts as closely as feasible to those anticipated by nonlinear dynamic analysis is the goal of pushover analysis. Numerous reaction characteristics are revealed by pushover analysis, which is not possible with elastic static or elastic dynamic analysis.

3.5 Limitations of Pushover Analysis

Despite the benefits of pushover analysis over elastic analysis techniques, it is important to recognise the limits of existing pushover processes as well as the underlying assumptions and accuracy of pushover forecasts. Important factors influencing the precision of pushover findings include the choice of lateral load patterns and the identification of failure mechanisms for estimating target displacement owing to higher modes of vibration. Global displacement is anticipated in an earthquake target design. The goal displacement is the mass centre of the roof displacement structure. The precision of pushover analysis's seismic demand estimates is influenced by the target displacement's precise estimation in relation to a particular performance goal. The worldwide displacement anticipated in a design earthquake is known as the target displacement. Important factors influencing the accuracy of pushover findings include the estimation of target displacement and the detection of failure mechanisms resulting from higher modes of vibration.

Types of loads considered

Different types of loads acting on the structure

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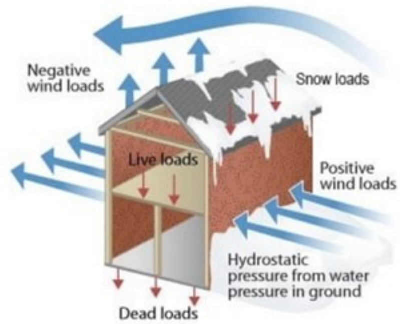
Vertical, horizontal, and longitudinal loads are the three general categories of loads that are applied to buildings and other structures. Dead loads, living loads, and impact loads make up the vertical loads. Wind and seismic loads are included in the horizontal loads. When designing bridges, gantry girders, and other structures, longitudinal loads—that is, tractive and braking forces—are taken into account.



Earthquake loads (EL)

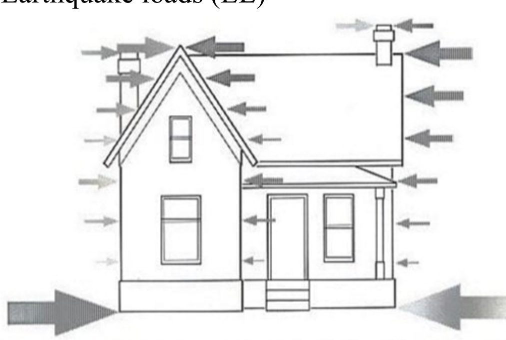


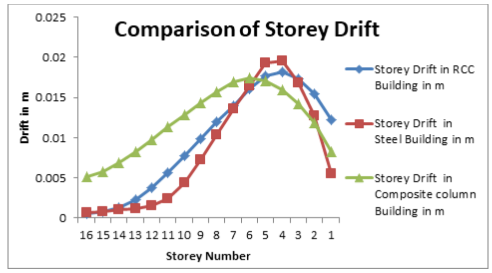
Figure 3.2 Horizontal earthquake forces

IV. RESULTS AND ANALYSIS

Push X Load Case

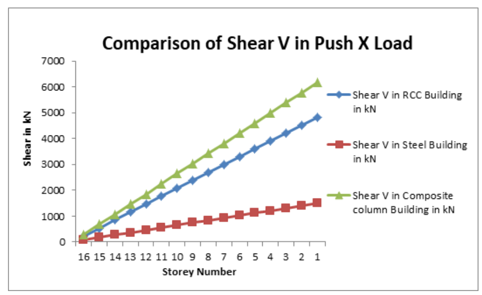
Storey Drift

Story	Load	Storey Drift in RCC Building in m	Storey Drift in Steel Building in m	Storey Drift in Composite column Building in m
16	PUSHX	0.000509	0.000653	0.005095
15	PUSHX	0.000769	0.000823	0.005812
14	PUSHX	0.001304	0.001011	0.006892
13	PUSHX	0.002301	0.00122	0.008234
12	PUSHX	0.003796	0.001542	0.009739
11	PUSHX	0.005649	0.002447	0.01131
10	PUSHX	0.007717	0.004388	0.012857
9	PUSHX	0.009861	0.007197	0.014383
8	PUSHX	0.011943	0.010417	0.015754
7	PUSHX	0.013942	0.013601	0.01688
6	PUSHX	0.016035	0.01643	0.017432
5	PUSHX	0.01763	0.01926	0.017082
4	PUSHX	0.018122	0.019552	0.01597
3	PUSHX	0.017371	0.016861	0.014239
2	PUSHX	0.015496	0.012738	0.01186
1	PUSHX	0.012171	0.005488	0.008192



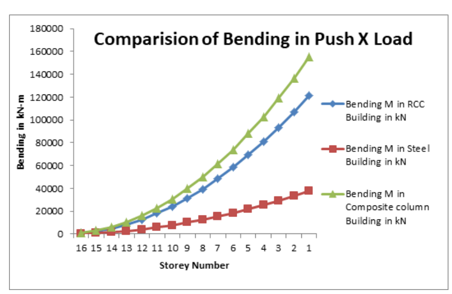
Storey Shear

Story	Load	Shear V in RCC Building in kN	Shear V in Steel Building in kN	Shear V in Composite column Building in kN
16	PUSHX	234.35	90.56	285.66
15	PUSHX	541.06	184.26	677.9
14	PUSHX	847.77	277.96	1070.14
13	PUSHX	1154.48	371.65	1462.37
12	PUSHX	1461.19	465.35	1854.61
11	PUSHX	1767.9	559.05	2246.85
10	PUSHX	2074.61	652.74	2639.09
9	PUSHX	2381.32	746.44	3031.33
8	PUSHX	2688.03	840.14	3423.56
7	PUSHX	2994.74	933.83	3815.8
6	PUSHX	3301.45	1027.53	4208.04
5	PUSHX	3608.16	1121.23	4600.28
4	PUSHX	3914.87	1214.92	4992.52
3	PUSHX	4221.58	1308.62	5384.76
2	PUSHX	4528.29	1402.32	5776.99
1	PUSHX	4835	1496.01	6169.23



Storey Bending

Story	Load	Bending M in RCC Building in kN	Bending M in Steel Building in kN	Bending M in Composite column Building in kN
16	PUSHX	703.086	271.695	856.979
15	PUSHX	2326.26	824.48	2890.673
14	PUSHX	4869.574	1658.354	6101.081
13	PUSHX	8333.009	2773.319	10488.203
12	PUSHX	12716.575	4169.373	16052.04
11	PUSHX	18020.27	5846.517	22792.591
10	PUSHX	24244.09	7804.751	30709.857
9	PUSHX	31388.037	10044.075	39803.837
8	PUSHX	39452.114	12564.489	50074.531
7	PUSHX	48436.32	15365.992	61521.94
6	PUSHX	58340.579	18448.585	74146.063
5	PUSHX	69165.044	21812.268	87946.9
4	PUSHX	80909.682	25457.041	102924.452
3	PUSHX	93574.549	29382.904	119078.719
2	PUSHX	107159.835	33589.857	136409.699
1	PUSHX	121664.614	38077.899	154917.394



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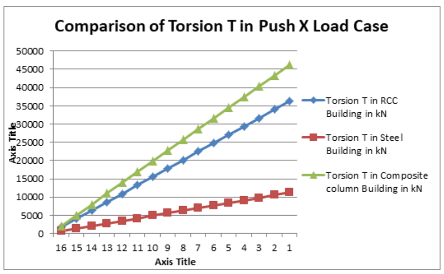
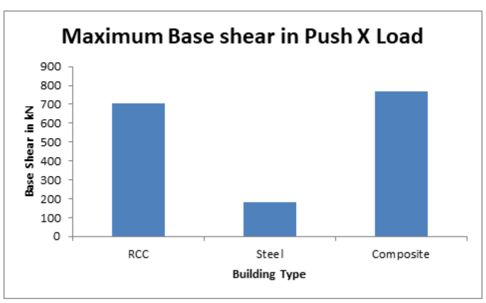
Torsion

Story	Load	Torsion T in RCC Building in kN	Torsion T in Steel Building in kN	Torsion T in Composite column Building in kN
16	PUSHX	1757.629	679.237	2142.448
15	PUSHX	4057.955	1381.962	5084.234
14	PUSHX	6358.281	2084.687	8026.02
13	PUSHX	8658.607	2787.411	10967.806
12	PUSHX	10958.933	3490.136	13909.592
11	PUSHX	13259.259	4192.86	16851.378
10	PUSHX	15559.585	4895.585	19793.164
9	PUSHX	17859.911	5598.309	22734.95
8	PUSHX	20160.236	6301.034	25676.736
7	PUSHX	22460.562	7003.759	28618.522
6	PUSHX	24760.888	7706.483	31560.308
5	PUSHX	27061.214	8409.208	34502.094
4	PUSHX	29361.536	9111.932	37443.88
3	PUSHX	31661.865	9814.657	40385.666
2	PUSHX	33962.192	10517.382	43327.451
1	PUSHX	36262.519	11220.106	46269.237



Base shear

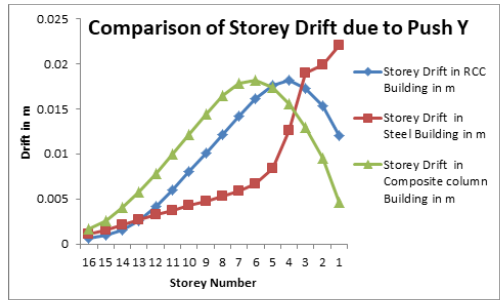
S. No	Building Type	Base shear in kN
1	RCC	706.73
2	Steel	183.98
3	Composite	767.62



Push Y Load Case

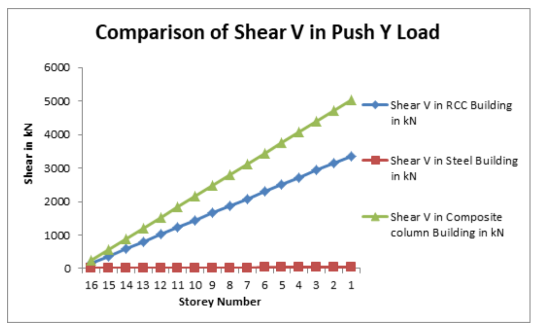
Storey Drift

Story	Load	Storey Drift in RCC Building in m	Storey Drift in Steel Building in m	Storey Drift in Composite column Building in m
16	PUSHY	0.000653	0.001047	0.001643
15	PUSHY	0.000937	0.00158	0.002576
14	PUSHY	0.001525	0.002121	0.004003
13	PUSHY	0.002583	0.00266	0.005785
12	PUSHY	0.004112	0.003197	0.007785
11	PUSHY	0.005974	0.003731	0.009938
10	PUSHY	0.008032	0.004261	0.0122
9	PUSHY	0.010149	0.004784	0.014408
8	PUSHY	0.012189	0.005301	0.016448
7	PUSHY	0.014165	0.005925	0.017873
6	PUSHY	0.016108	0.006712	0.018229
5	PUSHY	0.017635	0.008427	0.017389
4	PUSHY	0.018162	0.012642	0.015566
3	PUSHY	0.017292	0.019016	0.013001
2	PUSHY	0.015355	0.019896	0.00949
1	PUSHY	0.011982	0.022034	0.004579



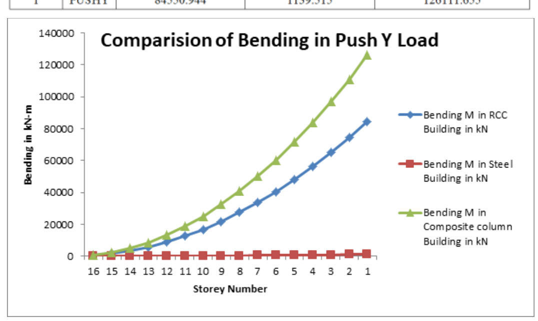
Storey Shear

Story	Load	Shear V in RCC Building in kN	Shear V in Steel Building in kN	Shear V in Composite column Building in kN
16	PUSHY	162.86	2.71	232.54
15	PUSHY	376.01	5.51	551.85
14	PUSHY	589.16	8.32	871.15
13	PUSHY	802.3	11.12	1190.46
12	PUSHY	1015.45	13.93	1509.76
11	PUSHY	1228.6	16.73	1829.07
10	PUSHY	1441.75	19.53	2148.37
9	PUSHY	1654.89	22.34	2467.67
8	PUSHY	1868.04	25.14	2786.98
7	PUSHY	2081.19	27.95	3106.28
6	PUSHY	2294.34	30.75	3425.59
5	PUSHY	2507.48	33.55	3744.89
4	PUSHY	2720.63	36.36	4064.2
3	PUSHY	2933.78	39.16	4383.5
2	PUSHY	3146.92	41.97	4702.8
1	PUSHY	3360.07	44.77	5022.11



Storey Bending

Story	Load	Bending M in RCC Building in kN	Bending M in Steel Building in kN	Bending M in Composite column Building in kN
16	PUSHY	488.531	8.131	697.63
15	PUSHY	1616.567	24.673	2353.174
14	PUSHY	3384.043	49.628	4966.63
13	PUSHY	5790.969	82.994	8538
12	PUSHY	8837.319	124.772	13067.283
11	PUSHY	12523.107	174.962	18554.478
10	PUSHY	16848.332	233.564	24999.587
9	PUSHY	21812.993	300.578	32402.609
8	PUSHY	27417.086	376.004	40763.544
7	PUSHY	33660.661	459.841	50082.392
6	PUSHY	40543.606	552.09	60359.153
5	PUSHY	48065.983	652.752	71593.827
4	PUSHY	56227.892	761.825	83786.414
3	PUSHY	65029.37	879.31	96936.915
2	PUSHY	74470.429	1005.207	111045.328
1	PUSHY	84550.944	1139.515	126111.655



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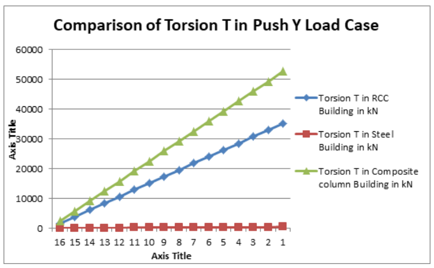
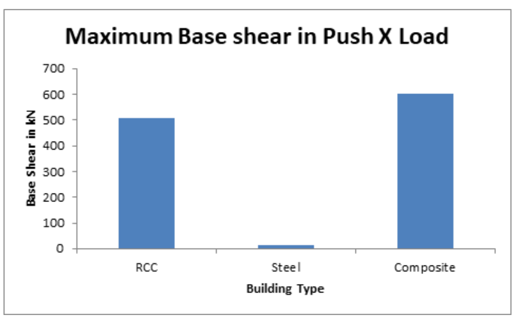
Torsion

Story	Load	Torsion T in RCC Building in kN	Torsion T in Steel Building in kN	Torsion T in Composite column Building in kN
16	PUSHY	1710.043	28.458	2441.706
15	PUSHY	3948.091	57.899	5794.402
14	PUSHY	6186.139	87.341	9147.098
13	PUSHY	8424.186	116.782	12499.794
12	PUSHY	10662.234	146.224	15852.489
11	PUSHY	12900.281	175.665	19205.185
10	PUSHY	15138.329	205.107	22557.881
9	PUSHY	17376.376	234.548	25910.577
8	PUSHY	19614.425	263.99	29263.272
7	PUSHY	21852.451	293.431	32615.968
6	PUSHY	24090.542	322.873	35968.664
5	PUSHY	26328.592	352.314	39321.36
4	PUSHY	28566.584	381.756	42674.055
3	PUSHY	30804.664	411.197	46026.751
2	PUSHY	33042.707	440.639	49379.447
1	PUSHY	35280.758	470.08	52732.143



Base shear

S. No	Building Type	Base shear in kN
1	RCC	506.21
2	Steel	14.98
3	Composite	600.7



V. CONCLUSION

The findings that were reached are as follows:

1. Compared to other models (RCC Building and Composite column Building), the steel building model exhibits lower values of story drift in both the Push X and Push Y load cases. Additionally, structures with composite columns get the highest results.
2. From the sixteenth to the lowest storey, the shear, bending, and twisting moment values are increased. Compared to RCC buildings and composite column systems, steel column buildings have lower shear and bending values.
3. The composite column construction achieves higher base shear values than the RCC column and composite column models in both X and Y directions push over load.
4. In comparison to the RCC and composite column buildings, the steel column building has lower values for shear, bending, torsion, story drift, and other characteristics.
5. Steel frames exhibit more storey drift in the X-direction of the analysis than do composite and RCC frames.
6. The orientation of column sections is the cause of the variations in storey drift for various stories in the X and Y directions. Column sections' moments of inertia vary in both directions.
7. Because RCC frames weigh more than steel and composite frames, their base shear is at its highest. When compared to RCC frames, base shear is decreased by 40% for composite frames and 45% for steel frames.
8. Compared to RCC frames, the cost of a composite frame is reduced by 33% and that of a steel frame by 27%. This solely includes material costs; it excludes costs for labour, manufacturing, shipping, etc.

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