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Comparative Analysis Of A Multi-Storey Tall Structure When It Is Braced With Shear Wall And Soft Storey At Different Levels By Performing Response Spectrum Analysis And Time History Analysis

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ABSTRACT

To understand the behaviour of a multi-storey reinforced concrete building when it is braced with shear wall with different location and soft storey at different levels. The routine of soft storey in seismic zones is incredibly crucial since soft storey structures is less rigid normally the soft storey is present at the bottom level moreover if the things is not engaged into concern it can cause the construction of building to be generally get affected by quake. By performing time history analysis as well as response spectrum analysis we will get to know the maximum response of an fundamentally elastic structures and also by measuring acceleration velocity or displacement as a function of structural period for a given time history and level of damping. The main idea of this project is to find out the good structural frame with soft storey and shear wall by comparing the results of time history as well as RSA to resist under diverse earthquake zone.

Keywords: Multi-storey, Shear wall, Response spectrum, Time history, Storey drift, Storey displacement.

I. INTRODUCTION

1.1 GENERAL

We are currently thriving in a contemporary era characterized by physical advancements, where the progress of the construction industry has been influenced by various factors. Over time, diverse architectural methods have been employed to create massive and expansive edifices. These structures, designed to withstand the forces of gravity and dynamic loads, must be engineered in a manner that prevents fragility, ensuring they do not succumb to the effects of mild seismic activity. Earthquakes stand as a primary driver of devastation to both human lives and property.

Earthquakes result from the sudden shaking of the ground, releasing a substantial amount of stored energy that propagates through different types of waves. These waves, in turn, have a profound impact on the structural integrity of buildings. The effects of an earthquake are influenced by factors like the distribution of the load's path, the earthquake's origin, and the specific conditions of the site.

In the context of reinforced concrete (RC) structures, the influence of gravity-related loads—such as the weight of the construction's elements and infill brick walls—typically has limited repercussions on the structure's stability. However, it's the lateral loads, like those generated by earthquakes and wind,that pose a more significant threat. These lateral loads can impose substantial lateral forces on the structure, often leading to its failure.

The presence of infill masonry walls in a reinforced concrete (RC) framed structure contributes to increased stiffness compared to an RC framed structure lacking such infill walls. This enhancement of stiffness occurs particularly during the elastic phase. It holds notable importance for structures to possess lateral stiffness, which can be effectively achieved through the incorporation of infill walls.On the other hand, buildings with soft stories exhibit lower stiffness when contrasted with those lacking such design features.

II. LITERATURE REVIEW

Mr. Zubair Ahmed Mr. Zubair Ahmed performed a comprehensive analysis focusing regarding seismic behavior of a RC structural framework featuring a soft story. In his investigation, he analyzed a 15-story RC framed building situated in seismic zone IV. The soft story was located at the bottom level, devoid of infill walls.

To address the soft story's vulnerabilities, he introduced steel bracing to the ground floor. This intervention led to gradual modifications in various structural aspects, including base shear, time period, storey drift, and displacement.Results from the study indicated that the deflections in the bare frames were notably higher compared to the other scenarios tested. The incorporation of steel bracing significantly enhanced the structure's stiffness. Notably, the type of X-shaped bracing system employed demonstrated reduced tensional effects.
In summary, Mr. Ahmed's study underscored the positive impact of employing steel bracing to mitigate the issues associated with soft stories in RC framed structures subjected to seismic forces.

P,P Chandrukar P. P. Chandrukar carried out an extensive case study that explored the behavior of a multi-story RC framed structure both with and without the inclusion of shear walls.. The scope of his research was centered on a 9-story RC framed building situated within seismic zone IV. Chandrukar's research model involved a 10-story building. He strategically incorporated shear walls in shorter spans, a decision driven by economic considerations.The study's findings indicated that larger shear wall dimensions did not necessarily yield more effective results. Across the various models examined, it became evident that the positioning of shear walls played a pivotal role in the distribution of forces. As a result, the appropriate placement of shear walls was crucial for their effectiveness. Moreover, the study highlighted that by positioning shear walls at suitable locations and with adequate thickness, significant reductions in displacements could be achieved.
This case study by P. P. Chandrukar emphasized the importance of well-placed and appropriately dimensioned shear walls in enhancing the seismic response of RC framed structures.

Anil Baral Anil Baral conducted a thorough research investigation delving into the seismic response of RC framed structure with varying shear wall positions. The study was centered around a 9-story RC framed building located in seismic zone IV.Within his research model, Baral examined a 10-story building. He strategically introduced shear walls in diverse positions, including configurations different shear wall configurations were explored, including both L-shaped and I-shaped arrangements. Additionally, a core wall was introduced at the center of the structure to house the elevator core. The study's outcomes revealed that positioning shear walls at the building's corner edges led to a reduction in the fundamental time period. In contrast, buildings without shear walls exhibited longer time periods. Incorporating shear walls contributed to consistent reductions in both storey drift and displacement, signifying their efficacy in enhancing the structural response to seismic forces.
Anil Baral's case study underscored the importance of shear wall placement and their significant impact on the seismic behavior of RC framed structures.

Hiten L. Kheni Hiten L. Kheni carried out an in-depth analysis investigating the reaction to seismic activity of RC framed structures featuring soft stories. The study encompassed various buildings with distinct placements of soft stories. The findings of the study indicated that lower stories exhibited smaller lateral displacement patterns compared to the upper stories. This implies that the structural response in terms of lateral movement was less pronounced in the lower levels of the buildings under investigation.
Hiten L. Kheni's research sheds light on the behavior of soft stories in RC framed structures, showcasing how the distribution of lateral displacements can vary between lower and upper stories.

III. OBJECTIVES AND SCOPE

3.1 OBJECTIVES

A. To conduct an investigation on a 15-story building with a ground floor (G+15) and determine the design approach for a reinforced concrete (RC) framed multistory structure.
B. Exploring different shear wall (SW) locations and assessing their structural behavior.
C. Studying the structural response by incorporating both shear walls (SW) and core walls (CW) to understand the influence of loads on the building.
D. Conducting an evaluation by eliminating infill walls and creating a weakened story in various levels to observe and characterize its behavior.
E. Evaluating immediate outcomes through the implementation of ESM, RSA, and THA techniques.

F. Determining essential structural parameters of the building's time period, base shear, story drift, and displacement.

3.2 SCOPE OF THE STUDY

The primary objective of this study is to characterize the response of a RC framed multistory building when subjected to dynamic loads. Additionally, the study aims to assess the building's seismic performance and its ability to withstand such loads.

IV. METHODOLOGY

4.1 METHODS

4.1.1 Equivalent Static Method

4.1.2 Response Spectrum Analysis

4.1.3 Time history analysis

4.1.1 EQUIVALENT STATIC METHOD

This approach is sanctioned in prominent seismic analysis codes and is widely applied for ordinary structures that satisfy the consistency condition. Referred to as the "lateral force method," this technique assumes earthquake effects to be equivalent to those resulting from statically applied lateral loads. It entails less computational effort and relies on formulas prescribed in the IS 1893:2002 code of practice. Additionally, the appropriate amount of forced load is combined with it on this floor.

The method of replacing the dynamic load of an earthquake with a static force distributed laterally across a structure for analysis is known as the equivalent static method.

4.1.2 RESPONSE SPECTRUM ANALYSIS

This approach constitutes a vibrational analysis approach primarily executed on a structure, offering an estimation of the inherent vibration's contribution, consequently yielding the seismic response of a flexible structure. The peak response is graphed against the structure's natural period. This process entails determining the maximum displacements across each vibration mode through the utilization of a design spectrum.

4.1.3 TIME HISTORY ANALYSIS

Furthermore, this technique represents a dynamic analysis approach, which finds practical application in modern times due to its effective investigation capabilities under dynamic loading conditions. Time History Analysis (THA) carries out analysis until the material reaches its limits, simplifying efficient design. THA stands out as a method where step-by-step analysis is conducted under various loading conditions that can evolve over time. In cases where a structure exhibits limited seismic efficiency, it becomes susceptible to inelastic behavior during an earthquake. Consequently, vulnerable parts of the structure start revealing themselves during strong vibrations. Weaknesses and post-elastic properties induced by an earthquake can be reliably assessed through the application of THA.

V. MODELS

5.1 Models

A) Model 1 The base model consists of a 15-story structure with ground floor (G+15). In this model, infill brickwork has been included, and the analysis has been carried out using the Etabs software.

B) Model 2: Similar to the base model, this G+15 structure includes infill brickwork. However, this model also features shear walls positioned at the corners. The analysis has been conducted using Etabs.

C) Model 3: Following the standard G+15 structure with infill brickwork, this model incorporates shear walls in the X-direction. The analysis has been performed using Etabs.

D) Model 4: This G+15 model involves infilled masonry alongside shear walls in the Y-direction. The analysis has been executed using Etabs.

E) Model 5: The standard G+15 model has been enriched by incorporating infilled masonry and shear walls at corner edges, along with a core wall at the center. The analysis was conducted using Etabs.

F) Model 6: Within this G+15 structure, infilled masonry is introduced above Story 3, while Stories 1, 2, and 3 below are designated as soft stories. The analysis was performed using Etabs.

G) Model 7: In this G+15 model, infilled masonry is integrated, and Stories 3, 4, and 5 are designated as soft stories. The analysis has been carried out using Etabs.

H) Model 8: The standard G+15 model incorporates infilled masonry frames, varying levels of soft stories, and the utilization of shear walls and core walls. The analysis was conducted using Etabs.

VI. RESULTS

6.1 TIME HISTORY

This represents solely the undamped natural oscillation of the structure. The tabulated data below presents the time period values obtained through the Etabs analysis. The table illustrates that time periods gradually vary with different analysis methods due to the structural dissimilarity, leading to variations in time periods. Notably, Model 8 exhibits the highest time period due to its incorporation of a soft story in contrast to the other models.

TABLE 6.1 TIME HISTORY

MODEL NO	ESM	THA	RSA
1	2.67	2.78	2.892
2	1.724	1.724	1.724
3	2.429	2.429	2.429
4	1.322	1.322	1.322
5	1.252	1.245	1.245
6	2.643	2.743	2.743
7	2.42	2.42	2.334
8	1.269	1.269	1.269

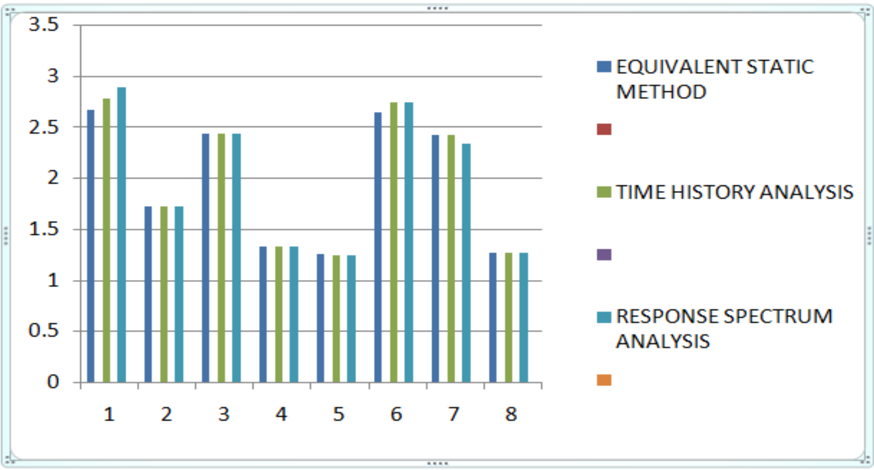

CHART 6.1

6.2 Calculate the seismic base shear for design.

The base shear serves as the identification of the expected maximum lateral forces that can arise due to ground shaking at the structure's base. The table below provides the seismic base shear values for various models, obtained through three different analysis methods: EQS, THA, and RSA.

The magnitude of the base shear is also influenced by the site's condition on which the structure is situated, as well as the characteristics of the underlying soil strata responsible for transmitting and supporting loads. The base shear values vary according to the model conditions, and these values are depicted in the plot below.

TABLE 6.2

BASE SHEAR(KN)						
MODEL NO	**ESM**		**THA**		**RSA**	
	UX	UY	UX	UY	UX	UY
1	4032.75	6354.08	4032.62	6533.976	4029.6749	6533.5875
2	6529.88	9449.25	6529.66	9449.49	6529.4741	9015.16
3	7234.77	6515.106	6080.95	6190.37	7235.789	6515.1029
4	4271.6	10036	4271.53	10035.84	4272.6009	10036.00016
5	8376.1	11773	27169.7854	13584.89	8376.0994	11773.0001
6	3501.02	5995.67	1943.48	5495.58	3501.0692	5537.6647
7	3444.63	5440.94	3443.28	5440.938	31206.8339	44921.28
8	6656.841	7113.714	3328.25	3556.769	6656.849	7113.724

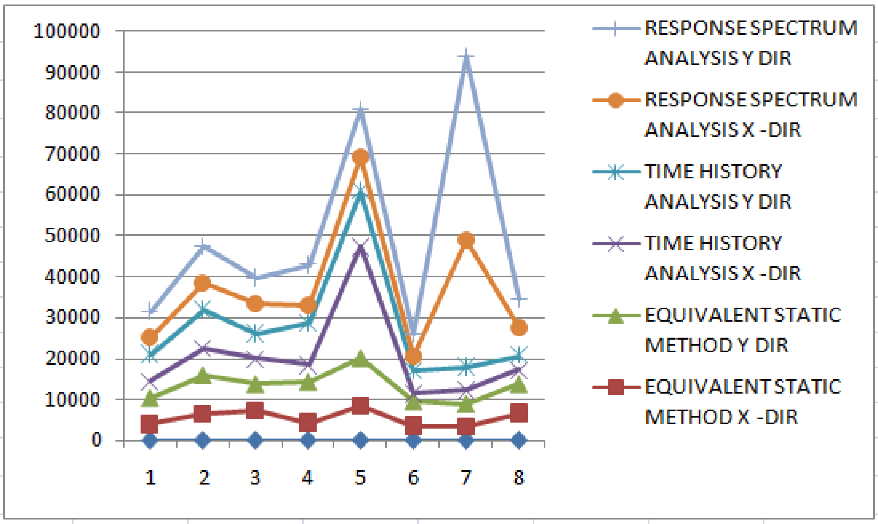

CHART 6.2

6.3 STOREY DRIFT :

Story drift refers to the difference in elevation either above or below a reference displacement point. It is commonly understood as the displacement between two consecutive stories. The drift values between stories are plotted and documented below, derived through various analysis techniques using Etabs.

The observed drift values exhibit variations as the structural model is altered through the addition or placement of shear walls (SW) and core walls (CW).

TABLE 6.3.1 STOREY DRIFT (MM)						
MODEL 1	**ESM**		**THM**		**RSM**	
STOREY	UX	UY	UX	UY	UX	UY
16	0.0003	0.0003	0.0003	0.0006	0.0003	0.0003
15	0.0005	0.0004	0.0005	0.0008	0.0005	0.0004
14	0.0006	0.0005	0.0006	0.0010	0.0006	0.0005
13	0.0008	0.0006	0.0008	0.0011	0.0007	0.0006
12	0.0009	0.0007	0.0009	0.0013	0.0008	0.0006
11	0.0010	0.0008	0.0010	0.0014	0.0009	0.0007
10	0.0011	0.0008	0.0011	0.0015	0.0010	0.0007
9	0.0011	0.0008	0.0011	0.0015	0.0010	0.0007
8	0.0012	0.0009	0.0012	0.0016	0.0011	0.0008
7	0.0012	0.0009	0.0012	0.0016	0.0011	0.0008
6	0.0012	0.0009	0.0012	0.0016	0.0012	0.0008
5	0.0012	0.0009	0.0012	0.0016	0.0012	0.0008
4	0.0012	0.0009	0.0012	0.0016	0.0013	0.0008
3	0.0012	0.0008	0.0012	0.0015	0.0013	0.0008
2	0.0013	0.0006	0.0013	0.0015	0.0015	0.0006
1	0.0008	0.0003	0.0008	0.0006	0.0008	0.0003
BASE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

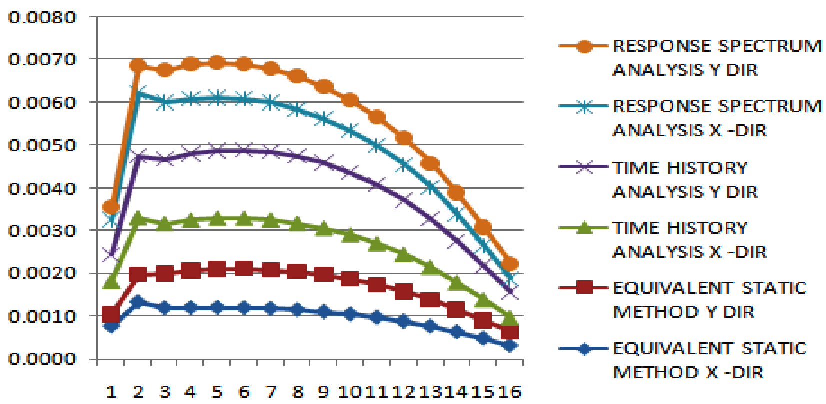

CHART 6.3.1

TABLE 6.3.2 STOREY DRIFT (MM)						
MODEL 2	**ESM**		**THM**		**RSM**	
STOREY	UX	UY	UX	UY	UX	UY
16	0.0006	0.0005	0.0002	0.0002	0.0004	0.0003
15	0.0007	0.0005	0.0002	0.0003	0.0004	0.0003
14	0.0007	0.0005	0.0002	0.0014	0.0004	0.0003
13	0.0007	0.0005	0.0002	0.0003	0.0005	0.0003
12	0.0007	0.0005	0.0002	0.0014	0.0005	0.0003
11	0.0007	0.0005	0.0002	0.0014	0.0005	0.0003
10	0.0007	0.0005	0.0002	0.0014	0.0005	0.0003
9	0.0007	0.0005	0.0002	0.0014	0.0005	0.0003
8	0.0007	0.0005	0.0002	0.0014	0.0004	0.0003
7	0.0006	0.0004	0.0002	0.0013	0.0004	0.0003
6	0.0006	0.0004	0.0002	0.0013	0.0004	0.0003
5	0.0005	0.0004	0.0002	0.0012	0.0004	0.0003
4	0.0005	0.0003	0.0001	0.0001	0.0003	0.0002

3	0.0004	0.0002	0.0001	0.0009	0.0003	0.0002
2	0.0003	0.0002	0.0001	0.0007	0.0002	0.0001
1	0.0002	0.0001	0.0001	0.0005	0.0001	0.0002
BASE	0.000	0.000	0.000	0.000	0.000	0.000

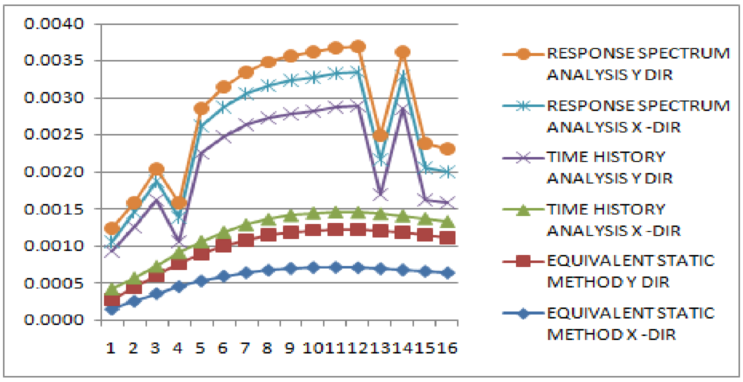

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TABLE 6.3.3 STOREY DRIFT (MM)						
MODEL 3	**ESM**		**THM**		**RSM**	
STOREY	UX	UY	UX	UX	UY	UX
16	0.00077	0.00033	0.00088	0.00033	0.00079	0.00032
15	0.00080	0.00040	0.00092	0.00040	0.00082	0.00039
14	0.00084	0.00049	0.00096	0.00049	0.00085	0.00047
13	0.00087	0.00057	0.00100	0.00058	0.00088	0.00054
12	0.00091	0.00064	0.00104	0.00069	0.00091	0.00059
11	0.00093	0.00070	0.00110	0.00079	0.00092	0.00064
10	0.00095	0.00075	0.00116	0.00088	0.00093	0.00068
9	0.00095	0.00079	0.00120	0.00097	0.00093	0.00071
8	0.00093	0.00081	0.00123	0.00106	0.00092	0.00073
7	0.00090	0.00083	0.00122	0.00115	0.00090	0.00076
6	0.00084	0.00083	0.00118	0.00124	0.00086	0.00077
5	0.00076	0.00082	0.00111	0.00129	0.00079	0.00078
4	0.00066	0.00078	0.00101	0.00133	0.00070	0.00078
3	0.00052	0.00072	0.00083	0.00129	0.00057	0.00073
2	0.00036	0.00058	0.00061	0.00109	0.00041	0.00060
1	0.00018	0.00026	0.00032	0.00050	0.00021	0.00027
BASE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

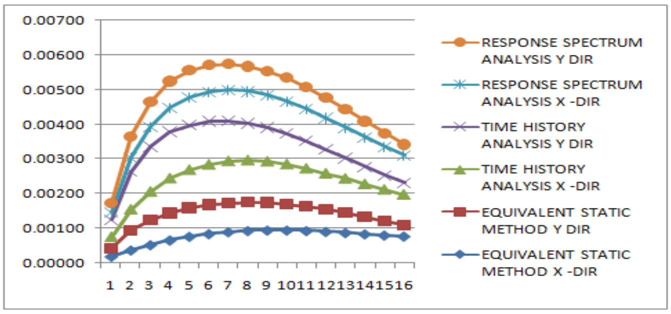

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TABLE 6.3.4 STOREY DRIFT (MM)						
MODEL 4	**ESM**		**THM**		**RSM**	
STOREY	UX	UY	UX	UY	UX	UY
16	0.00030	0.00059	0.00128	0.00029	0.00025	0.00057
15	0.00044	0.00061	0.00180	0.00215	0.00038	0.00059
14	0.00058	0.00063	0.00095	0.00220	0.00049	0.00060
13	0.00070	0.00064	0.00095	0.00237	0.00058	0.00061
12	0.00080	0.00065	0.00097	0.00241	0.00065	0.00062
11	0.00088	0.00065	0.00104	0.00097	0.00071	0.00062
10	0.00094	0.00065	0.00103	0.00099	0.00076	0.00061
9	0.00100	0.00063	0.00101	0.00252	0.00081	0.00060
8	0.00103	0.00061	0.00100	0.00255	0.00085	0.00057
7	0.00106	0.00058	0.00098	0.00254	0.00089	0.00054
6	0.00107	0.00053	0.00096	0.00249	0.00092	0.00050
5	0.00108	0.00047	0.00091	0.00237	0.00096	0.00045
4	0.00107	0.00040	0.00084	0.00218	0.00099	0.00038
3	0.00108	0.00031	0.00076	0.00190	0.00103	0.00030
2	0.00121	0.00023	0.00064	0.00154	0.00119	0.00022
1	0.00070	0.00014	0.00029	0.00071	0.00069	0.00013
BASE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

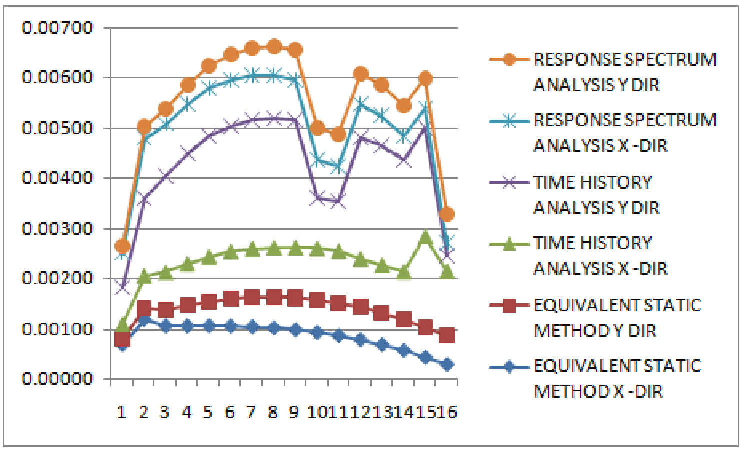

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TABLE 6.3.5 STOREY DRIFT (MM)						
MODEL 5	**ESM**		**THM**		**RSM**	
STOREY	UX	UY	UX	UX	UY	UX
16	0.00061	0.00046	0.00179	0.00058	0.00049	0.00040
15	0.00063	0.00048	0.00185	0.00060	0.00051	0.00042
14	0.00065	0.00049	0.00190	0.00061	0.00052	0.00043
13	0.00067	0.00050	0.00194	0.00062	0.00053	0.00043
12	0.00068	0.00050	0.00196	0.00063	0.00054	0.00044
11	0.00068	0.00050	0.00196	0.00063	0.00055	0.00044
10	0.00068	0.00049	0.00203	0.00064	0.00054	0.00043
9	0.00067	0.00048	0.00208	0.00063	0.00054	0.00042
8	0.00065	0.00046	0.00209	0.00062	0.00052	0.00040
7	0.00062	0.00043	0.00205	0.00060	0.00050	0.00038
6	0.00057	0.00040	0.00196	0.00057	0.00047	0.00035
5	0.00051	0.00035	0.00180	0.00053	0.00043	0.00032
4	0.00044	0.00030	0.00157	0.00047	0.00037	0.00027

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3	0.00035	0.00024	0.00128	0.00039	0.00030	0.00022
2	0.00024	0.00018	0.00095	0.00029	0.00021	0.00017
1	0.00014	0.00012	0.00058	0.00021	0.00013	0.00012
BASE	0.000	0.000	0.000	0.000	0.000	0.000

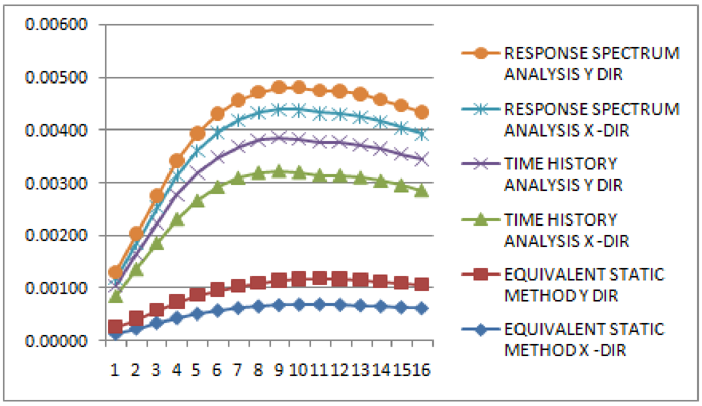

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TABLE 6.3.6 STOREY DRIFT (MM)						
MODEL 6	**ESM**		**THM**		**RSM**	
STOREY	UX	UY	UX	UX	UY	UX
16	0.00028	0.00030	0.00083	0.00024	0.00029	0.00031
15	0.00043	0.00037	0.00029	0.00092	0.00044	0.00038
14	0.00057	0.00045	0.00161	0.00040	0.00056	0.00045
13	0.00068	0.00053	0.00106	0.00229	0.00067	0.00052
12	0.00078	0.00060	0.00195	0.00045	0.00076	0.00058
11	0.00086	0.00066	0.00230	0.00057	0.00084	0.00063
10	0.00093	0.00071	0.00256	0.00324	0.00091	0.00067
9	0.00098	0.00075	0.00292	0.00072	0.00097	0.00070
8	0.00102	0.00077	0.00199	0.00078	0.00102	0.00073
7	0.00104	0.00079	0.00226	0.00411	0.00108	0.00076
6	0.00106	0.00079	0.00394	0.00086	0.00112	0.00078
5	0.00106	0.00078	0.00228	0.00571	0.00114	0.00078
4	0.00105	0.00075	0.00393	0.00089	0.00116	0.00076
3	0.00104	0.00068	0.00239	0.00088	0.00117	0.00070
2	0.00116	0.00055	0.00399	0.00084	0.00128	0.00057
1	0.00067	0.00023	0.00208	0.00326	0.00073	0.00025
BASE	0.000	0.000	0.000	0.000	0.000	0.000

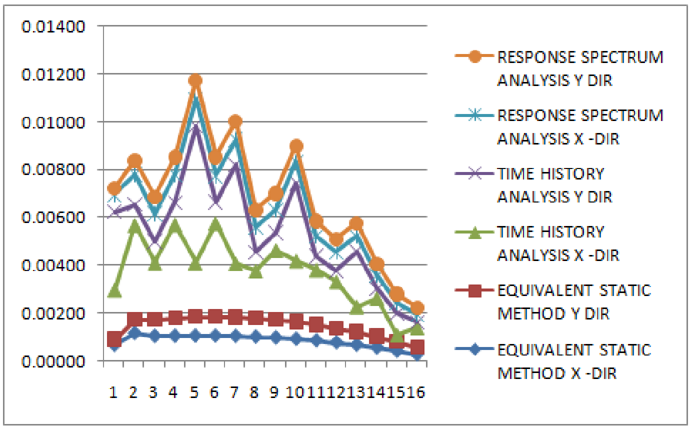

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TABLE 6.3.7 STOREY DRIFT (MM)						
MODEL 7	**ESM**		**THM**		**RSM**	
STOREY	UX	UY	UX	UX	UY	UX
16	0.000297	0.000288	0.001335	0.001227	0.00029	0.000286
15	0.000405	0.000347	0.001887	0.001561	0.000393	0.000337
14	0.000497	0.000411	0.000567	0.001704	0.000477	0.000392
13	0.000582	0.000477	0.002806	0.002195	0.000552	0.000447
12	0.000692	0.000547	0.003463	0.002583	0.00065	0.000505
11	0.000789	0.000613	0.004182	0.004182	0.000744	0.000562
10	0.000869	0.000668	0.004182	0.003622	0.000827	0.000613
9	0.000932	0.000713	0.005373	0.004094	0.000901	0.000659
8	0.000979	0.000745	0.006021	0.004479	0.000968	0.000698
7	0.001011	0.000765	0.006556	0.006556	0.001028	0.000731
6	0.001031	0.000772	0.006947	0.005549	0.001082	0.000755
5	0.001033	0.000764	0.005549	0.005549	0.001111	0.000762
4	0.001028	0.000734	0.007395	0.005549	0.001128	0.000746
3	0.001023	0.00067	0.007504	0.005235	0.00114	0.000693
2	0.001145	0.00054	0.008387	0.004312	0.001252	0.000565
1	0.000662	0.000232	0.004814	0.004814	0.000715	0.000246
BASE	0.000	0.000	0.000	0.000	0.000	0.000

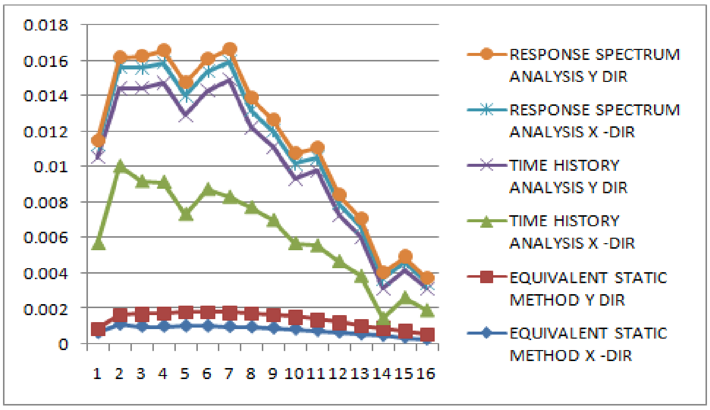

CHART 6.3.7

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TABLE 6.3.8 STOREY DRIFT (MM)						
MODEL 8	**ESM**		**THM**		**RSM**	
STOREY	UX	UY	UX	UX	UY	UX
16	0.00039	0.000603	0.000782	0.000782	0.000513	0.000338
15	0.00042	0.000617	0.000817	0.000817	0.000526	0.000363
14	0.000449	0.000631	0.000832	0.000843	0.000537	0.000387
13	0.000479	0.000644	0.000843	0.000922	0.000548	0.000412
12	0.000511	0.000657	0.000851	0.000976	0.000558	0.00044
11	0.000538	0.000664	0.000847	0.000847	0.000564	0.000465
10	0.00056	0.000664	0.000895	0.001207	0.000565	0.000486
9	0.000572	0.000655	0.000799	0.001267	0.000559	0.000501
8	0.000575	0.000635	0.000753	0.001278	0.000546	0.000509
7	0.000566	0.000604	0.000868	0.001238	0.000524	0.000508
6	0.000543	0.00056	0.000789	0.00115	0.000491	0.000495
5	0.000504	0.000501	0.000527	0.00107	0.000445	0.000467
4	0.000447	0.000427	0.000419	0.000419	0.000384	0.00042
3	0.000369	0.000337	0.000301	0.000722	0.000307	0.000352
2	0.000268	0.000241	0.000722	0.000285	0.000224	0.000261
1	0.000133	0.000137	0.000733	0.00029	0.000131	0.000134
BASE	0.000	0.000	0.000	0.000	0.000	0.000

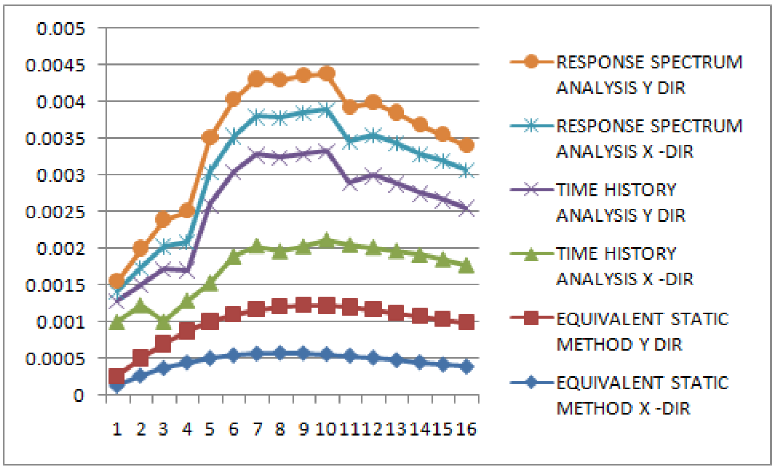

CHART 6.3.8

6.4 DISPLACEMENT BETWEEN STORIES :

Displacement between stories refers to the pertains to the lateral shifting of a story concerning the base.. It represents the absolute displacement of a story concerning the ground. The distinct displacement values for different models have been graphed and recorded below. These story displacements are determined by conducting analyses using ETABS through various methods.

It's evident that under the EQA method, displacement is comparatively higher than the other two methods for different models. This difference is attributed to the models incorporating various elements such as shear walls (SW), core walls (CW), and soft stories (SS).

TABLE 6.4.1 STOREY DISPLACEMENT (MM)						
MODLE1	**ESM**		**THM**		**RSM**	
STOREY	UX	UY	UX	UY	UX	UY
16	51.503	36.872	67.049	95.557	47.554	10.996
15	50.419	35.745	65.671	93.243	46.668	10.742
14	48.773	34.331	60.916	90.272	45.383	10.412
13	46.614	32.600	63.875	86.540	43.711	9.996
12	44.010	30.567	61.557	82.048	41.684	9.495
11	41.030	28.269	58.690	76.839	39.333	8.916
10	37.738	25.745	55.276	70.973	36.684	8.264
9	34.195	23.040	51.332	64.517	33.759	7.547
8	30.457	20.195	46.887	57.818	30.578	6.767
7	26.575	17.252	41.983	50.643	27.159	5.931
6	22.594	14.252	36.669	43.038	23.516	5.042
5	18.555	11.235	31.006	35.088	19.662	4.105
4	14.497	8.255	25.070	26.894	15.610	3.128
3	10.451	5.387	90.467	18.606	11.381	2.129
2	6.417	2.767	56.982	10.467	6.991	1.148
1	1.939	0.676	14.904	9.904	2.083	0.291
BASE	0.000	0.000	0.000	0.000	0.000	0.000

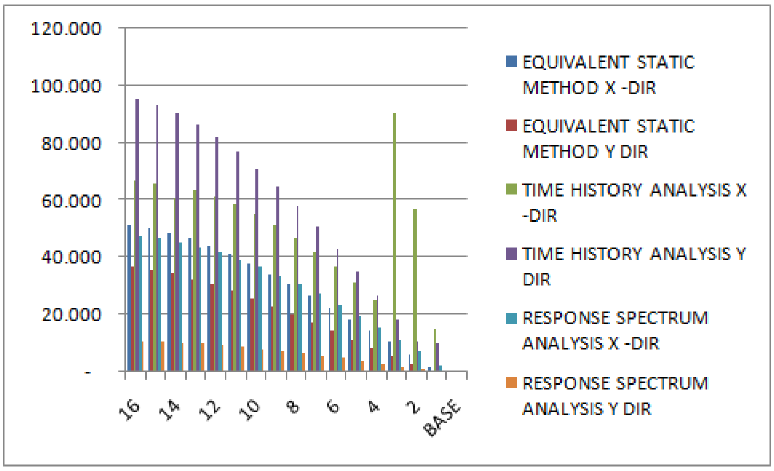

CHART 6.4.1

TABLE 6.4.2 STOREY DISPLACEMENT (MM)						
MODEL 2	**ESM**		**THM**		**RHM**	
STOREY	UX	UY	UX	UY	UX	UY
16	40.647	3.032	51.59	43.589	40.167	9.589
15	38.05	2.839	48.631	42.679	37.634	9.048
14	35.35	2.638	45.56	41.538	35.024	8.48
13	32.534	2.428	42.36	40.094	32.325	7.882
12	29.595	2.209	39.041	38.309	29.53	7.252
11	26.546	1.981	35.561	36.179	26.646	6.592
10	23.413	1.747	31.92	33.725	23.683	5.906
9	20.23	1.509	28.169	30.976	20.663	5.199
8	17.045	1.271	24.302	27.956	17.61	4.478
7	13.91	1.037	20.35	24.673	14.563	3.751
6	10.889	0.812	16.368	21.114	11.57	3.029

5	8.052	0.6	12.447	17.271	8.695	2.324
4	5.482	0.408	8.716	13.164	6.024	1.653
3	3.27	0.243	5.35	8.896	3.662	1.039
2	1.525	0.113	2.575	4.723	1.747	0.515
1	0.454	0.033	1.975	1.478	0.921	0.132
BASE	0.000	0.000	0.000	0.000	0.000	0.000

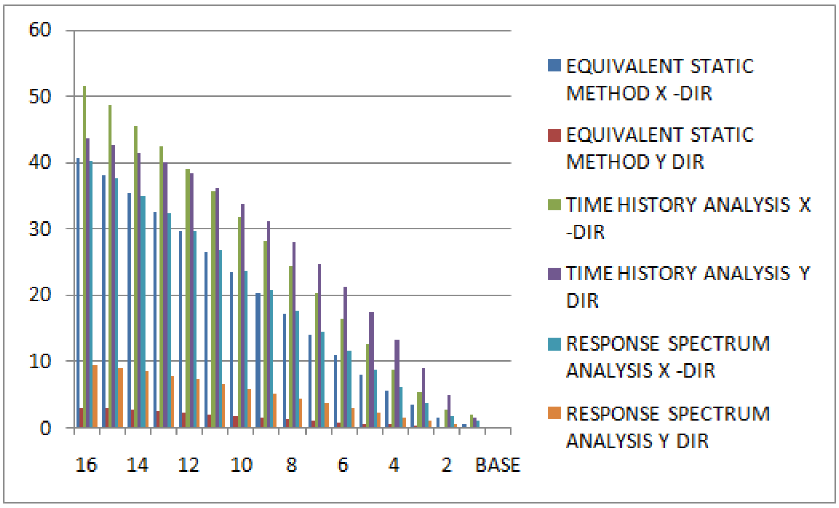

CHART 6.4.2

TABLE 6.4.3 STOREY DISPLACEMENT (MM)						
MODEL 3	**ESM**		**THM**		**RHM**	
STOREY	UX	UY	UX	UY	UX	UY
16	30.861	21.745	58.904	55.022	19.75	14.826
15	28.692	20.143	55.357	50.724	18.384	13.751
14	26.455	18.487	51.845	46.269	16.979	12.642
13	24.153	16.796	48.184	41.721	15.54	11.511
12	21.793	15.08	44.313	37.121	14.07	10.364
11	19.393	13.353	40.198	33.19	12.576	9.209
10	16.974	11.631	35.839	29.364	11.069	8.055
9	14.564	9.934	31.271	25.506	9.564	6.914
8	12.195	8.285	26.567	21.655	8.076	5.799
7	9.904	6.706	21.834	17.86	6.623	4.725
6	7.73	5.222	17.206	14.186	5.229	3.709
5	5.716	3.86	13.153	10.706	3.918	2.767
4	3.91	2.648	9.39	7.51	2.721	1.919
3	2.364	1.615	5.946	4.696	1.675	1.186
2	1.138	0.793	3.026	2.377	0.827	0.594
1	0.394	0.321	1.037	1.057	0.551	0.241
BASE	0.000	0.000	0.000	0.000	0.000	0.000

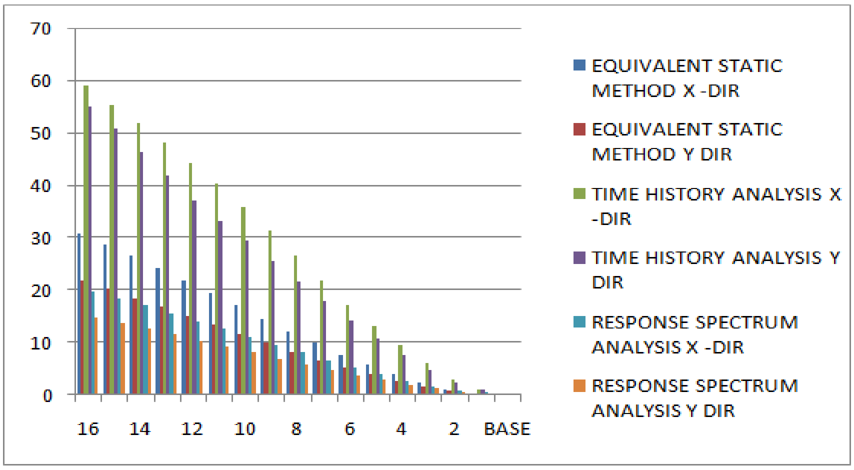

CHART 6.4.3

TABLE 6.4.4 STOREY DISPLACEMENT (MM)						
MODEL 4	**ESM**		**THM**		**RHM**	
STOREY	UX	UY	UX	UY	UX	UY
16	46.105	27.618	45.158	87.329	37.132	26
15	45.11	25.628	42.136	80.39	36.435	24.098
14	43.625	23.57	39.057	73.502	35.432	22.148
13	41.681	21.464	35.921	66.447	34.126	20.163
12	39.341	19.315	29.45	59.258	32.548	18.149
11	36.667	17.138	26.135	51.985	30.72	16.117
10	33.717	14.954	22.795	44.703	28.663	14.084
9	30.544	12.786	19.461	37.503	26.395	12.069
8	27.2	10.663	16.171	30.498	23.93	10.095
7	23.729	8.619	12.974	23.815	21.283	8.189
6	20.174	6.689	9.926	17.6	18.466	6.383
5	16.571	4.913	7.097	12.014	15.491	4.711
4	12.955	3.332	7.097	7.234	12.366	3.214
3	9.35	1.992	4.566	3.454	9.101	1.935
2	5.736	0.943	2.417	2..675	5.67	0.925
1	1.74	0.338	1.375	1.395	1.758	0.336
BASE	0.000	0.000	0.000	0.000	0.000	0.000

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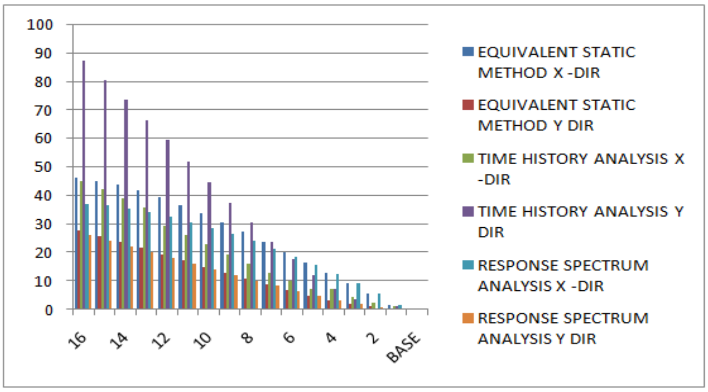

CHART 6.4.4

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TABLE 6.4.5 STOREY DISPLACEMENT (MM)						
MODEL5	**ESM**		**THM**		**RSM**	
STOREY	UX	UY	UX	UY	UX	UY
16	29.267	21.1	5.999	1.942	24.5	19.337
15	27.208	19.548	6.186	1.999	22.797	17.935
14	25.088	17.946	6.346	2.041	21.05	16.492
13	22.905	16.309	6.5	2.078	19.259	15.02
12	20.668	14.647	6.601	2.107	17.428	13.526
11	18.39	12.972	6.629	2.124	15.567	12.019
10	16.093	11.302	6.567	2.127	13.689	10.513
9	13.803	9.655	6.404	2.112	11.813	9.024
8	11.55	8.052	6.985	2.075	9.959	7.568
7	9.37	6.517	5.751	2.01	8.15	6.165
6	7.301	5.074	5.255	1.909	6.415	4.836
5	5.384	3.749	6.028	1.763	4.786	3.605
4	3.666	2.569	5.273	1.561	3.304	2.496
3	2.198	1.564	4.271	1.295	2.014	1.54
2	1.039	0.765	3.165	0.986	0.974	0.767
1	0.357	0.309	1.035	0.533	0.639	0.313
BASE	0.000	0.000	0.000	0.000	0.000	0.000

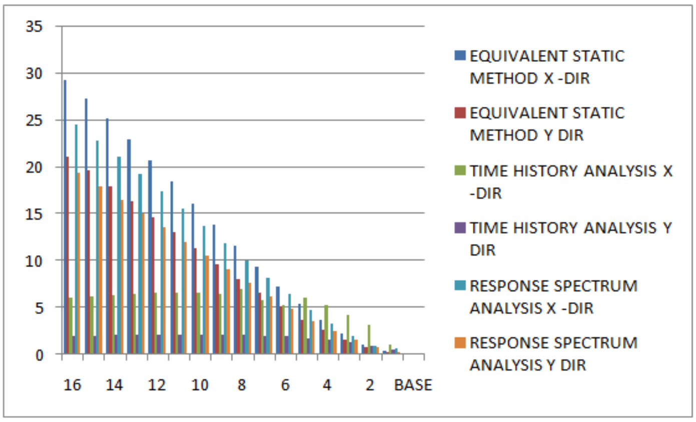


CHART 6.4.5

TABLE 6.4.6 STOREY DISPLACEMENT (MM)						
MODEL 6	**ESM**		**THM**		**RSM**	
STOREY	UX	UY	UX	UY	UX	UY
16	51.503	36.872	147.132	172.165	44.706	30.420
15	50.419	35.745	144.818	167.488	43.877	29.493
14	48.773	34.331	141.410	161.662	42.674	28.379
13	46.614	32.600	136.826	154.518	41.097	27.050
12	44.010	30.567	131.028	146.062	39.173	25.507
11	41.030	28.269	123.982	136.366	36.927	23.765
10	37.738	25.745	115.690	125.513	34.382	21.841
9	34.195	23.040	106.776	113.587	31.560	19.751
8	30.457	20.195	96.902	100.676	28.479	17.508
7	26.575	17.252	85.880	86.893	25.156	15.127
6	22.594	14.252	73.841	72.404	21.605	12.627
5	18.555	11.235	61.016	57.460	17.855	10.044
4	14.497	8.255	47.846	42.441	14.004	7.440
3	10.451	5.387	34.542	27.813	10.093	4.894
2	6.417	2.767	21.170	14.333	6.141	2.535

1	1.939	0.676	19.350	7.350	1.820	0.624
BASE	0.000	0.000	0.000	0.000	0.000	0.000

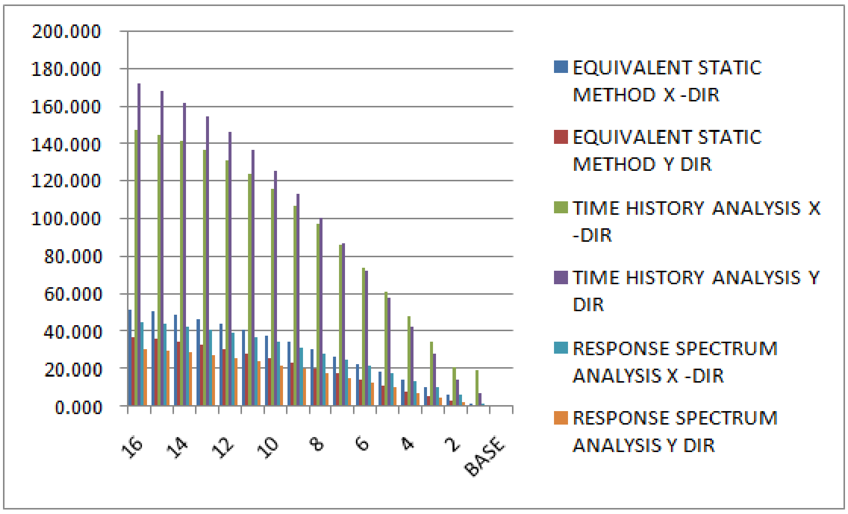


CHART 6.4.6

TABLE 6.4.7 STOREY DISPLACEMENT (MM)						
MODEL 7	**ESM**		**THM**		**RSM**	
STOREY	UX	UY	UX	UX	UY	UX
16	43.1040	30.8970	55.6210	81.3020	45.6870	32.1920
15	42.1010	29.9320	54.3670	79.3880	44.7710	31.2320
14	40.7360	28.7690	52.8170	77.0640	43.5770	30.1140
13	39.0620	27.3920	50.9180	74.2740	42.1220	28.8170
12	37.1000	25.7940	48.6240	70.9620	40.3990	27.3250
11	34.7690	23.9620	45.8520	66.9710	38.3030	25.6070
10	32.1100	21.9090	42.5870	62.2860	35.8370	23.6600
9	29.1820	19.6700	38.8590	56.9470	33.0250	21.4950
8	26.0440	17.2830	34.7140	51.0220	29.8920	19.1300
7	22.7470	14.7870	30.2100	44.5890	26.4600	16.5850
6	19.3400	12.2230	25.4180	37.7410	22.7520	13.8880
5	15.8680	9.6350	20.4280	30.5980	18.8050	11.0800
4	12.3870	7.0770	15.3560	23.3400	14.7330	8.2340
3	8.9260	4.6170	10.3220	16.1080	10.5880	5.4380
2	5.4790	2.3710	7.8710	9.0810	6.4010	2.8300
1	1.6560	0.5790	2.6500	6.5300	1.8890	0.6990
BASE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

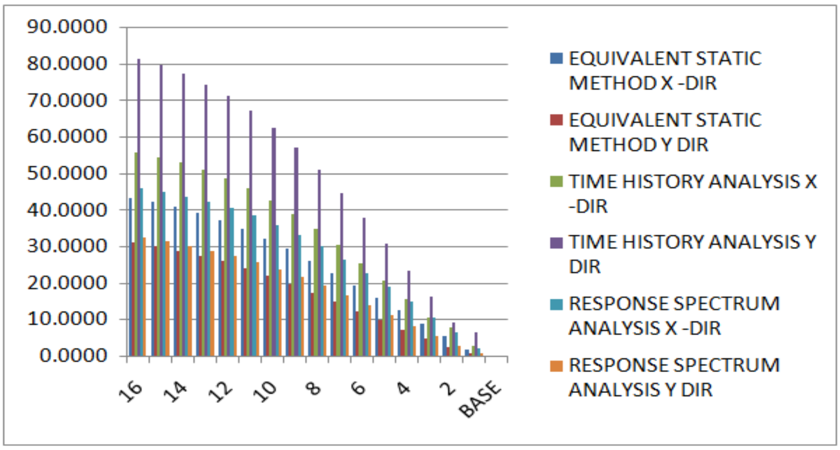
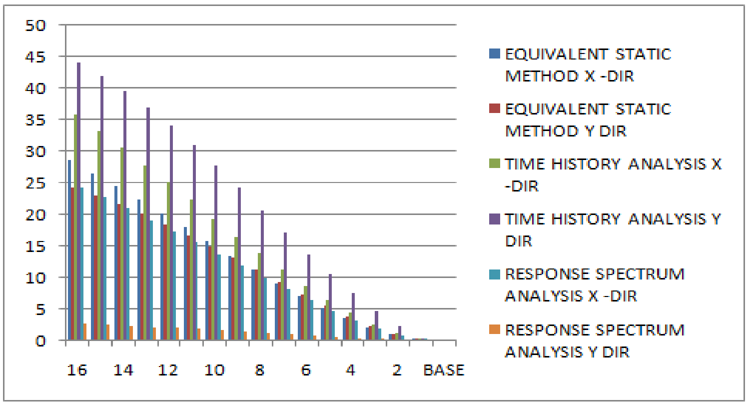


CHART 6.4.7

TABLE 6.4.8 STOREY DISPLACEMENT (MM)						
MODEL 8	**ESM**		**THM**		**RSM**	
STOREY	UX	UY	UX	UX	UY	UX
16	28.592	24.364	35.95	44.211	24.431	2.694
15	26.566	23.058	33.332	41.95	22.734	2.519
14	24.49	21.65	30.65	39.516	21.002	2.338
13	22.369	20.146	27.911	36.9	19.235	2.152
12	20.204	18.542	25.123	34.074	17.436	1.96
11	17.997	16.832	22.291	31.012	15.6	1.762
10	15.765	15.028	19.439	27.731	13.739	1.559
9	13.533	13.153	16.601	24.277	11.869	1.353
8	11.332	11.236	13.82	20.716	10.011	1.146
7	9.197	9.31	11.23	17.129	8.191	0.941
6	7.167	7.415	8.799	13.797	6.439	0.743
5	5.286	5.597	6.522	10.694	4.793	0.556
4	3.601	3.908	4.467	7.662	3.3	0.385
3	2.165	2.41	2.7	4.844	2.009	0.235
2	1.033	1.174	1.298	2.421	0.975	0.114
1	0.342	0.334	0.424	0.543	0.327	0.085
BASE	0.000	0.000	0.000	0.000	0.000	0.000



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VII. CONCLUSION

The objective of this investigation is to comprehend the behavior of a multi-story RC structure featuring shear walls at different locations, alongside soft stories, when subjected to dynamic loading. The objective is to analyze various parameters including Base Shear, Time Period, Story Drift, and Story Displacement.

This analysis strives to grasp the response of the RC structure under seismic loads, incorporating shear walls, core walls, and soft stories at varying positions. Employing the Etabs software, Base Shear, Time Period, Story Drift, and Story Displacement have been assessed. Three methods—ESA, THA, and RSA—were selected for this purpose, and the results, including data and diagrams, have been presented.

Among the models, Model 6 demonstrated higher storey displacement than the others. The structure displayed minimal storey drift at the top and bottom levels, with a slight increase in the middle sections. The time period was observed to be longer than that calculated using the equivalent static method, specifically 2.89 seconds through response spectrum analysis. Notably, the base shear was notably higher during earthquakes due to the influence of seismic zone 4 and severe conditions.

In terms of seismic condition, Model 2 and 3, where corner columns in the y direction were omitted, exhibited a more critical situation in the x direction. The inclusion of shear walls proved notably effective in addressing seismic forces.

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