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# Effect of Floating Column in Stability of Building

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**ABSTRACT:** The objective of this study is to compare the structural behavior and performance of building with floating column and rotating column with the conventional multi-storey building. Floating columns are designed to suspend the upper floors of a building, offering potential benefits in terms of architectural aesthetics. It increased usable space, as the ground floor can be utilized for parking or commercial purposes. Rotating columns, on the other hand are designed to allow rotational movement or rotation around their vertical axis. The construction of a rotating column involves using specialized design considerations and detailing. This study presents a comprehensive seismic analysis comparing buildings with floating columns and rotating columns to a conventional building. To achieve this objective, analyses will be conducted using software and structural analysis techniques. The study will include the evaluation of various parameters such as storey drift, base shear, deflection, bending moment, shear force. Additionally, this study aims to provide solution to enhance seismic performance of buildings and provide structural stability to building with floating column and rotating columns.

**KEYWORDS:** base shear, bending moment, column, deflection, Floating column, rotating column, rotational movement, seismic analysis, shear force, structure stability, storey drift.

## I. INTRODUCTION

India, being a developing country, is witnessing a rapid pace of urbanization, resulting in significant advancements in building construction methods and architectural designs over the past few decades. This progress has led to the construction of multi-storey buildings with different types, such as soft storeys, floating columns, heavy load considerations, and reduction in stiffness. In the current urban landscape, it has become customary for most multi-storey buildings to incorporate an open first storey, primarily dedicated to accommodating parking spaces or hall. In the context of multi-storey structures, based on upper floor plan the columns are placed in the plan, it becomes undesirable for the lower floors. In order to mitigate this issue, the building with floating column is introduced.

In general, buildings incorporating floating columns (FC) are primarily design to withstand self weight, rendering them safe under such conditions. However, it is important to note that they may not be specifically engineered to endure earthquake loads, making them vulnerable in seismic-prone regions. As a consequence, the main objective of this research is to raise awareness regarding the potential issues related to seismic-resistant design of multi-storey buildings featuring floating columns.

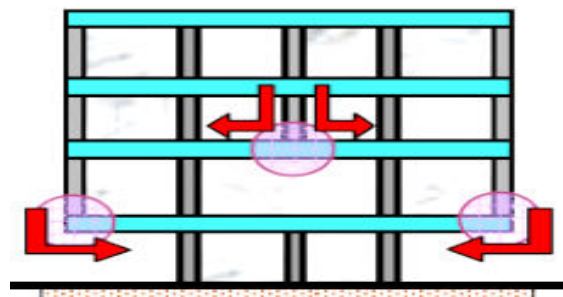


Fig No. 1 Floating Column

In traditional RCC structures, columns are that support the load of the structure and transfer it to the foundation. They are usually designed to be static and fixed in position, not intended to rotate. Rotating columns are designed to allow rotational movement or rotation around their vertical axis. The construction of rotating columns involves specialized design considerations and detailing to ensure their functionality, stability, and safety. The rotating column should be designed to handle the loads it will be subjected to during its intended use. This includes both the vertical loads from the structure it supports and any additional rotational loads that might occur. Consequently, the stiffness of the building assumes an important role in design of tall structure with lateral forces. One suitable solution for addressing this issue is the utilization of a Special Moment Resisting Frame (SMRF) as the structural system, particularly effective for low to mid-rise buildings. The SMRF is designed to bear the lateral loads through a combined action of axial, shear, and bending forces within its beams and columns.

## II. RELATED WORK

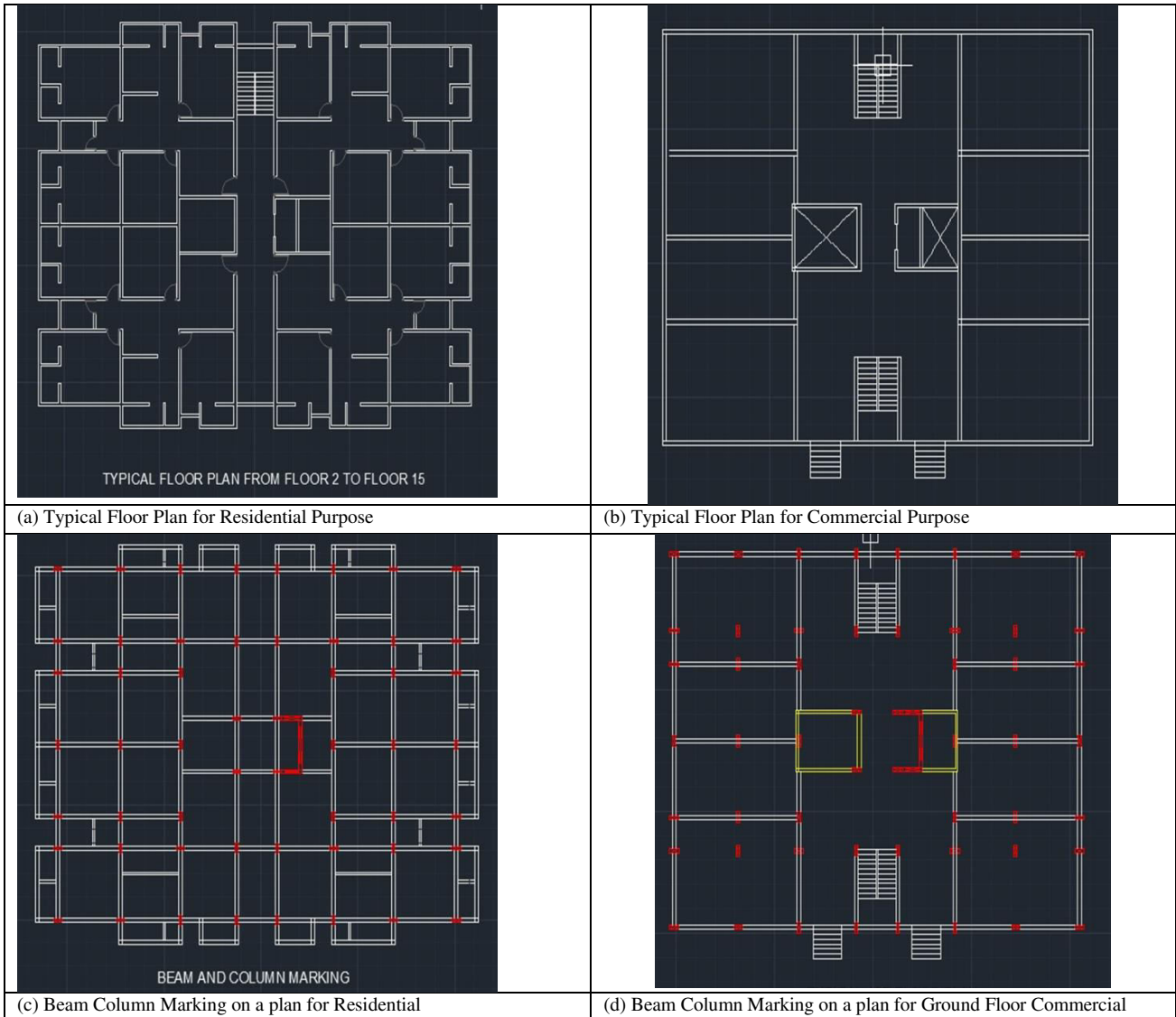
ManeeshAhirwar, Rahul Satbhaiya (2020) conducted the analysis, multi-story building is subjected to various types of seismic excitation, maintaining constant time for each result by controlling the variable frequency content. The analysis encompasses key parameters, including storey displacement, base shear structural behavior. Finite Element Method (FEM) codes are employed for this investigation, with the commercially available tool StaadPro v8i.0 utilized for the detailed modeling and analysis. This paper conclude that during the seismic event, the structural integrity of the building was compromised, rendering it unsafe. Pratyush Malaviya (2014) explained in his study explains that the column acts as a concentrated load on the supporting beam. From an analytical standpoint, it is commonly assumed that the column is pinned at its base, treating it as a point load on the transfer beam. STAAD Pro V8i is a suitable software tool for analyzing structures of this nature. Floating columns are capable of handling gravitational loads, but it is crucial for the transfer girder to have sufficient dimensions (stiffness) to ensure minimal deflection

A.P. Mundada, focuses on the investigation of architectural drawing and the plan of a structure with FC. The research project involves the selection of an existing residential G+7 structure for the study. The primary objective is to analyze the load distribution on the FC and its associated effects. Special attention is given to understanding the importance and implications of the force's line of action. Also this paper undertakes a study of the seismic analysis between a building with floating columns and one without. To achieve this, an equivalent static analysis is conducted on a comprehensive 3D mathematical model. The findings of this analysis are presented, enabling the identification of various analytical properties of the structure. The ultimate goal is to develop a systematic and cost-effective design for the building. The study reveals that the deflection observed in buildings with floating columns is comparatively higher when compared to those equipped with struts. The incorporation of struts in structures featuring floating columns significantly mitigates deflection. This can be attributed to the stabilizing effect that strut offer to the columns, effectively balancing the moments and promoting greater structural stability.

## III. METHODOLOGY

The main aim of the project appears to be related to the modeling and analysis of structures that involve floating columns and rotating columns. The preparation of plan for the G+15 building is done for the analysis the structure for the project. The building consists of 15 floors; where the ground floor and the basement have specific purposes, and floors two to the top floor are meant for residential use. Each floor from the second to the top floor is designed to accommodate four 2BHK flats. The basement is used for parking purposes, which means it serves as a parking area for residents and visitors. Parking spaces are essential in tall buildings where space is limited and there is a need for efficient parking management. The ground floor is utilized for commercial purposes. This could mean that the space on the ground floor is designated for shops, offices, or any other commercial establishments. Having commercial spaces on the ground floor is beneficial for generating rental income and providing convenience to residents who can access essential services without leaving the building. Overall, the building is designed to optimize space and cater to both residential and commercial needs. The residential floors provide a total of 56 flats, while the ground floor's commercial spaces and basement's parking facilities add further functionality to the building. The G+15 building can offer a balance between housing and commercial opportunities, making it a potentially valuable and multifunctional structure for its occupants and investors.

The duct is provided in the building. A duct used in an apartment building refers to a passage designed to facilitate the flow of air, ventilation, and AC systems throughout the building. Ducts also facilitate the exchange of indoor air with fresh outdoor air, helping to remove stale air, odors, and pollutants. Proper duct design is crucial to ensure balanced airflow, minimal pressure loss, and even distribution of conditioned air to all areas of the building.



In structural engineering, determining the sizes of structural members such as beams, columns, and slabs is a critical step in the design process. These sizes directly impact the strength, stability, and overall performance of the structure. Manual calculations play a fundamental role in arriving at initial member sizes before the software modeling takes place. Manual calculations involve using engineering principles, codes, and standards to analyze the loads and forces acting on the structure. Engineers consider factors like dead loads DL (self weight of the structure), live loads LL and other relevant forces. The goal is to guarantee that the structure can securely support all anticipated loads for the duration of its life. Based on the manual calculations, engineers determine the required sizes of individual structural members like beams and columns. The size of a member directly relates to its cross-sectional dimensions, such as the width, depth, and thickness.

•Floating Column and rotating Column determining and marking :-

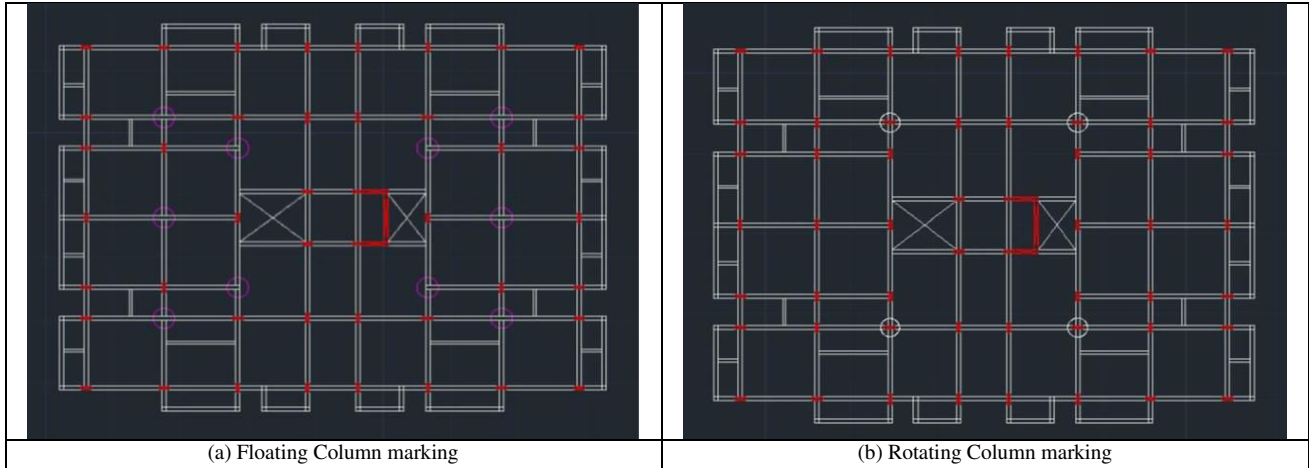


Fig. 2. Column Positions

#### IV. ANALYSIS OF STRUCTURE

Three models were developed to analyze the structure involving floating and rotating columns. The first model represents a conventional structure, wherein all columns are of standard design and are supported directly by the foundation. In contrast, the second model simulates a floating column structure, where some columns rest on beams while the remaining columns are supported by the foundation. Lastly, the third model represents a column with a rotating feature, wherein certain columns are capable of rotating along their vertical axis. These distinct models have been formulated to thoroughly investigate the effects of such configurations on the overall structural behavior.

Model.1- G+15 Conventional structures without floating and rotating column (Fig.No3.5).

Model.2- G+15 Structures with floating column (Fig.No3.6).

Model.3- G+15 Conventional structures without floating and rotating column (Fig.No3.7).

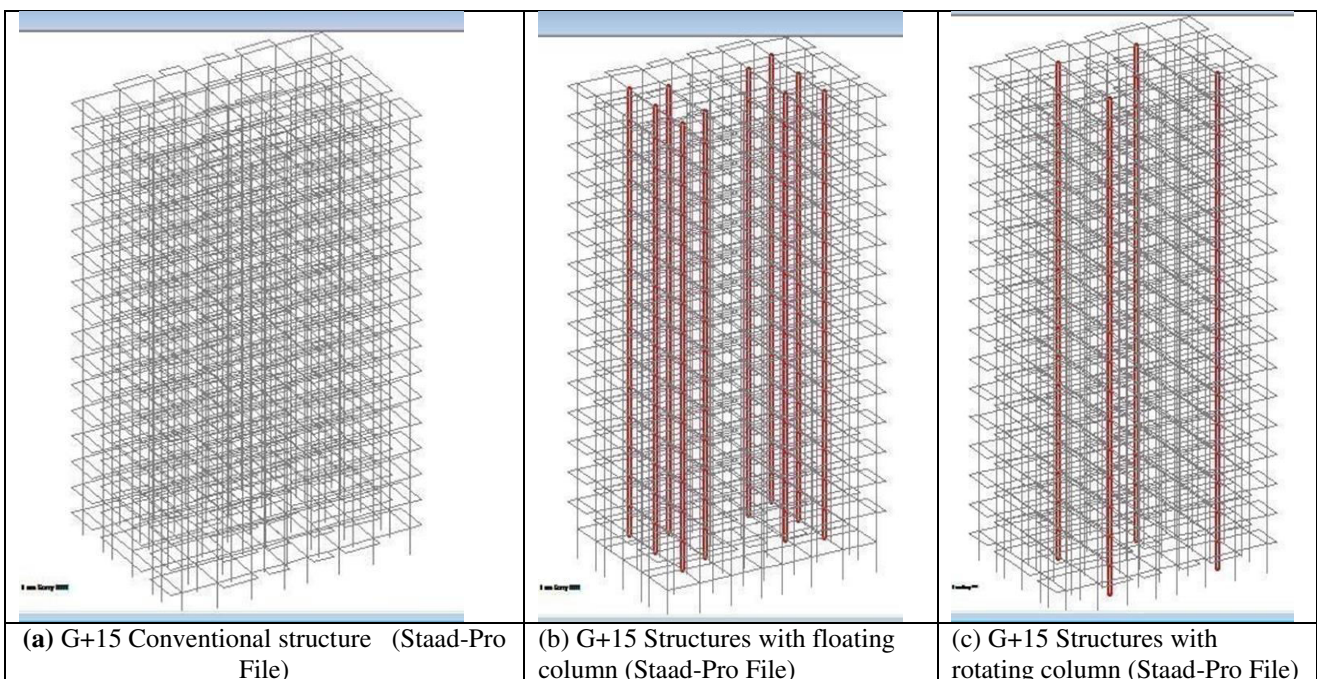


Fig. 3 Structure Details

- Other Details-
- 1. Height of one floor- 3m
- 2. Overall height of the building- 48 m
- 3. Grade of concrete- M20 (For beam and slab), M25 (For column)
- 4. Grade of steel- Fe 415
- 5. Size of beam and column- As per design
- 6. Size of slab- 125mm
- 7. Soil type- Class II moderate soil
- 8. Wall thickness- 9" (230mm)
- 9. Structure Type- RC frame structure.
- 10. Seismic zone- III
- 11. Damping ratio- 5%

#### **LOADING DETAILS**

- 1) Dead Load (DL) - For dead load main part is structural members like beam, column. DL for this is calculated as dimensions multiply by the unit weight of concrete (25kN/m<sup>3</sup>). Wall is also considered as a dead load. Unit weight for brick is taken as 19 KN/m<sup>3</sup>.
- 2) Live Load (LL) - The live load in a case of residential buildings, a common practice is to consider a LL of 2 kN/m<sup>2</sup> on each floor and FF is conceded as 1 kN/m<sup>2</sup>.
- 3) Seismic Loading-  
As per IS 1893-2002  
For Zone III (Z) - 0.16  
Importance factor (I) - 1  
Soil Type- Class II moderate soil  
Damping Ratio- 5%  
Response reduction factor- 5 (Special Moment Resisting Frame)

#### **LOAD COMBINATION**

For analysis following load combinations are used.

1. 1.5(DL+LL)
2. 1.2(DL+LL+EQ X)
3. 1.2(DL+LL+EQ Z)

#### **ANALYSIS AND RESULT FROM SOFTWARE**

##### **1) Support Reaction-**

The support reaction known as a support force or simply reaction is the force developed at these support points to counteract the applied loads and maintain equilibrium. Fig. No 10 shows a number of nodes for the support reactions.

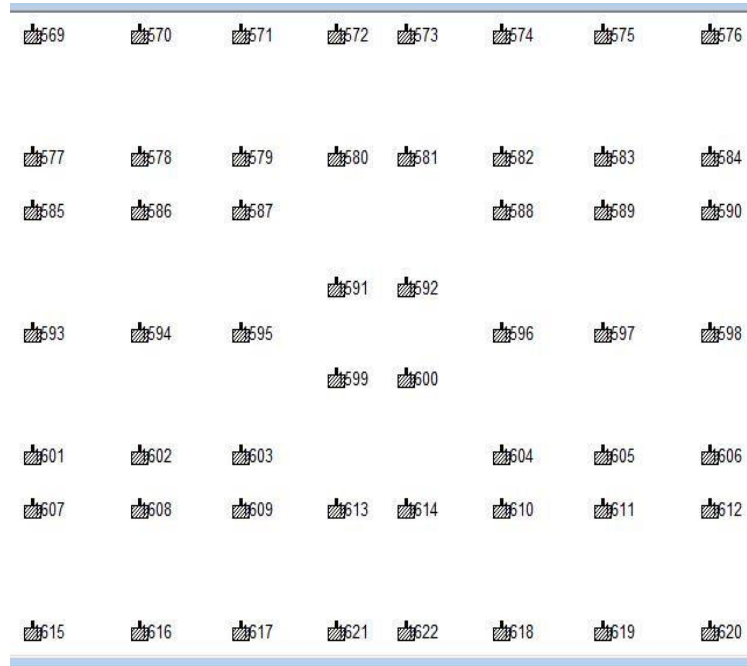


Fig No 4.1 Support Reaction Node Point (Staad-Pro File)

Table No. 4.1 Support Reactions For 1.2 (DL+LL+EQX) Load Combination

Node No	Load Combination	Conventional Structure	Structure With Floating Columnn	Structure With Rotating Column
1569	1.2(DL+LL+EQ X)	2555.646	2551.027	2548.207
1570	1.2(DL+LL+EQ X)	3570.942	3815.636	3560.367
1571	1.2(DL+LL+EQ X)	4148.702	4227.774	4121.485
1572	1.2(DL+LL+EQ X)	3203.072	3216.262	3184.965
1573	1.2(DL+LL+EQ X)	3389.504	3434.79	3407.09
1574	1.2(DL+LL+EQ X)	3993.972	4047.103	4001.168
1575	1.2(DL+LL+EQ X)	3618.928	3890.379	3596.983
1576	1.2(DL+LL+EQ X)	3410.961	3519.477	3415.881
1577	1.2(DL+LL+EQ X)	2794.537	3081.85	2796.764
1578	1.2(DL+LL+EQ X)	3344.906	FC	3407.09
1579	1.2(DL+LL+EQ X)	3254.91	5288.375	3396.061(RC)
1580	1.2(DL+LL+EQ X)	3385.473	3505.185	3019.025
1581	1.2(DL+LL+EQ X)	3509.673	3628.624	3339.36
1582	1.2(DL+LL+EQ X)	3176.042	5027.081	3583.791(RC)
1583	1.2(DL+LL+EQ X)	3188.845	FC	2932.267
1584	1.2(DL+LL+EQ X)	3713.625	3883.879	3163.292
1585	1.2(DL+LL+EQ X)	2807.925	3020.064	3759.125
1586	1.2(DL+LL+EQ X)	3441.278	5381.93	2800.359
1587	1.2(DL+LL+EQ X)	2852.062	FC	3469.19
1588	1.2(DL+LL+EQ X)	2607.239	FC	3007.055
1589	1.2(DL+LL+EQ X)	3242.558	5432.748	2734.38
1590	1.2(DL+LL+EQ X)	3716.023	3799.905	3234.987
1591	1.2(DL+LL+EQ X)	3021.659	3115.379	3755.493
1592	1.2(DL+LL+EQ X)	3351.523	3528.423	3038.596
1593	1.2(DL+LL+EQ X)	4193.168	4261.152	3361.848

1594	1.2(DL+LL+EQ X)	3751.805	4018.249	4132.612
1595	1.2(DL+LL+EQ X)	3660.557	4278.956	3756.238
1596	1.2(DL+LL+EQ X)	3511.379	4206.131	3746.534
1597	1.2(DL+LL+EQ X)	3790.902	4086.013	3531.135
1598	1.2(DL+LL+EQ X)	5071.195	5042.654	3793.824
1599	1.2(DL+LL+EQ X)	3021.659	3115.408	5081.26
1600	1.2(DL+LL+EQ X)	3351.523	3528.453	3038.596
1601	1.2(DL+LL+EQ X)	2807.925	3026.401	3361.848
1602	1.2(DL+LL+EQ X)	3441.278	5455.71	2800.359
1603	1.2(DL+LL+EQ X)	2852.062	FC	3469.19
1604	1.2(DL+LL+EQ X)	2607.239	FC	3007.055
1605	1.2(DL+LL+EQ X)	3242.559	5506.512	2734.38
1606	1.2(DL+LL+EQ X)	3716.023	3806.243	3234.987
1607	1.2(DL+LL+EQ X)	2794.537	3122.411	3755.493
1608	1.2(DL+LL+EQ X)	3344.906	FC	2796.764
1609	1.2(DL+LL+EQ X)	3254.91	5331.37	3396.061(RC)
1610	1.2(DL+LL+EQ X)	3176.042	5070.076	3019.025(RC)
1611	1.2(DL+LL+EQ X)	3188.845	FC	2932.267
1612	1.2(DL+LL+EQ X)	3713.625	3924.434	3163.292
1613	1.2(DL+LL+EQ X)	3385.473	3506.303	3759.125
1614	1.2(DL+LL+EQ X)	3509.673	3629.741	3339.36
1615	1.2(DL+LL+EQ X)	2555.646	2556.093	3583.791
1616	1.2(DL+LL+EQ X)	3570.942	3856.284	2548.207
1617	1.2(DL+LL+EQ X)	4148.702	4232.884	3560.367
1618	1.2(DL+LL+EQ X)	3993.971	4052.212	4121.485
1619	1.2(DL+LL+EQ X)	3618.927	3931.023	4001.168
1620	1.2(DL+LL+EQ X)	3410.961	3524.544	3596.983
1621	1.2(DL+LL+EQ X)	3203.072	3219.06	3415.881
1622	1.2(DL+LL+EQ X)	3389.504	3437.587	3184.965

Table No. 4.2 Support Reactions For 1.2 (DL+LL+EQY) Load Combination

Node No	Load Combination	Conventional Structure	Structure With Floating Column	Structure With Rotating Column
1569	1.2(DL+LL+EQ Y)	2729.784	2705.467	2719.602
1570	1.2(DL+LL+EQ Y)	3288.036	3427.263	3269.97
1571	1.2(DL+LL+EQ Y)	3688.536	3758.558	3626.349
1572	1.2(DL+LL+EQ Y)	2875.887	2941.892	2889.303
1573	1.2(DL+LL+EQ Y)	2875.885	2941.883	2889.303
1574	1.2(DL+LL+EQ Y)	3688.508	3758.517	3626.333
1575	1.2(DL+LL+EQ Y)	3287.694	3426.852	3269.624
1576	1.2(DL+LL+EQ Y)	2729.485	2705.17	2719.296
1577	1.2(DL+LL+EQ Y)	3051.953	3183.541	3067.226
1578	1.2(DL+LL+EQ Y)	2865.021	FC	2895.756
1579	1.2(DL+LL+EQ Y)	2957.684	4878.62	2722.971(RC)
1580	1.2(DL+LL+EQ Y)	3496.082	3602.634	3481.181
1581	1.2(DL+LL+EQ Y)	3496.078	3602.622	3481.178
1582	1.2(DL+LL+EQ Y)	2957.677	4878.554	2722.965(RC)
1583	1.2(DL+LL+EQ Y)	2864.729	FC	2895.445
1584	1.2(DL+LL+EQ Y)	3051.489	3183.244	3066.782
1585	1.2(DL+LL+EQ Y)	3385.39	3546.364	3414.306
1586	1.2(DL+LL+EQ Y)	3651.694	5569.325	3659.545



1587	1.2(DL+LL+EQ Y)	2835.38	FC	3049.447
1588	1.2(DL+LL+EQ Y)	2835.363	FC	3049.422
1589	1.2(DL+LL+EQ Y)	3651.327	5568.56	3659.162
1590	1.2(DL+LL+EQ Y)	3384.891	3545.948	3413.822
1591	1.2(DL+LL+EQ Y)	3307.817	3375.283	3305.756
1592	1.2(DL+LL+EQ Y)	3307.814	3375.268	3305.754
1593	1.2(DL+LL+EQ Y)	4632.354	4652.059	4607.092
1594	1.2(DL+LL+EQ Y)	3771.639	4052.474	3775.327
1595	1.2(DL+LL+EQ Y)	3585.989	4242.575	3638.857
1596	1.2(DL+LL+EQ Y)	3585.967	4242.535	3638.833
1597	1.2(DL+LL+EQ Y)	3771.225	4051.973	3774.905
1598	1.2(DL+LL+EQ Y)	4631.827	4651.558	4606.58
1599	1.2(DL+LL+EQ Y)	3065.367	3268.565	3094.689
1600	1.2(DL+LL+EQ Y)	3065.368	3268.552	3094.691
1601	1.2(DL+LL+EQ Y)	3138.837	3280.133	3141.794
1602	1.2(DL+LL+EQ Y)	3032.667	5320.227	3045.186
1603	1.2(DL+LL+EQ Y)	2623.954	FC	2692.027
1604	1.2(DL+LL+EQ Y)	2623.94	FC	2692.013
1605	1.2(DL+LL+EQ Y)	3032.356	5319.389	3044.856
1606	1.2(DL+LL+EQ Y)	3138.376	3279.782	3141.357
1607	1.2(DL+LL+EQ Y)	3456.473	3822.831	3488.903
1608	1.2(DL+LL+EQ Y)	3669.246	FC	3664.142
1609	1.2(DL+LL+EQ Y)	3473.308	5479.962	3228.358(RC)
1610	1.2(DL+LL+EQ Y)	3473.275	5479.859	3228.326(RC)
1611	1.2(DL+LL+EQ Y)	3668.873	FC	3663.754
1612	1.2(DL+LL+EQ Y)	3456.001	3822.575	3488.438
1613	1.2(DL+LL+EQ Y)	3399.07	3532.31	3441.971
1614	1.2(DL+LL+EQ Y)	3399.069	3532.299	3441.973
1615	1.2(DL+LL+EQ Y)	3236.906	3370.144	3244.574
1616	1.2(DL+LL+EQ Y)	3902.396	4320.09	3887.952
1617	1.2(DL+LL+EQ Y)	4454.213	4521.522	4496.369
1618	1.2(DL+LL+EQ Y)	4454.14	4521.44	4496.306
1619	1.2(DL+LL+EQ Y)	3901.996	4319.598	3887.55
1620	1.2(DL+LL+EQ Y)	3236.601	3369.854	3244.251
1621	1.2(DL+LL+EQ Y)	3716.692	3711.967	3702.753
1622	1.2(DL+LL+EQ Y)	3716.69	3711.959	3702.753

**Base Shear –**

Base shear is a measurement of the greatest predicted lateral stress from seismic activity on the base of the structure. To calculate the base shear, engineers consider various factors such as the building's mass, height, stiffness, and the ground motion expected during an earthquake at the building's location. Building codes and standards dictate the specific procedures for calculating base shear to ensure that structures are built to withstand the forces imposed by seismic events, thus enhancing public safety and reducing the risk of significant damage.

Values obtained from software regarding base shear

<pre> ***** * TIME PERIOD FOR X 1893 LOADING = 0.80290 SEC * * SA/G PER 1893= 1.694, LOAD FACTOR= 1.000 * * VB PER 1893= 0.0271 X 68879.52= 1866.76 KN * *****  ***** * TIME PERIOD FOR Z 1893 LOADING = 0.92550 SEC * * SA/G PER 1893= 1.469, LOAD FACTOR= 1.000 * * VB PER 1893= 0.0235 X 68879.52= 1619.47 KN * ***** </pre>	<pre> ***** * TIME PERIOD FOR X 1893 LOADING = 0.80290 SEC * * SA/G PER 1893= 1.694, LOAD FACTOR= 1.000 * * VB PER 1893= 0.0271 X 73577.48= 1994.08 KN * *****  ***** * TIME PERIOD FOR Z 1893 LOADING = 0.92550 SEC * * SA/G PER 1893= 1.469, LOAD FACTOR= 1.000 * * VB PER 1893= 0.0235 X 73577.48= 1729.93 KN * ***** </pre>	<pre> ***** * TIME PERIOD FOR X 1893 LOADING = 0.90290 SEC * * SA/G PER 1893= 1.694, LOAD FACTOR= 1.000 * * VB PER 1893= 0.0271 X 69926.03= 1895.12 KN * *****  ***** * TIME PERIOD FOR Z 1893 LOADING = 0.92550 SEC * * SA/G PER 1893= 1.469, LOAD FACTOR= 1.000 * * VB PER 1893= 0.0235 X 69926.03= 1644.07 KN * ***** </pre>
<p><b>Fig No 4.2</b> Base Shear for Conventional Structure</p>	<p><b>Fig No 4.3</b> Base Shear for Structure with Floating Column (Staad-Pro File)</p>	<p><b>Fig No 4.4</b> Base Shear for Structure with Rotating Column (Staad-Pro File)</p>

**Storey Displacement –**

If the building is not adequately designed to withstand forces, it may experience deformation, leading to storey displacement. The displacement can be in the form of lateral (horizontal) or vertical movement.

Table No 4.3. Average Displacement for X-Direction (cm)					Table No 4.4. Average Displacement for Z-Direction (cm)				
Storey No.	Storey Height (m)	Conventional Structure	Structure With Floating Column	Structure With Rotating Column	Storey No.	Storey Height (m)	Conventional Structure	Structure With Floating Column	Structure With Rotating Column
Basement	0	0	0	0	Basement	0	0	0	0
Ground F	3	0.2603	0.3007	0.2719	Ground F	3	0.1672	0.2377	0.1683
Storey 1	6	0.8134	0.942	0.847	Storey 1	6	0.5246	0.7363	0.5271
Storey 2	9	1.5086	1.7528	1.5679	Storey 2	9	0.9755	1.3461	0.9756
Storey 3	12	2.2713	2.6456	2.3771	Storey 3	12	1.4742	2.0118	1.4615
Storey 4	15	3.0645	3.5757	3.2206	Storey 4	15	1.9978	2.705	1.9684
Storey 5	18	3.8875	4.539	4.0961	Storey 5	18	2.5493	3.427	2.4993
Storey 6	21	4.7071	5.4977	4.9666	Storey 6	21	3.1038	4.1486	3.0317
Storey 7	24	5.5096	6.4356	5.8174	Storey 7	24	3.6504	4.8572	3.5542
Storey 8	27	6.2873	7.3431	6.6417	Storey 8	27	4.1826	5.545	4.0543
Storey 9	30	7.0626	8.2426	7.604	Storey 9	30	4.7137	6.225	4.4975
Storey 10	33	7.7782	9.0702	8.4899	Storey 10	33	5.2089	6.8574	4.9098
Storey 11	36	8.4239	9.8146	9.2815	Storey 11	36	5.66	7.4331	5.287
Storey 12	39	8.9969	10.4733	9.9662	Storey 12	39	6.0649	7.9508	5.6279
Storey 13	42	9.5853	11.1366	10.7113	Storey 13	42	6.5005	8.4853	5.9914
Storey 14	45	10.0172	11.6166	11.2544	Storey 14	45	6.8249	8.8812	6.2675
Storey 15	48	10.2856	11.9083	11.5684	Storey 15	48	7.0324	9.1352	6.4533

**Storey Drift –**

Storey drift, also known as inter-story drift, is a term used in structural engineering and earthquake engineering to describe the lateral displacement or movement that occurs between adjacent floors of a multi-story building or structure during a seismic event or other lateral loads.

Table No 4.5. Storey Drift for X-Direction (cm)					Table No. 4.6. Storey Drift for Z-Direction (cm)				
Storey No.	Storey Height(m)	Conventional Structure	Structure With Floating Column	Structure With Rotating Column	Storey No.	Storey Height(m)	Conventional Structure	Structure With Floating Column	Structure With Rotating Column
Basement	0	0	0	0	Basement	0	0	0	0
Ground F	3	0.2603	0.3006	0.2719	Ground F	3	0.1672	0.2377	0.1683
Storey 1	6	0.5532	0.6412	0.5751	Storey 1	6	0.3574	0.4985	0.3588
Storey 2	9	0.6952	0.8106	0.7209	Storey 2	9	0.451	0.6098	0.4485
Storey 3	12	0.7625	0.8926	0.8092	Storey 3	12	0.4987	0.6655	0.4859
Storey 4	15	0.7932	0.9299	0.8435	Storey 4	15	0.5235	0.6931	0.507
Storey 5	18	0.823	0.9632	0.8755	Storey 5	18	0.5515	0.7218	0.5308
Storey 6	21	0.8195	0.9586	0.8705	Storey 6	21	0.5545	0.7216	0.5324
Storey 7	24	0.8025	0.9377	0.8508	Storey 7	24	0.5466	0.7084	0.5226
Storey 8	27	0.7777	0.9074	0.8243	Storey 8	27	0.5323	0.6877	0.5001
Storey 9	30	0.7752	0.8994	0.9622	Storey 9	30	0.531	0.6799	0.4432
Storey 10	33	0.7156	0.8274	0.8859	Storey 10	33	0.4952	0.6323	0.4122
Storey 11	36	0.6457	0.7442	0.7916	Storey 11	36	0.4511	0.5756	0.3772
Storey 12	39	0.573	0.6586	0.6848	Storey 12	39	0.4049	0.5175	0.3409
Storey 13	42	0.5884	0.6632	0.7469	Storey 13	42	0.4357	0.5344	0.3635
Storey 14	45	0.4319	0.4799	0.5413	Storey 14	45	0.3244	0.3958	0.2762
Storey 15	48	0.2684	0.2916	0.314	Storey 15	48	0.2075	0.254	0.1858

Node Displacement–

TableNo 4.7. Maximum Node Displacement(mm)

Dir.	Node No.	Load Combination	Conventional Building	Building with Floating Column	Building with Rotating Column
Max X-Dir.	1374	1.2(DL+LL+E QX)	104.266	120.92	116.99
Max Y-Dir	1374	1.2(DL+LL+E QX)	-30.318	-31.685	-31.385
Max Z-Dir	1383	1.2(DL+LL+E QZ)	71.888	91.791	65.494

6) Shear force and bending moment –

TableNo 4.8. Maximum positive and negative Shear Force for Beam

Shear Force (KN)	Conventional Building	Building with Floating Column	Building with Rotating Column
SF Z-Direction Positive (KN)	87.295 KN	205.489 KN	85.686 KN
SF Z-Direction Negative (KN)	-77.279 KN	-151.433 KN	-83.101 KN

TableNo 4.9. Maximum positive and negative Shear Force for Column

Shear Force (KN)	Conventional Building	Building with Floating Column	Building with Rotating Column
SF Y-Direction Positive(KN)	124.451 KN	481.605 KN	124.499 KN
SF Y-Direction Negative(KN)	-127.35 KN	-465.65 KN	-125.284 KN

TableNo 4.10. Maximum Bending Moment in Y-Direction

Bending Moment	Conventional Building	Building with Floating Column	Building with Rotating Column
BM Y-Direction Positive (KN.m)	370.047 KN.m	576.672 KN.m	363.744 KN.m
BM Y-Direction Negative(KN.m)	-111.097 KN.m	-325.734 KN.m	-125.586 KN.m

TableNo 4.11. Maximum Bending Moment in Z-Direction

Bending Moment	Conventional Building	Building with Floating Column	Building with Rotating Column
BM Z-Direction Positive(KN.m)	174.976 KN.m	415.46 KN.m	159.671 KN.m
BM Z-Direction Negative (KN.m)	-480.866 KN.m	-578.99 KN.m	-359.094 KN.m

V. CONCLUSION

Conventional building, building with floating column and building with rotating column are compared and conclusion is obtained.

1) Support reaction values for the building with floating column are 9.82% higher than the conventional building support reaction values. In building with a rotating column, it can be observed that the support reactions closely approximate those of a conventional building.

2) Base shear for the building with floating column is 6.83% higher in X-Direction as compared to the base shear of the conventional structure, also base shear for the building with rotating column is 1.52% higher as compared to the conventional building.

In Z-Direction base shear value for the building with floating column is 7.02% higher as compared with the conventional building and base shear value for building with rotating column is 1.70% higher than values from conventional building.

3) In X-Direction average storey displacement for the building with floating column and building with rotating column is 15.77% and 12.47% higher respectively than the average storey drift of the conventional building.

Average storey drift in Z-direction for the building with floating column is 29.33% higher and values for building with rotating column is 8.23% less as compare to the conventional building.

4) Maximum storey drift are occur at storey number 5 in X direction and storey number 6 in Z direction in all building i.e. conventional building, building with floating column and building with rotating column.

5) Node displacement values for the building with floating column is 15.97% higher in X direction as compare to the conventional building and for building with rotating column 12.20% higher than conventional. In Z direction node displacement values for building with floating column is 27% higher than the node displacement of conventional building. For building with rotating column node displacement is 8.93% less as compare to the conventional building.

6) The building with floating column is not safe in the seismic zone III as compare to the building with rotating column and conventional building. Different structural parameters values is higher in the building with floating column as compare to the conventional and building with rotating column.

For the safe design of the building with floating column and rotating column the dimension of beams and columns is increased. The dimension of the beam on which the floating column is rest is increased and also the size and reinforcement of supported column of the beams are increased.

For building with rotating column the sizes and reinforcement of the column on which the upper column is rotated is increased and design of the column is done carefully.

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