IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

COMPARITIVE STUDY OF SEISMIC BEHAVIOUR OF RCC BUILDING FRAMES WITH AND WITHOUT MASONRY INFILL WALLS

[1] Abhishek, [2] Galanna Karningol
[1]PG Student, [2] Assistant Professor
[1] Department of Structural Engineering
[1] Sharnbasva University, Kalaburagi, India

Abstract: In emerging nations with seismically active areas, RC frames with masonry infills are typical. In reinforced concrete (RC) frame buildings, masonry infills (MI), which typically have high stiffness and strength, are essential during earthquakes, however these are typically as non-structural components, their contributions to stiffness are typically disregarded in actuality, such a strategy can result in a dangerous design. the MI was designed as a secondary. The way that elements function as constituents of the structural system affects the overall especially when it is subjected to seismic loads, the behavior of the structure. The MI stands for the masonry infill. Comparable diagonal strut Results from factors including natural timing, static base shear, and dynamic base. The studies provide shear, storey displacement, and inter-storey drift. This paper discusses and comes to a conclusion. In this study, 3D RC frames with and without brick infill are subjected to seismic analysis proposing a soft story for the G+15 storey and a wall.

Index terms: **ETABS, Time period, Storey stiffeness, base shear, Displacement, Response spectrum analysis.**

I. INTRODUCTION

1.1 GENERAL

Among the normal perils quakes are potential for causing the best harms. Since tremor waves are arbitrary and eccentric. There are four parts of structures that planners and configuration engineers work with to make the tremor safe plan of a structure, to be specific seismic primary design, sidelong firmness, horizontal strength and flexibility, notwithstanding different viewpoints like structure, feel, usefulness and solace of building. Horizontal firmness, parallel strength and malleability of structures can be guaranteed by rigorously following most seismic plan codes. In any case, great seismic underlying arrangement can be guaranteed by following cognizant building highlights that outcome in great primary way of behaving.

1.2 SEISMIC WAVES

During a quake, enormous strain energy is transmitted through the Earth's strata as seismic waves, which reflect and refract at each associated location. Both body and surface waves are available, but only the latter may travel toward Earth's surface (Fig1). Love waves & Rayleigh waves are examples of surface waves, whereas P-waves & S-waves are examples of body waves. At right focuses to the S-waves, material particles undergo both extensional & compressional stresses throughout the path of energy transmission (Figure 2). In the same way as S-waves affect the surface, love waves have a similar effect, but without the vertical component. In the vertical plane, Rayleigh wave exerts an elliptic impact on material particle.

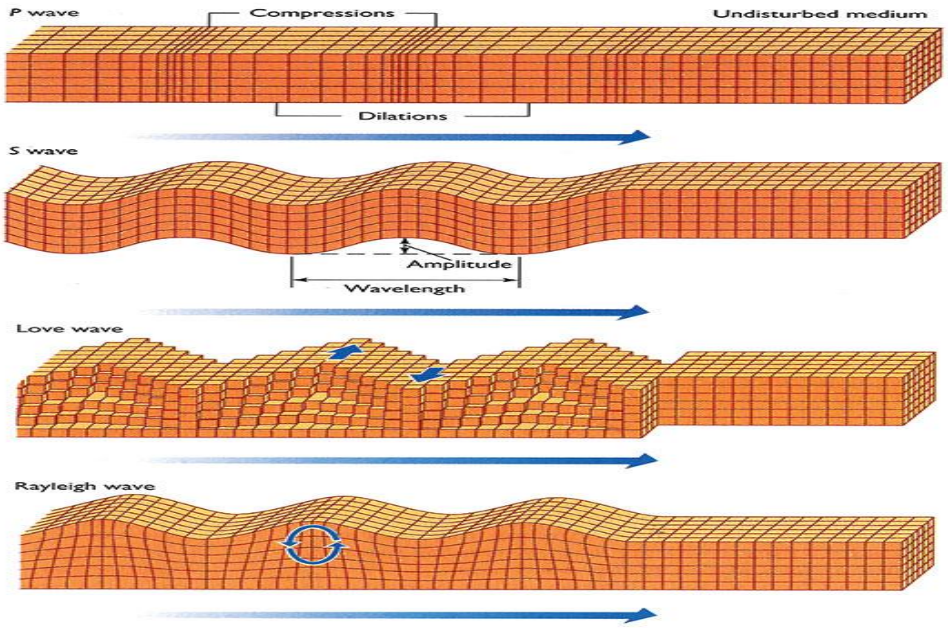

Fig 1. Different types of seismic waves

Essential objective of quake planning is planning and build plan so the mischief with development & hidden part during a tremor is restricted. It is the commitment of essential shudder experts to ensure the created environment can persevere through crazy strong exercises, similar to breeze, traffic or seismic quake Tremor engineers should comprehend how the assembled climate will answer such unique activities. A quick impact of seismic tremors is various fatalities because of underlying breakdown and falling flotsam and jetsam, while in the drawn out a large number of people are passed on destitute because of imploded or perilous structures and the subsequent sluggish course of modifying. The primary quake designing local area can impact the immediate outcomes of these occasions by better figuring out the seismic reaction of building structures and planning to further develop their seismic plan continually.

II. GOALS OF THE WORK

Following are the goals considered for the current work,

- To assess the reaction of exposed outline and infilled outlines exposed to seismic burdens according to Is(1893-2002) codal arrangements.
- To achive seismic examination utilizing comparable static technique reaction range strategy.
- To concentrate on the reaction of customary and sporadic structure outlines with without infill dividers
- To analyze the same swagger width utilizing hendry mainstone strategy.
- To assess the delicate story impact.
- To analyze the outcomes got by story removal, entomb story float, base shear story firmness and major time span.

III. LITERATURE REVIEW

1. **Mr.Jasdeep Singh Rehal, 2 Dr.G.D Awchat (2016) IJSDR|Volume 1**, near investigation of seismic way of behaving of Rcc building outlines with and without stone work infill dividers" the block workmanship infill is viewed as a non-underlying component, yet it has its own solidarity and firmness. Hence expecting the effect of block work is seen as in assessment an arrangement, noteworthy development in strength and robustness of by and large development may be taken note. Planned consideration of the impact of infill is prohibited under the current IS 1893(Part-I): 2000 code. If the influence of infill is included in the evaluation and design of the edge, the final design may be fundamentally unusual.. In addition, infill, if present in all records, places a fundamental requirement on energy dispersion limitation, decreasing the most extreme motions. However, despite this, importance of stone work cannot be overestimated, especially for outlines that have been created without reference to seismic capabilities. A "delicate tale" is one in which the amount of hardness suddenly shifts along the structure's axis. If the sidelong stiffness is still under half of tale above or below, the narrative is considered delicate according to IS 1893(Part-I): 2000. A corner-to-corner swagger is used to show block stone work infill's strength and stiffness in this article. The principal boundaries considered in the review to think about the seismic execution are time span, base shear, normal recurrence, story float and horizontal dislodging.
2. **Kiran Tidke1, Sneha Jangave2 / JIRSET (2016**) "Seismic Analysis of Buildings with or Without Infill Wall" Workmanship Reinforced Structural Frame buildings have employed brick infill dividers as both inside and exterior package dividers. Today, infill dividers are seen as a non-load-bearing component. When planning and inspecting a building, infill dividers are often viewed as a non-hidden portion of the structure, and they are typically ignored by logical modeling because they are deemed not to be critical to fundamental response.

   Upheld concrete framed structures with infills are normally examined as uncovered frame, dismissing the strength and solidness responsibilities of the infills. In any case during wind and quake these infill dividers contribute a couple of response of the development and addition the strength and immovability of the edge. According to this article, the impact of stonework infill partitioning has been examined. End of dynamic evaluation of working with alternative game-plan. The G+7 R.C. frame construction is shown for your perusal. The aslant strut method does not completely settle the breadth of strut. SAP2000 software conveys an evaluation. Shearing at the base and a maximum float of one story aren't set in stone, as we looked at them for all models.

3. **Dr. U. P. Waghe & Bhnaupratap R Mehadia | IJSTE (2016)** In countries like India, where earthquakes are common, reinforced concrete structures (RCCs) with blockwork infill walls are a common practice. "Relative Studies in Design and Analysis of RCC Structures with & without Infill Wall with Seismic Effect" When doing a basic inspection, the stone work dividers are often handled as if they were not underlying components, and just their mass is taken into consideration, rather than their underlying attributes like strength & solidity. High-seismic zones have designs that are utterly defenseless in the face of catastrophic consequences. In addition to bearing the weight of the gravity load, the structure must withstand a parallel burden that might raise tensions. In today's building development practice, significant built-up edges are the most common. Segments and shafts create upward-facing holes that are often filled with block or stone work & referred to as "block infill dividers," "block infill boards," etc. These separators are made of concrete mortared mud bricks after the casing construction is accomplished. These separators are typically between 200 and 115 millimeters in thickness. For practical reasons, apertures are made in casings for windows, doors, and so on.

4. **Jabin jamesIRJET2016:** "seismic investigation of Rcc outline with workmanship infill dividers utilizing ETABS" RC outlined structures are by and large planned disregarding the primary activity of workmanship infill dividers present. These dividers are generally utilized as segments and considered as non-primary components. Be that as it may, they influence both the primary and non-underlying execution of the RC structures during seismic tremors.

   The impact of stone work infill board upon reaction of RC outlines exposed to seismic activity is generally perceived & also is subjected in various trial examinations, whereas a few endeavors for showing it scientifically has accounted for. In scientifically examination infill dividers are demonstrated as identical swagger methodology there are different equation determined researchers and researcher for width of swagger and displaying. Infill acts like pressure swagger among segment and bar and pressure powers are moved starting with one hub then onto the next. In this study the impact of workmanship dividers on tall structure is contemplated. The non-straight static weakling examination is performed for RC outline with different infill course of action

5. **Haroon rashed tamboli and umesh karadi (2012)**: Masonry in fills are ordinarily thought to be as non-primary components and their firmness commitments are by and large disregarded by and by, such a methodology can prompt a risky plan. The stone work infill dividers however built as optional components acts as a constituent piece of the underlying framework and decide the general way of behaving of the design particularly whenever it's exposed earthquake loads. Using the Equivalent Lateral Force Method, different built-up concrete (RC) outline building models, including those with an uncovered outline, infilled casing, and an open first story outline, were seismically examined for this article. Exposed outline, infilled casing, and open first-story outline are discussed and their impacts are concluded. Brickwork infill boards are shown using Equivalent tilting Strut technique, and the ETABS software package is used to examine all edge models.

6. **Arulmozhi.N , Jegidha.K, Srinivasan.R , Dr.Sureshbabu (2015)** Scientific Study on Seismic Performance Of RCC Frames In-Filled With Masonry Walls by E-Tabs" Moderate and serious quakes have struck better places on the planet, making extreme harm built up substantial designs. Quake frequently impact the connection between the primary components and workmanship in-fills of the structure. Workmanship in-fills are much of the time used to make up for the shortfalls among even and vertical opposing components of the structure outline. An infill divider improves impressively the strength and inflexibility of the design. It has perceived that casings with in-fills have more strength and unbending nature in conditions omparison to the exposed edges. Subsequently the examinations about the way of behaving of 3D-RC outlines regardless of stone work in-fills are important.

7. **KH. Abdelkareem. FK.Abdel sayed Almekhlafy (2013):** The full scale models procedure is one of the principal classes for modeming infills considering a similar strut technique. The solidity and strength of these struts are negatively impacted by their indistinguishable breadth at center. While there are many ways to describe this vast expanse, this article provides an overview of some of the most often used terms. Paulay and Priestley's precondition is best logical option for understanding adjusting unidentifiable strut width because of its easiness and since it offers an uncomfortable regular value among the enunciations examined in this research. As a result, we plan to apply the model in our subsequent research to evaluate the RC in filled frame.

8. **Shobha. L1, Lakshmikantha. B. A2, R. Prabhakara (2016)** A scientific study of equivalent corner-to-corner swagger while displaying stone work infill's" scientific survey To make up for the gaps between levels as well as vertical basic pieces like bars and segments, Masonry Infills (MI) have been utilized for a long time. They are not taken into account during analysis and formulation of strategy since they are regarded as non-basic components. Even yet, MI's general interaction with RC frame changes the key method to acting when it is Laterally layered. Equivalent Diagonal Strut (EDS) construction is being investigated here, and its width is determined utilizing the numerous relations offered by skilled specialists in this study. In order to determine the EDS's breadth, a basic summary of the researchers' hypothesized relationships is being compiled and double-checked. As an example, article employs MI as an EDS to demonstrate and play out a direct evaluation of Deflection and Stiffness of edge. ANSYS is tool being utilized to conduct examination.

IV. METHODOLOGY

1. A definite writing survey is done the investigation of RC outlines with and without stone work infill and delicate story.
2. Demonstrating will be finished for building outlines with and without infill dividers utilizing ETABS.

3. For 15-story building models, 3D RC frame arrangement for dead weight, living weight, & quake load has been completed. The Mainstone & Hendry formulas are used to calculate the breadth of nearly equal slanting strut for work infill and sensitive story.
4. The same static examination is completed to get static base shear, story relocation, Inter story float , Story firmness And reaction range investigation to acquire the normal time span.
5. The outcomes got are organized, talked about and ends are drawn.

4.1 MODELLING AND ANALYSIS OF THE BUILDING

4.1.1 Structural Model

In this current review seismic way of behaving of building outline with and without infill is contemplated. Importance and impact of various boundaries are concentrated on exhaustively. Seismic examination is conveyed according to IS 1893-2002 rules. Identical static and reaction range are embraced and investigation is done utilizing ETABS programming.

For the review building plan with 15 story is thought of. The component of the structure is 30mx30m. The primary model ground story level 4m and average floor level is 3m.the structure plan and height as displayed in figure.

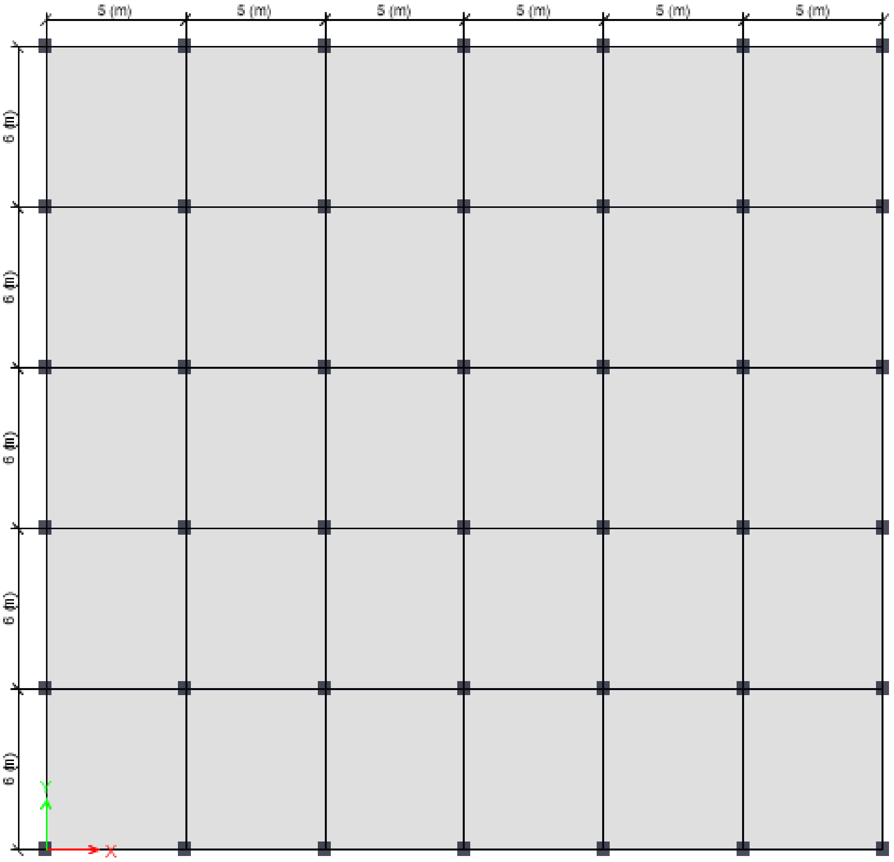

Fig 2:Building plan

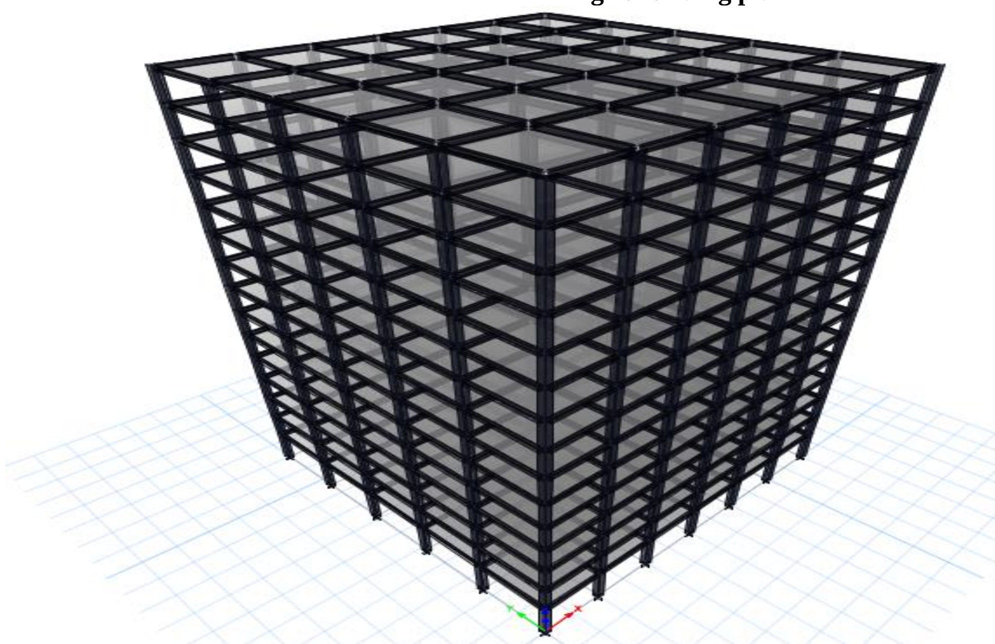

Fig 3 : 3d building model

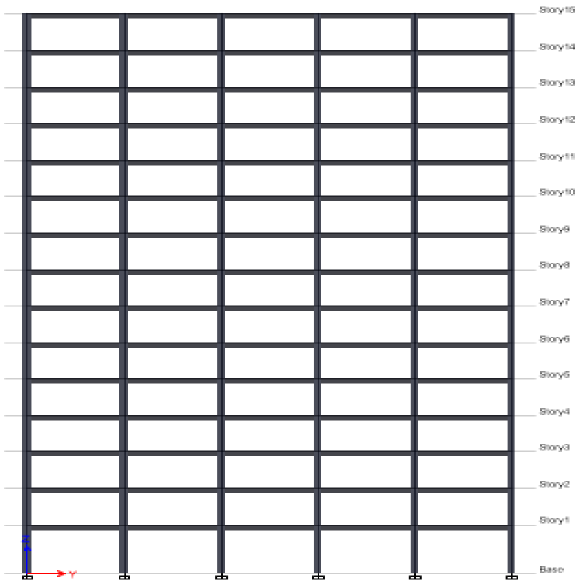

Fig 4:Elevation of building

Frame in current research is M (1,2,3,4,5,6,7,8,9,10,11) are subjected to equivalent static and response spectrum analysis.

4.2 INPUT DETAILS

Table 1 Selecting of building parameter

Numbers of stories	**G + 15**
Storey height	**Ground floor – 4m** **Typical floor – 3m**
Column size	**500 mm x 500 mm**
Beam size	**230 mm x 450mm**
Slab thickness	**150 mm**
Wall thickness	**230 mm**

4.2.1 Seismic details as per code IS (1893 2002)

Table 2 selection of seismic parameters

Details	**Zone III**
R (reduction factor) omrf	**3**
Importance factor	**1**
Zone factor	**0.16**
Sa/g	**Medium soil**

4.2.2 Material properties

Table: 3 material properties

Column	**M25**
Beam	**M25**
Slab	**M25**
Density of concrete	25Kn/m^3
Density of masonry	21.2Kn/m^3

4.2.3 Equivalent diagonal strut

Table 4 diagonal strut width

Method	**Width in m**	
	5m bay size	**6m bay size**
Mainstone	645	800
Hendry	1042	1110

4.3 Load case details

Dead load : As per is 875-1987(part-1) calculated based on size of the section & density of material

Live load : live load is intended to move or variable loads according to occupancy as per IS 875-1987 (part-2) live load upon floor = (2kN/m^2)

live load upon roof -1.5kN/m^2

Quake loads : according to IS 1893-2002 Zone considered is III consequently zone factor 0.16 according to table (2) ,importance factor is 1 and damping ratio is 5% type of soil is medium.

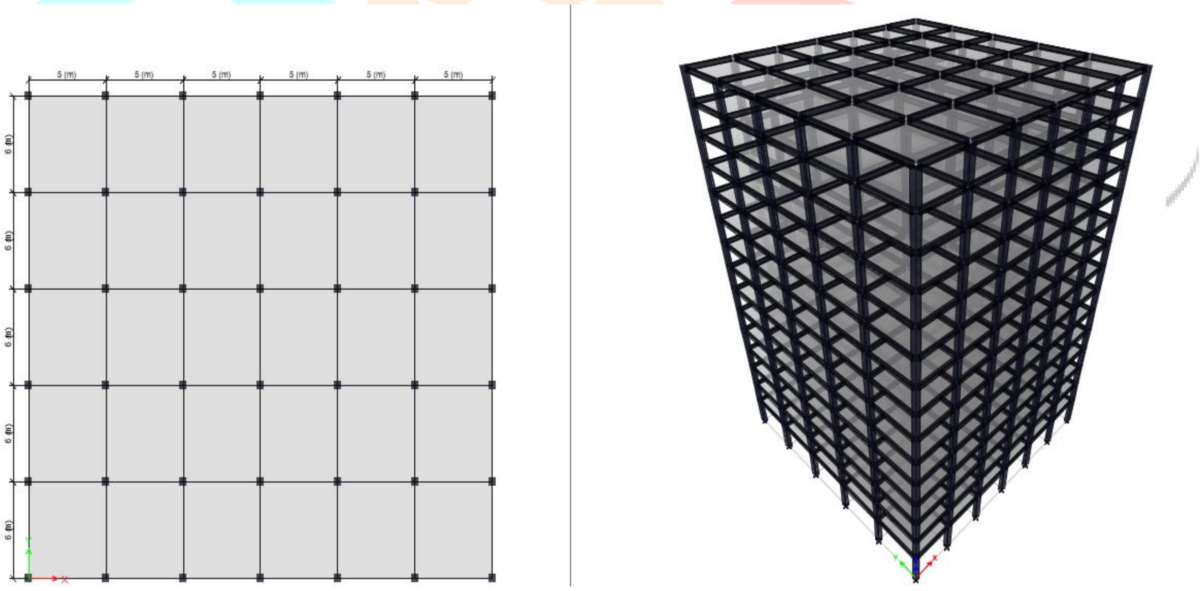

Fig.5: Plan & 3D view model1

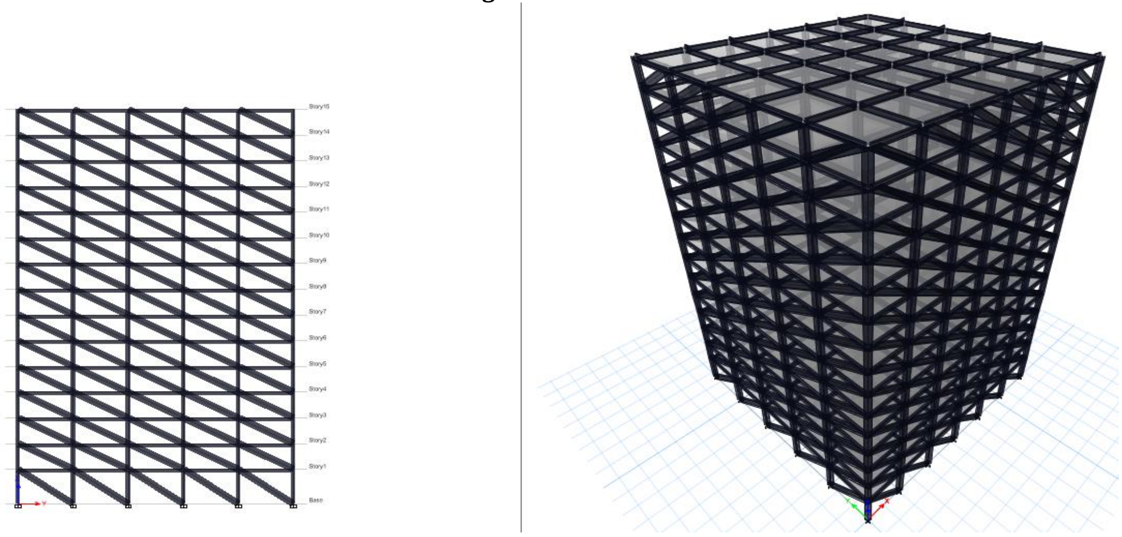

Fig 6 : Elevation & 3D view model2

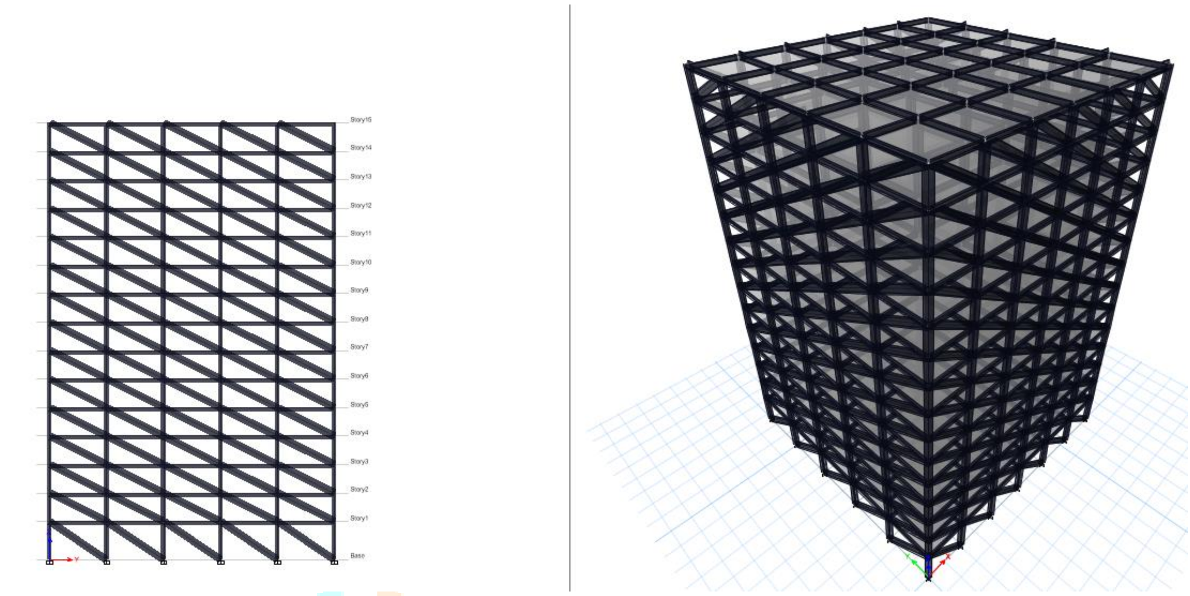

Fig7 : Elevation & 3D view of model 3

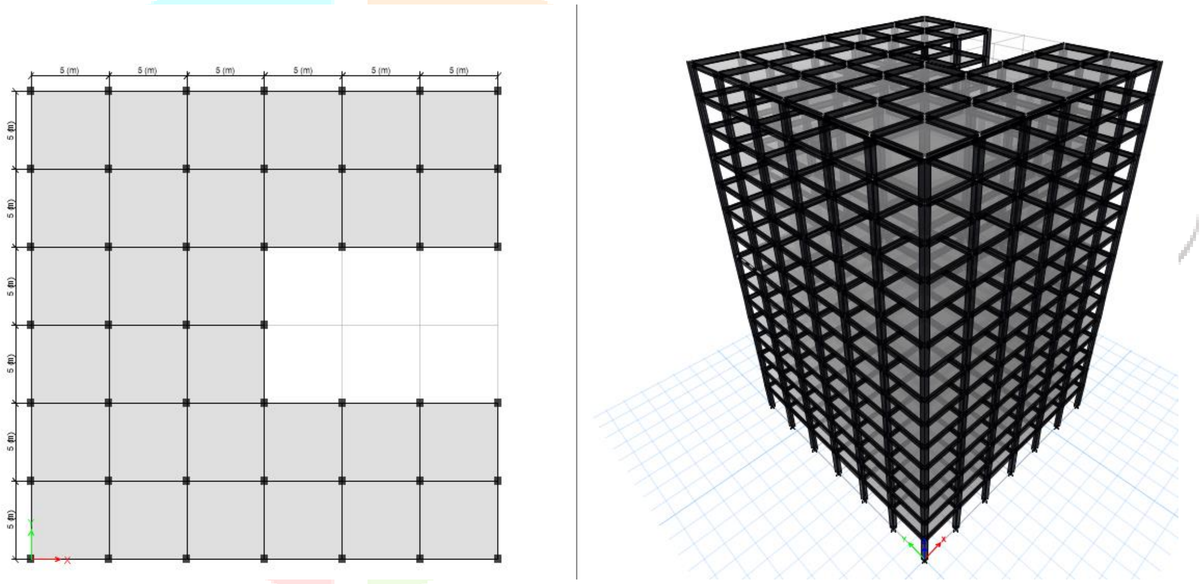

Fig 8: Plan & 3D view of model4

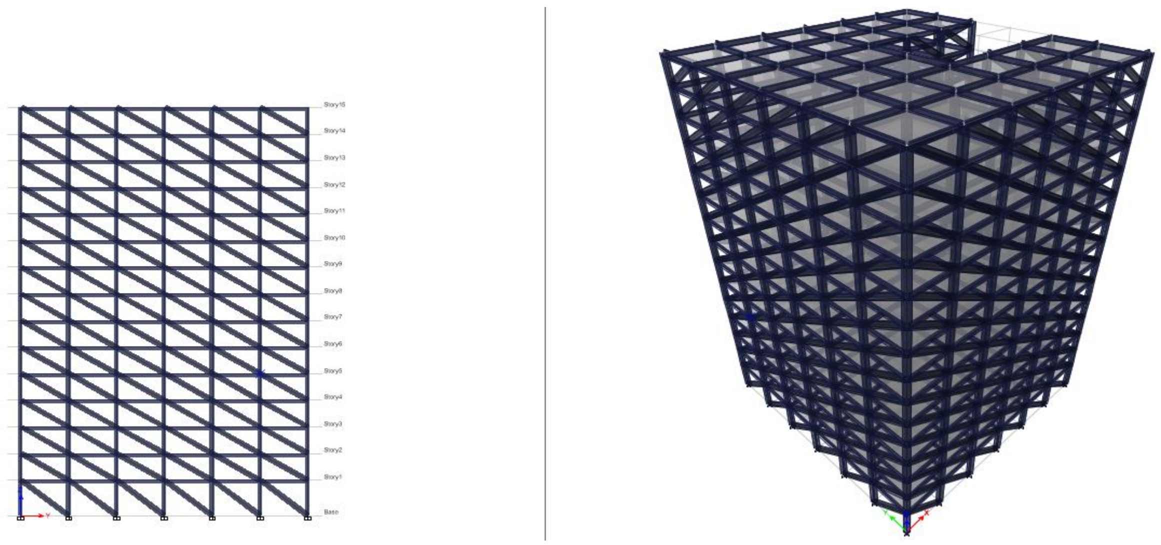

Fig 9 : Elevation & 3D view of model5

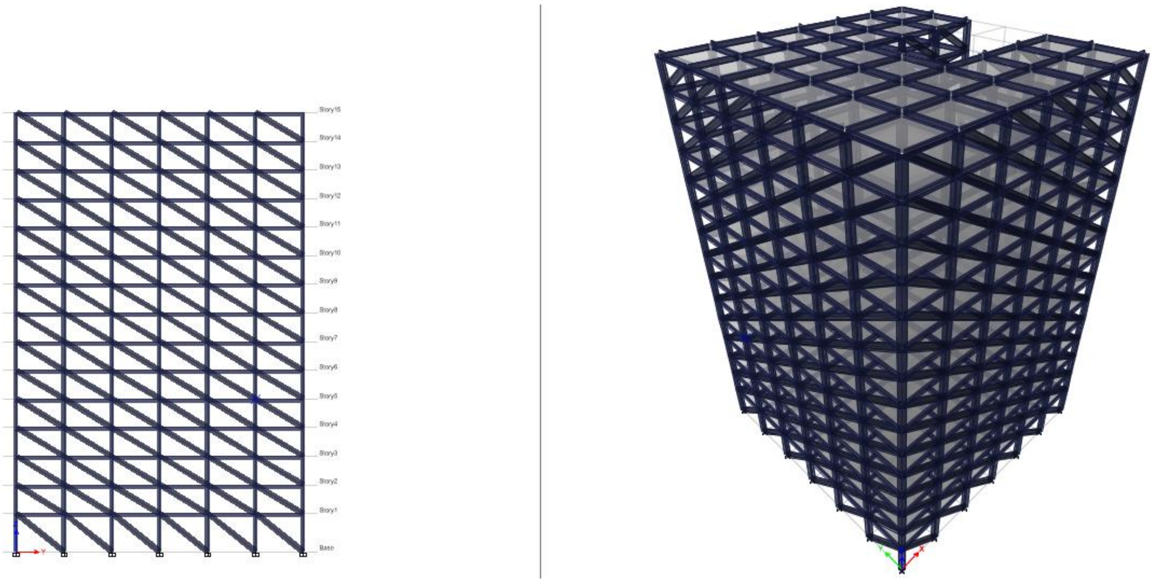

Fig 10 : Elevation & 3D view of model6

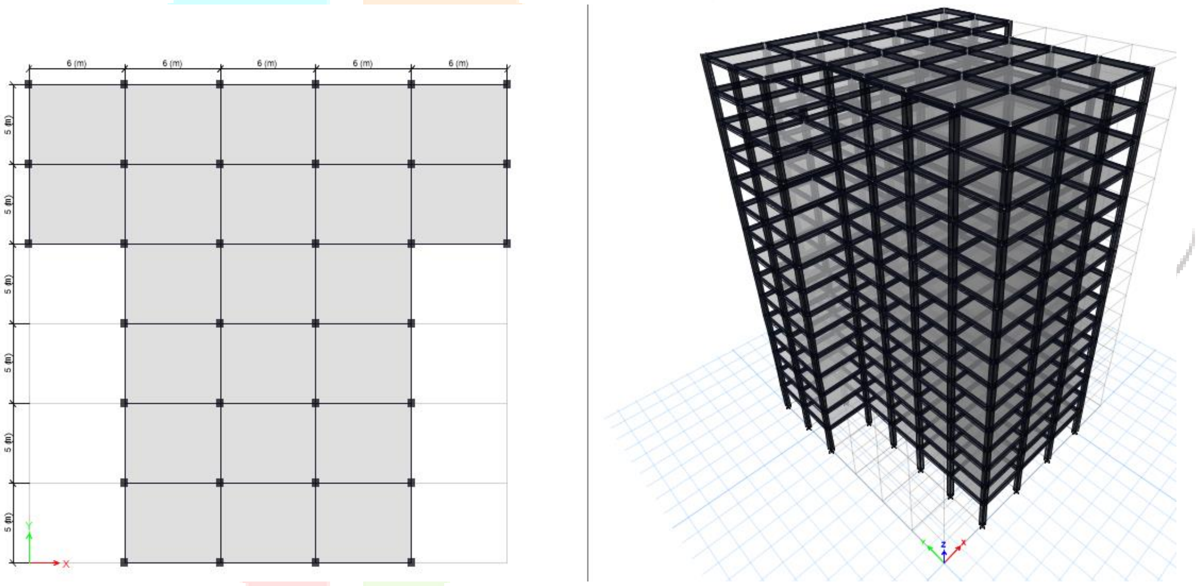

Fig 11 : Plan & 3D view model7

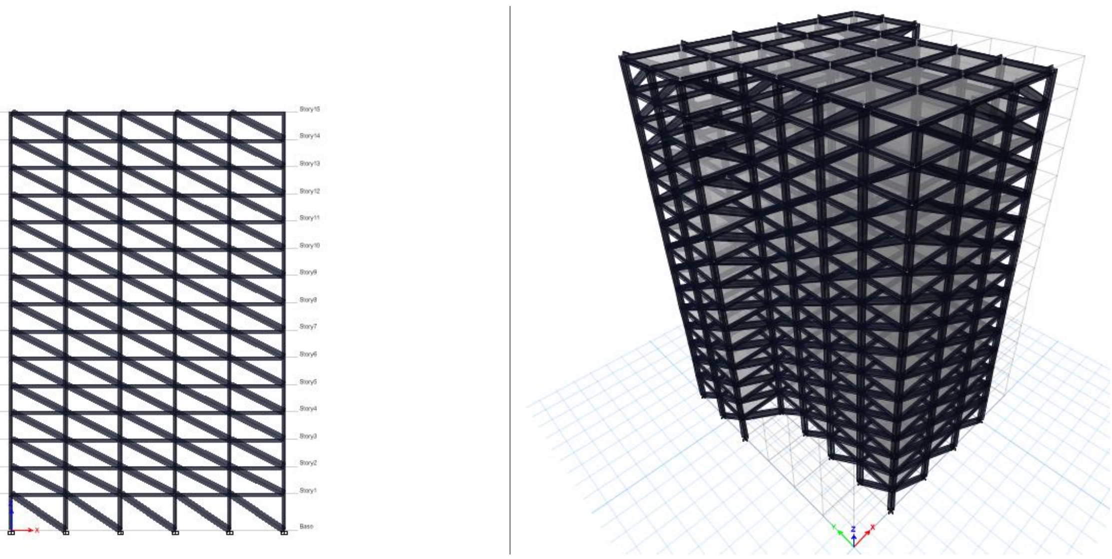

Fig 12 : Elevation & 3D view of model 8

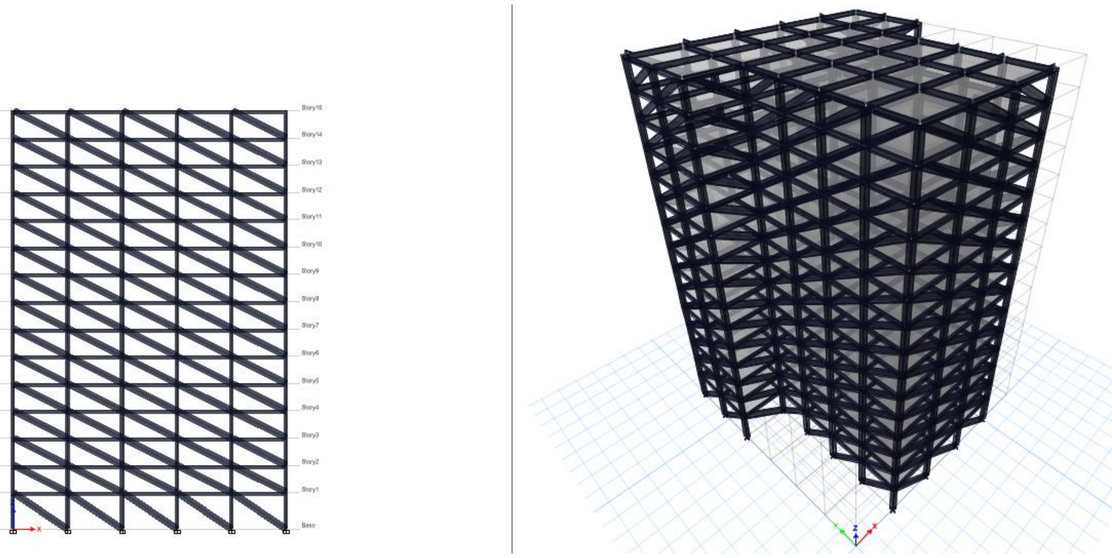

Fig 13 : Elevation & 3D view of model9

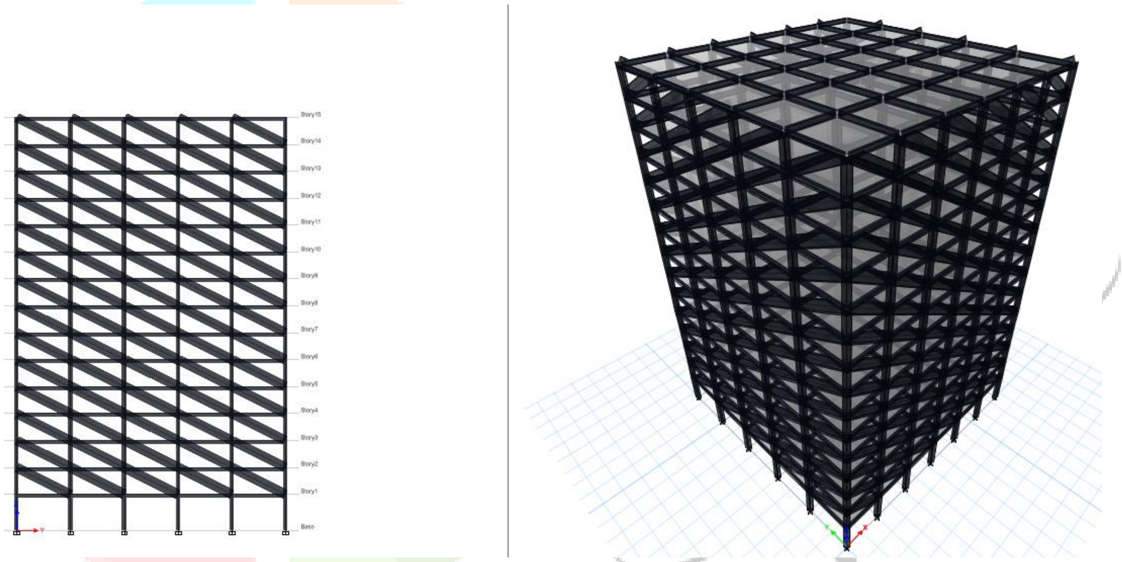

Fig14: Elevation & 3D view of model 10

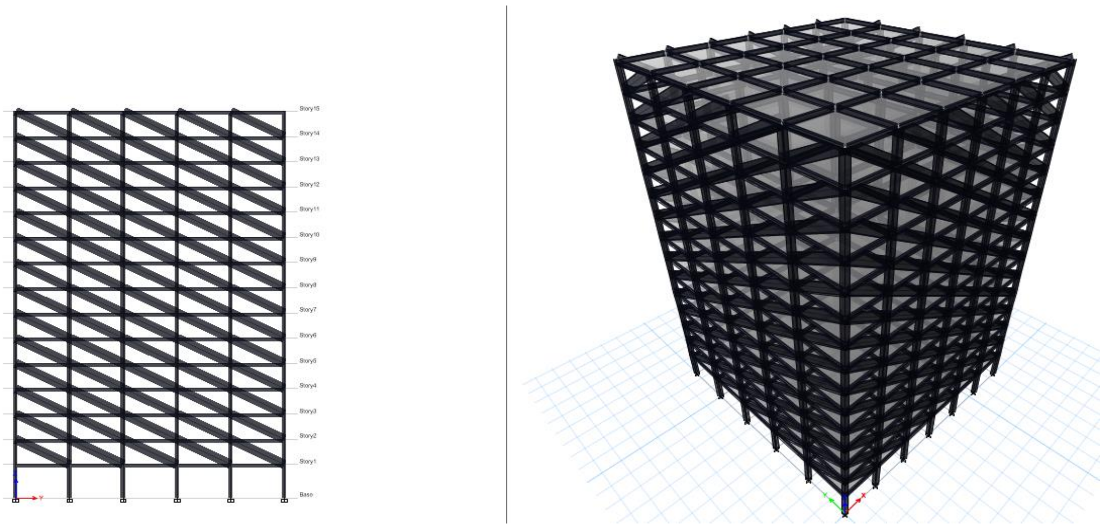

Fig 15 Elevation & 3D view of model 11

V. RESULTS AND DISCUSSION

5.1 EQUIVALENT STATIC METHOD:

Table 5 Displacement along X- direction in mm

ST NO	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11
15	93	35	26	58	16	12	82	22	18	39	31
14	91	34	26	56	15	11	80	22	18	38	30
13	88	33	25	55	14	11	78	21	17	36	29
12	84	31	23	52	14	10	74	20	16	35	27
11	79	29	22	49	13	10	70	18	15	33	26
10	74	27	20	46	12	9	65	17	14	31	24
9	67	25	18	42	11	8	59	15	12	29	22
8	60	22	16	37	10	7	53	14	11	26	20
7	53	20	14	33	9	6	47	12	10	23	18
6	46	17	12	28	7	5	40	10	8	20	16
5	38	14	10	23	6	4	33	8	7	18	14
4	30	11	8	18	5	3	26	6	5	15	12
3	22	8	6	13	3	3	19	5	4	12	10
2	14	5	4	8	2	2	12	3	3	9	8
1	6	3	2	4	1	1	5	2	1	6	6
0	0	0	0	0	0	0	0	0	0	0	0

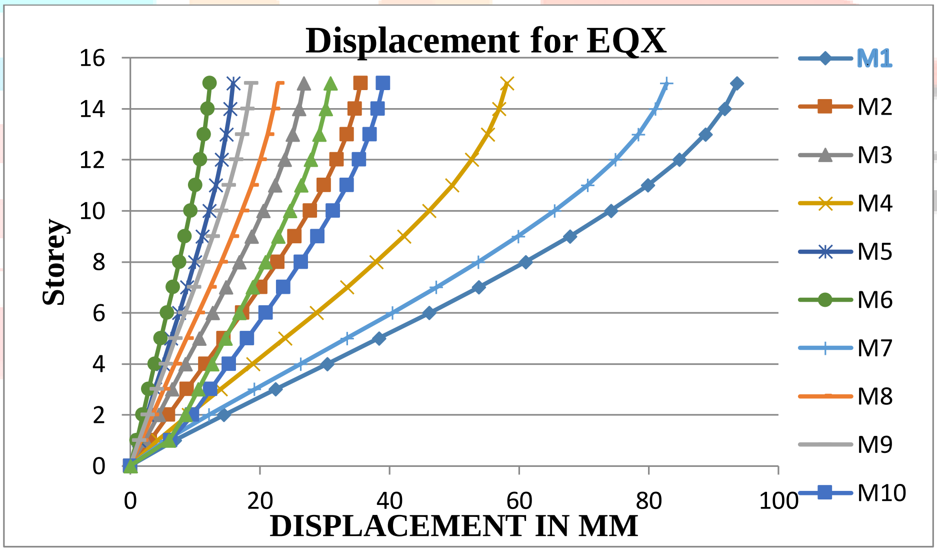

Fig 16 Displacement graph for EQX

Following are the outcomes gotten for story dislodging

- The relocations are greatest at popular narratives.
- The uprooting of uncovered outline is more contrasted with infilled outlines.
- The dislodging is greatest in M1 model & least in M6 model.
- The evacuating of M6 model is 86% less diverged from M1 model , M5 model is 83% lesser , M9 is 80% lesser , M8 is 75% lesser , M3 is 71% lesser, M11 is 68% lesser , M2 is 64% lesser , M10 is 58% lesser , M4 is 38% lesser & M7 is 11% lesser separately.

5.1.2 Displacement along Y-direction in mm

Table 6 : displacement along Y direction

ST NO	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11
15	109	36	30	66	26	21	68	20	15	40	34
14	107	35	29	64	25	20	66	19	15	39	33
13	103	34	28	62	24	19	64	19	14	38	32
12	99	32	26	59	23	18	61	18	13	36	31
11	93	30	25	55	21	17	58	17	12	34	29
10	86	28	23	51	19	15	54	15	11	32	27
9	79	26	21	47	17	14	49	14	10	30	25
8	71	23	19	42	15	12	44	12	9	27	23
7	62	20	16	37	13	11	39	11	8	24	20
6	53	17	14	31	11	9	33	9	7	21	18
5	44	14	12	26	10	7	27	8	6	18	16
4	35	11	9.	20	8	6	22	6	4	15	13
3	25	9	7	15	6	4	16	4	3	12	11
2	16	5	4	9	4	2	10	3	2	9	9
1	7	3	2	4	2	1	5	2	1	6	6
0	0	0	0	0	0	0	0	0	0	0	0

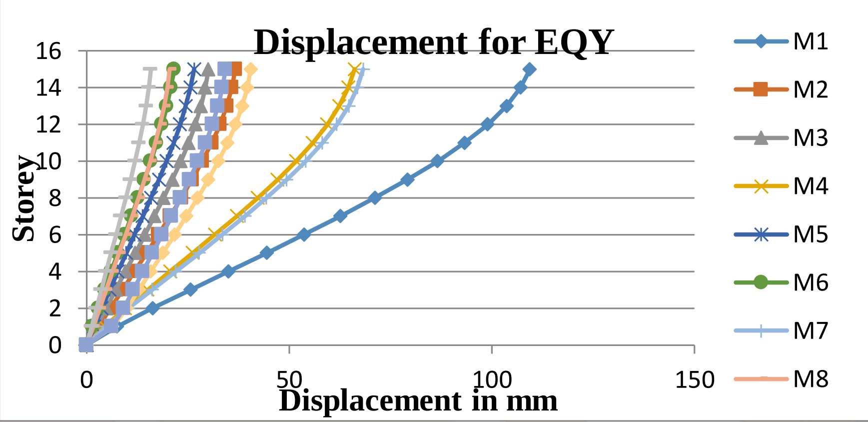

Fig 17 : Displacement graph for EQY

- The removal is most extreme in M1 model and least in M9 model.
- The uprooting of M9 model is 85% less contrasted with M1 model , M8 model is 81% lesser , M6 is 80% lesser, M5 is 76% lesser , M3 is 72% lesser, M11 is 68% less , M2 is 66% lesser, M10 is 63% lesser , M4 is 40% lesser and M7 is 38% less individually

5.2 INTER STOREY DRIFT

5.2.1Inter storey drift along X-direction

Table 7 : Inter storey drift along X – direction

ST. No.	M1	M2	M3	M4	M5
15	0.00065	0.00029	0.00026	0.000389	0.000146
14	0.00099	0.00042	0.00035	0.000601	0.000201
13	0.00133	0.00054	0.00044	0.000816	0.000251
12	0.00163	0.00064	0.0005	0.001008	0.000295
11	0.00189	0.00073	0.00059	0.001172	0.00033
10	0.00211	0.0008	0.00061	0.001308	0.00036
9	0.00228	0.00086	0.00064	0.001419	0.000382
8	0.00242	0.0009	0.00067	0.001506	0.000399
7	0.00253	0.00093	0.00069	0.001572	0.00041
6	0.0026	0.00095	0.0007	0.00162	0.000416
5	0.00265	0.00095	0.0007	0.00165	0.000418
4	0.00267	0.00095	0.0007	0.001663	0.000415
3	0.00265	0.00094	0.00068	0.00165	0.000408
2	0.00253	0.00094	0.00068	0.001571	0.000406
1	0.00171	0.00077	0.00058	0.001061	0.000336
0	0	0	0	0	0

ST. No.	M6	M7	M8	M9	M10	M11
15	0.00013	0.000581	0.000222	0.00013	0.000287	0.000255
14	0.00017	0.000871	0.000301	0.00017	0.000414	0.000352
13	0.000206	0.001174	0.000374	0.000206	0.000534	0.000436
12	0.000237	0.001448	0.000436	0.000237	0.000638	0.000504
11	0.000262	0.001684	0.000486	0.000262	0.000724	0.000592
10	0.000282	0.001881	0.000527	0.000282	0.000795	0.000605
9	0.000298	0.002041	0.000558	0.000298	0.000851	0.000642
8	0.000309	0.002167	0.00058	0.000309	0.000893	0.00067
7	0.000315	0.002264	0.000594	0.000315	0.000922	0.000689
6	0.000318	0.002332	0.000599	0.000318	0.00094	0.000698
5	0.000316	0.002375	0.000598	0.000316	0.000948	0.0007
4	0.000312	0.002387	0.00059	0.000312	0.000946	0.000695
3	0.000303	0.002349	0.000577	0.000303	0.000941	0.000676
2	0.000299	0.002188	0.000565	0.000299	0.001117	0.000837
1	0.000257	0.001379	0.000427	0.000257	0.001551	0.001486
0	0	0	0	0	0	0

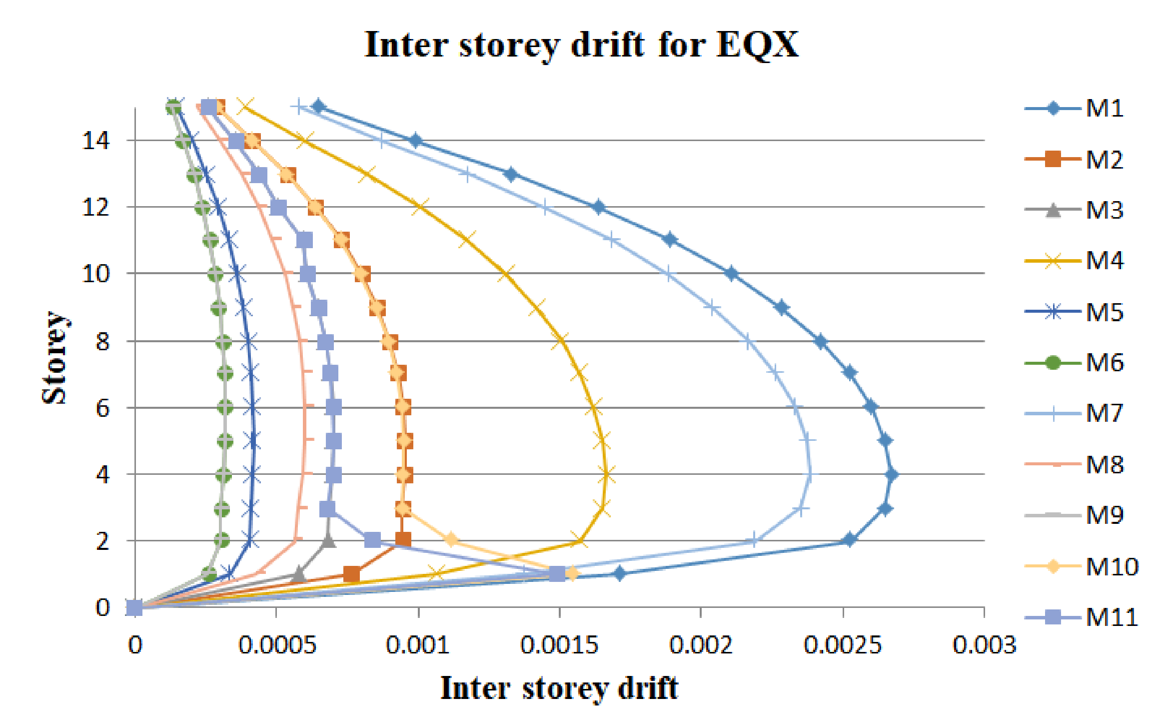

Fig.18: Inter storey drift graph for EQX

Following are the results obtained for inter storey drift results

- Bury story float is most extreme if there should be an occurrence of exposed outline contrast with different models aside from delicate story conditions.
- In delicate story condition, the story float is greatest at the delicate story level itself.
- The bury story float most extreme in M1 model at story-4 and least in M6 and M9 models at story-6.
- Bury story float of M6 & M9 model at story-6 has 88% less contrasted with M1 model at story-4, M5 model at story-5 has 84% lesser , M8 at story-6 has 77% lesser, M3 at story-5 has 73% lesser, M2 at storey5 has 64% lesser, M11 at story-1 has 44% lesser , M10 at story-1 has 40% lesser , M4 at story-5 has 38% lesser and M7 at story-4 has 10% lesser story float contrasted with M1 at story-4 individually.

5.2Inter storey drift along Y-direction

Table 8 : Inter storey drift along Y-direction

ST. No.	M1	M2	M3	M4	M5
15	0.00076	0.00029	0.00027	0.00053	0.00031
14	0.00115	0.00043	0.00038	0.00075	0.00039
13	0.00155	0.00055	0.00048	0.00098	0.00046
12	0.00191	0.00066	0.00056	0.00119	0.00053
11	0.00222	0.00075	0.00067	0.00137	0.00058
10	0.00248	0.00083	0.00068	0.00152	0.00062
9	0.00269	0.00089	0.00072	0.00163	0.00065
8	0.00285	0.00093	0.00076	0.00173	0.00068
7	0.00298	0.00096	0.00078	0.00179	0.00069
6	0.00307	0.00098	0.00079	0.00184	0.00069
5	0.00313	0.00099	0.0008	0.00186	0.00068
4	0.00315	0.00099	0.0008	0.00186	0.00067
3	0.00311	0.00098	0.00079	0.00183	0.00065
2	0.00292	0.00098	0.00078	0.00171	0.00063
1	0.00188	0.00076	0.00063	0.00111	0.00048
0	0	0	0	0	0

ST. No.	M6	M7	M8	M9	M10	M11
15	0.00028	0.00048	0.0002	0.00017	0.00029	0.00027
14	0.00034	0.00072	0.00027	0.00022	0.00042	0.00038
13	0.00039	0.00097	0.00033	0.00027	0.00055	0.00048
12	0.00044	0.00119	0.00039	0.00031	0.00066	0.00056
11	0.00048	0.00139	0.00043	0.00034	0.00075	0.00066
10	0.00051	0.00154	0.00047	0.00037	0.00082	0.00068
9	0.00053	0.00167	0.0005	0.00039	0.00088	0.00072
8	0.00055	0.00177	0.00052	0.0004	0.00093	0.00076
7	0.00056	0.00185	0.00053	0.00041	0.00096	0.00078
6	0.00056	0.0019	0.00054	0.00041	0.00098	0.00079
5	0.00055	0.00194	0.00054	0.00041	0.00099	0.0008
4	0.00053	0.00195	0.00054	0.0004	0.00099	0.0008
3	0.00051	0.00193	0.00053	0.00039	0.00098	0.00078
2	0.00049	0.00183	0.00052	0.00038	0.00118	0.00097
1	0.00038	0.00123	0.00042	0.00032	0.00161	0.00156
0	0	0	0	0	0	0

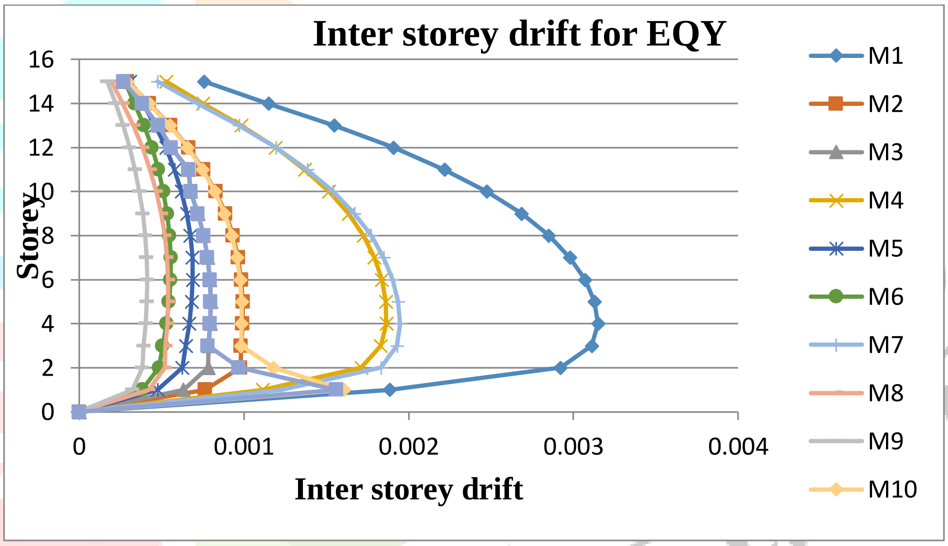

Fig.19: Inter storey drift graph EQY

- The bury story float greatest in M1 model at story-4 and least into M9 model at story-6.
- Bury story float in M9 model at story-6 is 86% less contrasted with M1 model at story-4, M6 & M8 models at story-6 has 82% less story float contrasted with M1 at story-4, M5 at story-6 have 78% less , M3 at story-5 has 74% lesser, M2 at story-5 have 68% lesser, M11 at story-1 have 52% lesser ,M10 at story-1 has half less, M4 at story-4 has 40% lesser and M7 at story-4 has 38% lesser separately.

5.3 BASE SHEAR

5.3.1Base shear along X & Y direction in kN

Table 9 Base shear along X &Y direction

Model	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11
Base shear (kN)	2755	3532	3626	1859	2079	2214	1564	1755	1850	3509	3616

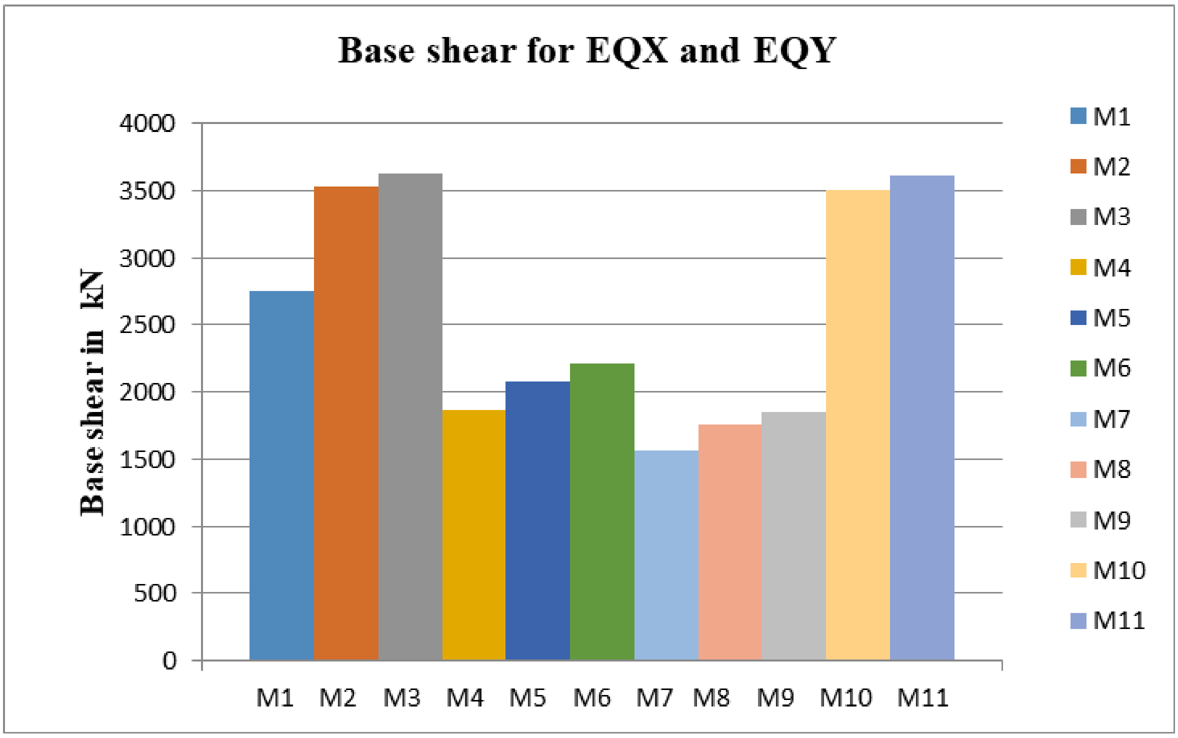

Fig.20: Base shear graph for EQX and EQY

Following are the results obtained from base shear

- Base shear is greatest in the event of infilled outline contrasted with exposed outline
- As seen from the outcomes base shear is greatest in M3 model and least in M11 model
- Base shear of M7 model has 60% less contrasted with M3 model, M8 model has 51% lesser , M4 and M9 models having 48% less base shear contrast with M3 model, M5 have 42% lesser, M6 model has 38% lesser, M10 model has 3% lesser, M2 model have 2.5% lesser and M11model has 1% less individually.

5.4 STOREY STIFFNESS

5.4.1Storey stiffness ratio along X- direction

Table 10 Storey stiffness ratios along X-direction

Model	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11
Storey stiffness ratio	1.10	0.93	0.89	1.11	0.91	0.88	1.18	0.98	0.95	0.53	0.42

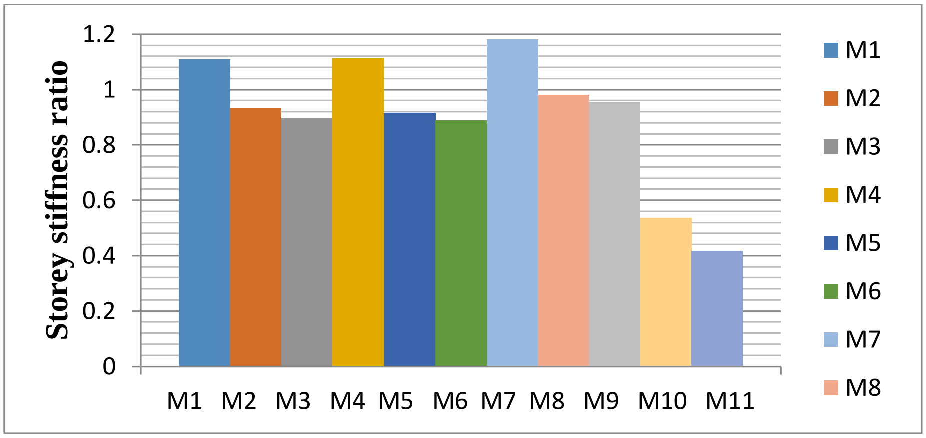

Fig.21: Storey stiffness comparison graph at ground floor level

Following are the results obtained for storey stiffness.

- Stiffness of bare frame is less comparing with infilled frames.
- Comparison of storey stiffness by first floor to ground floor is 58% less in M11 model, 46% less in M10 model , 12% less in M6 model ,11% less in M3 model, 9% less in M5 model , 7% less in M2 model , 5% less in M9 model and 2% less in M8 model.
- The comparison of the storey stiffness from first floor to ground floor is 10% more in M1 model, 12% in M4 model and 18% in M7 model.

5.4.2 Storey stiffness along Y- direction

Table 11 Storey stiffness ratio along Y-direction

Model	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11
Storey stiffness ratio	1.16	0.97	0.94	1.14	0.97	0.94	1.12	0.93	0.90	0.54	0.45

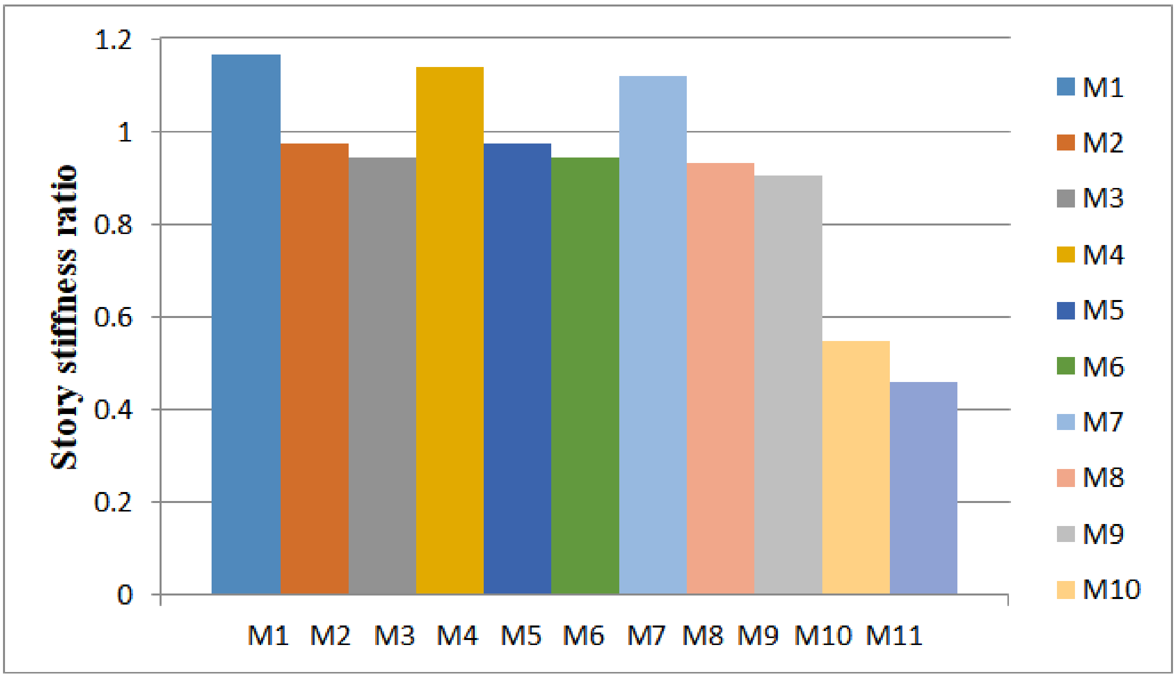

Fig.22: Storey stiffness comparison graph at ground floor level

- The variation of the storey stiffness from ground floor to first floor is 55% for M11 model, 46% for M10 model , 10% for M9 model , 7%l less for M8 model , 6% for M3 and M6 models, 3% for M2 and M5 models.
- The comparison of the storey stiffness from first floor to ground floor is 16% more in M1 model, 14% in M4 model and 12% in M7 model.

5.5 RESPONSE SPECTRUM METHOD

5.5.1 Scale factor for Response spectrum analysis:

Table 12 Scale factor for Response spectrum analysis

Model	Static base shear (kN) V_b		Dynamic base shear V_B		Scale factor (V_b/V_B)	
	EQX	EQY	RX	RY	Along X	Along Y
M1	2755	2755	1204	1111	3.740	4.053
M2	3532	3532	2521	2480	2.290	2.328
M3	3626	3626	2950	2798	2.009	2.118
M4	1859	1859	1028	978	2.956	3.107
M5	2079	2079	1835	1895	1.852	1.793
M6	2214	2214	2583	2015	1.635	1.796
M7	1564	1564	728	799	3.512	3.200
M8	1755	1755	1554	1605	1.846	1.787
M9	1850	1850	1787	1919	1.692	1.635
M10	3509	3509	2383	2340	2.407	2.451
M11	3616	3616	2767	2633	2.136	2.245

Dynamic analysis was performed using scale factor Ig/2R and base shear obtained from dynamic analysis is compared with static analysis as per codal provisions.

5.6 DISPLACEMENT

5.6.1 Displacement along X direction in mm

Table 13 Displacement along X - direction

ST NO.	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11
15	74	28	22	47	13	10	69	20	16	31	25
14	72	27	21	46	13	10	68	20	15	31	24
13	70	26	20	45	12	9	66	19	15	30	24
12	68	25	19	43	12	9	64	18	14	29	23
11	65	24	18	41	11	8	61	17	13	28	22
10	61	23	17	39	10	8	57	16.	12	26	21
9	56	21	16	36	10	7	53	15	11	25	19
8	52	19	14	33	9	7	48	13	10	23	18
7	46	17	13	30	8	6	43	12	9	21	17
6	41	15	11	26	7	5	38	10	8	19	15
5	34	13	10	22	6	4	32	9	7	17	14
4	28	11	8	18	5	4	26	7	6	14	12
3	21	8	6	13	4	3	19	5	4	12	10
2	14	6	4	9	2	2	12	4	3	9	8
1	7	3	2	4	1	1	6	2	1	6	6
0	0	0	0	0	0	0	0	0	0	0	0

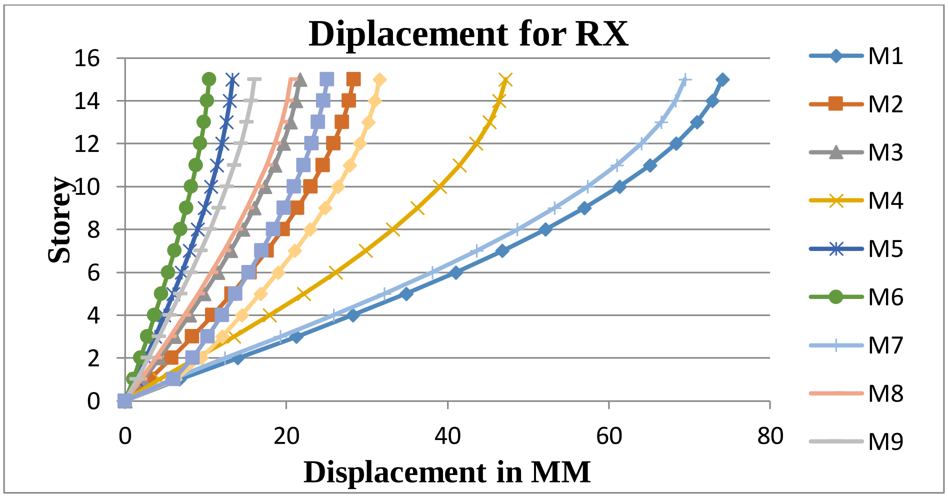

Fig 23 : Displacement graph for RX

- The dislodging is greatest in M1 model and least in M6 model.
- The dislodging of M6 model is 86% less contrasted with M1 model , M5 model is 82% less , M9 is 78% less , M8 is

73% less, M3 is 70% less , M11 is 66% less, M2 is 62% less, M10 is 58% less, M4 is 36% less and M7 is s7% less separately

5.6.2 Displacement along Y – direction in mm

Table 14 Displacement along Y direction

ST NO.	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11
15	86	29	24	56	23	19	54	17	14	28	27
14	84	28	23	54	22	18	53	16	13	28	27
13	82	27	22	53	21	17	51	16	13	27	26
12	79	26	22	51	20	16	50	15	12	26	25
11	75	25	20	48	19	15	47	14	11	25	24
10	71	23	19	45	18	14	44	13	11	23	23
9	66	22	18	42	16	13	41	12	10	22	22
8	60	20	16	38	15	12	38	11	9	20	20
7	54	18	14	34	13	10	34	10	8	19	19
6	47	16	13	30	11	9	30	9	7	17	17
5	40	13	11	25	10	7	25	7	6	15	15
4	32	11	9	20	8	6	20	6	5	13	13
3	24	8	7	15	6	4	15	4	4	10	11
2	15	6	5	10	4	3	10	3	3	8	9
1	7	3	2	4	2	1	5	2	1	5	6
0	0	0	0	0	0	0	0	0	0	0	0

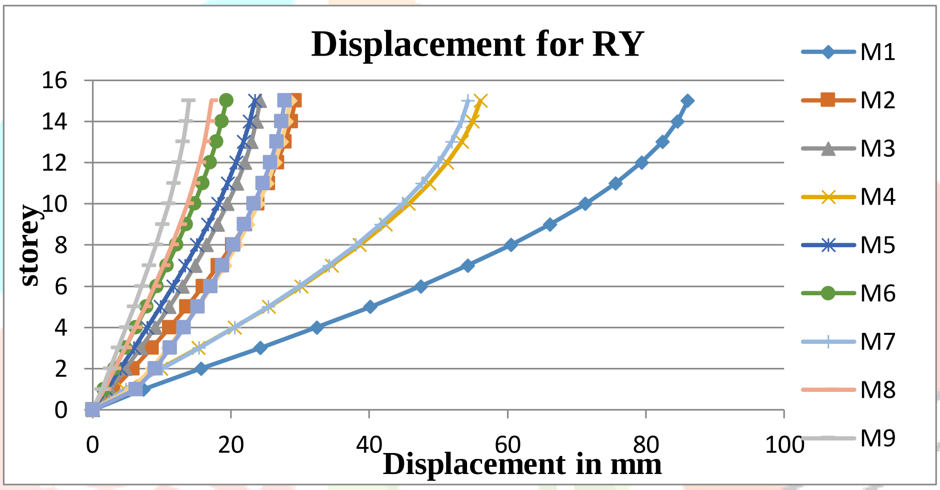

Fig 24: Displacement graph for RY

- The dislodging is greatest in M1 model and least in M9 model.
- The dislodging of M9 model is 83% less contrasted with M1 model , M8 model is 80% less, M6 is 78% less, M5 is 73% less, M3 is 72% less, M11 is 68% less, M10 is 67% less, M2 is 66% less, M7 is 37% less and M4 is 35% less separately.

5.7 INTER STOREY DRIFT

5.7.1Inter storey drift along X-direction

Table 15 Inter storey drift along X direction

ST. No.	M1	M2	M3	M4	M5
15	0.00058	0.00023	0.0002	0.00034	0.00011
14	0.00089	0.00034	0.00028	0.00052	0.00015
13	0.00115	0.00044	0.00035	0.0007	0.00019
12	0.00136	0.00053	0.0004	0.00084	0.00023
11	0.00154	0.00059	0.00048	0.00096	0.00026
10	0.00169	0.00065	0.00049	0.00106	0.00029
9	0.00183	0.00069	0.00052	0.00114	0.00031
8	0.00195	0.00072	0.00054	0.00122	0.00033
7	0.00207	0.00075	0.00057	0.00129	0.00035
6	0.00218	0.00079	0.00059	0.00136	0.00036
5	0.00228	0.00082	0.00061	0.00142	0.00037
4	0.00237	0.00084	0.00062	0.00149	0.00038
3	0.00244	0.00087	0.00064	0.00153	0.00039
2	0.00242	0.00091	0.00066	0.00151	0.0004
1	0.00168	0.00076	0.00057	0.00104	0.00034
0	0	0	0	0	0

ST No.	M6	M7	M8	M9	M10	M11
15	0.0001	0.00055	0.00018	0.00015	0.00022	0.00019
14	0.00013	0.00082	0.00025	0.00021	0.00032	0.00026
13	0.00016	0.00107	0.00032	0.00026	0.00042	0.00033
12	0.00019	0.00128	0.00038	0.0003	0.0005	0.00038
11	0.00021	0.00145	0.00043	0.00033	0.00057	0.00046
10	0.00023	0.0016	0.00046	0.00036	0.00063	0.00047
9	0.00024	0.00173	0.0005	0.00038	0.00068	0.0005
8	0.00026	0.00185	0.00052	0.0004	0.00071	0.00053
7	0.00027	0.00196	0.00054	0.00042	0.00075	0.00055
6	0.00028	0.00207	0.00056	0.00043	0.00078	0.00057
5	0.00029	0.00216	0.00058	0.00044	0.0008	0.00059
4	0.00029	0.00225	0.0006	0.00045	0.00083	0.00061
3	0.00029	0.0023	0.00061	0.00045	0.00086	0.00061
2	0.0003	0.00222	0.00062	0.00045	0.00108	0.00081
1	0.00026	0.00143	0.00049	0.00036	0.00156	0.0015
0	0	0	0	0	0	0

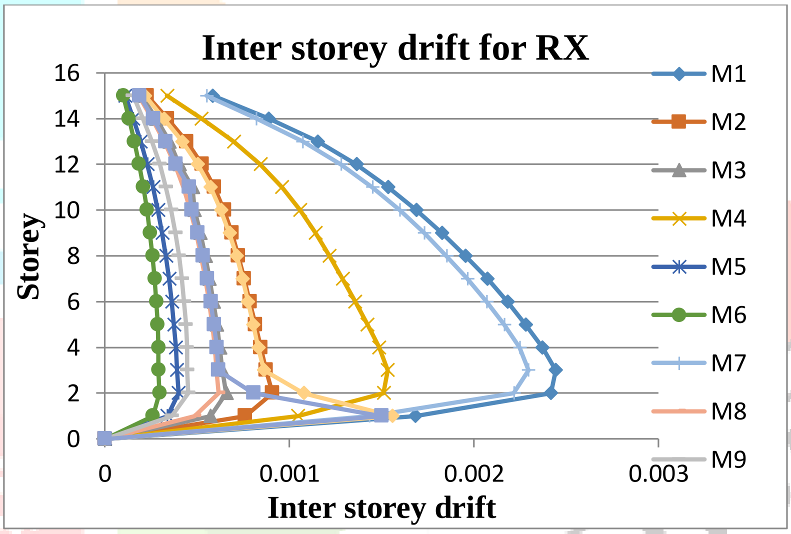

Fig25: Inter storey drift graph for RX

- The entomb story float greatest in M1 model at story-3 and least in M6 models at story-2.
- Entomb story float in M6 model at story-2 has 88% less story float contrasted with M1 model at story-3, M5 model at story-2 has 83% less , M9 at story-2 has 81% less, M8 at story-2 has 75% less, M3 at story-2 has 72% less, M2 at story-2 has 62% less, M11 at story-1 has 38% less, M4 at story-3 has 37% less, M10 at story-1 has 35% less and M7 at story-3 has 10% less separately.

5.7.2 Inter storey drift along Y direction

Table 16: Inter storey drift along Y directon

ST. No.	M1	M2	M3	M4	M5
15	0.00071	0.00023	0.00021	0.00047	0.00026
14	0.00106	0.00035	0.00031	0.00068	0.00033
13	0.00136	0.00046	0.00039	0.00088	0.0004
12	0.0016	0.00055	0.00045	0.00105	0.00045
11	0.00179	0.00062	0.00054	0.00119	0.0005
10	0.00197	0.00067	0.00054	0.0013	0.00054
9	0.00214	0.00071	0.00058	0.0014	0.00057
8	0.0023	0.00075	0.00061	0.00148	0.0006
7	0.00244	0.00078	0.00064	0.00156	0.00062
6	0.00257	0.00082	0.00067	0.00163	0.00063
5	0.00268	0.00085	0.00069	0.00171	0.00064
4	0.00278	0.00088	0.00071	0.00177	0.00065
3	0.00285	0.00091	0.00073	0.00181	0.00065
2	0.00278	0.00094	0.00076	0.00175	0.00066
1	0.00184	0.00076	0.00063	0.00116	0.00052
0	0	0	0	0	0

ST. No.	M6	M7	M8	M9	M10	M11
15	0.00023	0.00041	0.00015	0.00013	0.00019	0.0002
14	0.00029	0.00063	0.00021	0.00017	0.00029	0.00029
13	0.00034	0.00083	0.00026	0.00021	0.00038	0.00037
12	0.00038	0.00099	0.00031	0.00024	0.00045	0.00043
11	0.00042	0.00113	0.00035	0.00027	0.00052	0.00052
10	0.00045	0.00124	0.00038	0.00029	0.00057	0.00053
9	0.00047	0.00134	0.00041	0.00032	0.00061	0.00057
8	0.00049	0.00143	0.00043	0.00033	0.00065	0.0006
7	0.0005	0.00151	0.00045	0.00035	0.00068	0.00063
6	0.00051	0.00159	0.00047	0.00036	0.0007	0.00065
5	0.00052	0.00167	0.00048	0.00037	0.00073	0.00067
4	0.00052	0.00174	0.00049	0.00037	0.00076	0.0007
3	0.00051	0.00179	0.0005	0.00037	0.00078	0.00071
2	0.00051	0.00176	0.00051	0.00037	0.00099	0.00093
1	0.00042	0.00121	0.00042	0.00032	0.0014	0.00157
0	0	0	0	0	0	0

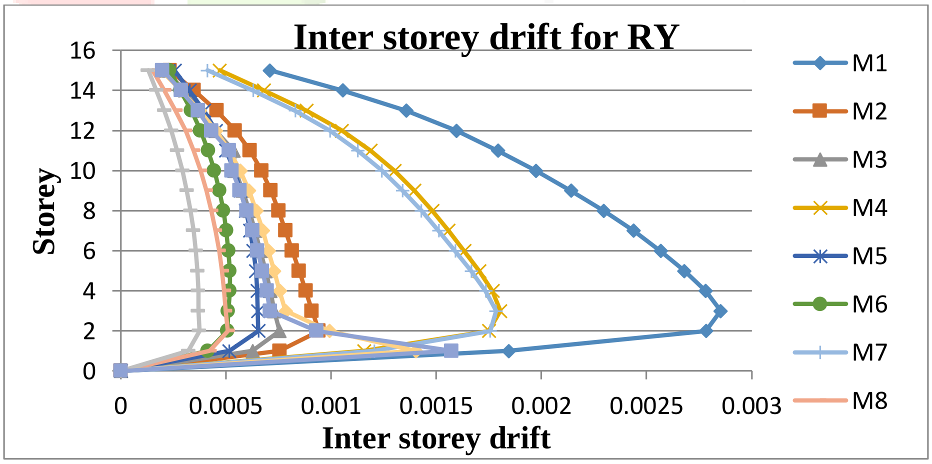

Fig 26 : Inter storey drift graph for RY

- The entomb story float greatest in M1 model at story-3 and least in M9 models at story-2.
- Entomb story float in M9 model at story-2 has 86% less bury story float contrasted with M1 model at story-3, M8 model at story-2 has 82% less, M6 at story-4 has 81% less, M5 at story-2 has 76% less, M3 at story-2 has 73% less, M2 at story-2 has 66% less, M10 at story-1 has half less ,M10 at story-1 has 46% less and models M4 and M7 at story-3 having 37% less separately.

5.8 BASE SHEAR

5.8.1Base shear along X and Y Direction inKN

Table 17 : Base shear along X and Y direction

Model	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11
Base shear (kN)	2755	3532	3625	1861	2078	2213	1563	1755	1849	3508	3615

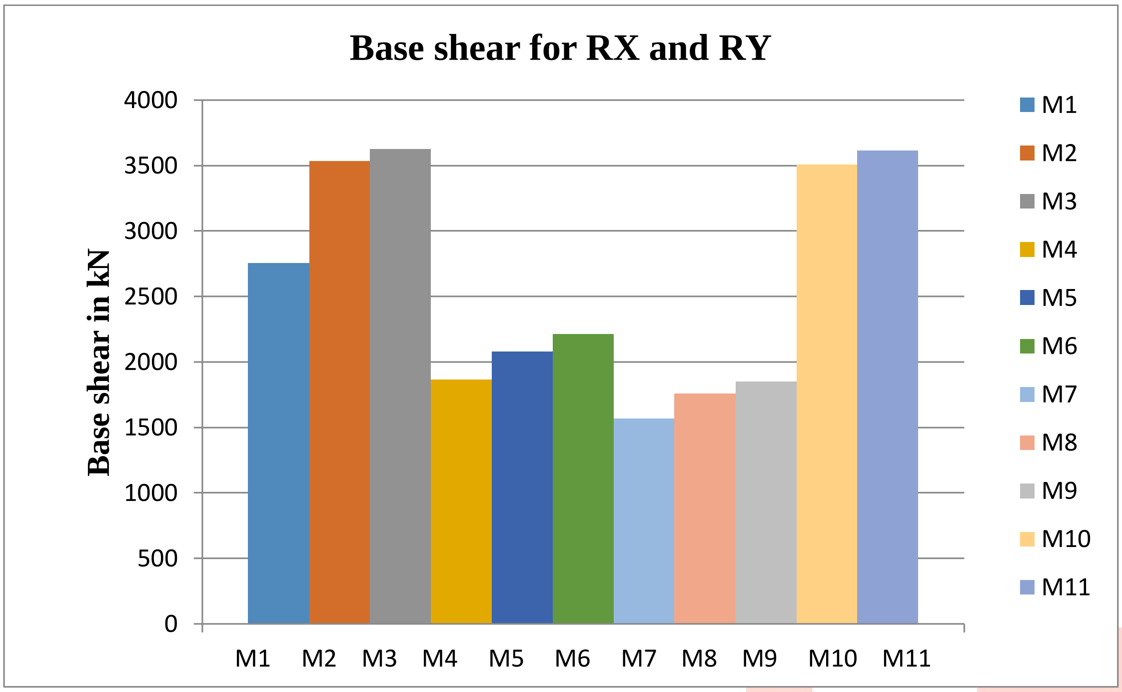

Fig.27: Base shear graph for RX and RY

- From the outcomes base shear is greatest in M3 model and least in M11 model.
- Base shear of M7 model has 60% less contrasted with M3 model, M8 model is 51% less, M4 and M9 models having 48% less , M5 has 42% less, M6 model has 38% less, M10 model has 3% less, M2 model has 2.5% less and M11model has 1% less separately.

5.9 STOREY STIFFNESS

5.9.1 Storey stiffness along X- direction

Table 18 : storey stiffness along X direction

Model	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11
Storey stiffness ratio	1.10	0.93	0.89	1.11	0.91	0.88	1.18	0.96	0.95	0.53	0.42

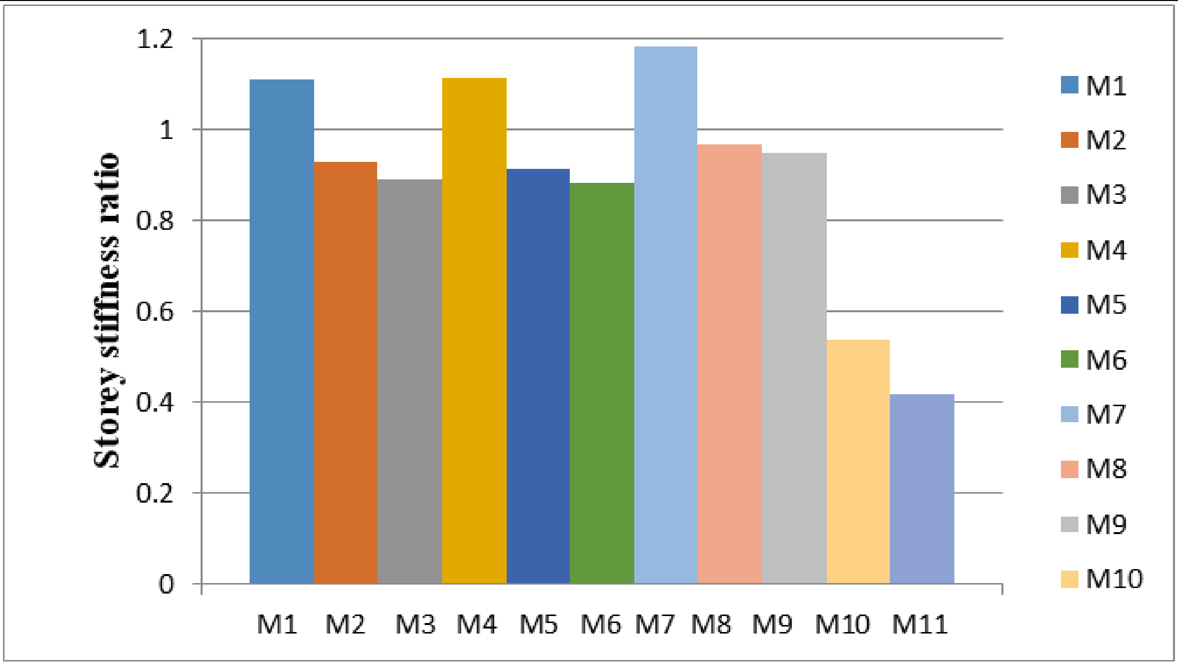

Fig28: Storey stiffness comparison graph at ground floor level

- The variation of the storey stiffness from ground floor to first floor is 58% for M11 model, 47% for M10 model ,12% for M6 , 11% for M3 model, 7% for M2 model, 9% for M5 model, 5% for M9 model, 4% for M8 model.
- The comparison of the storey stiffness from first floor to ground floor is 10% more in M1 model, 11% in M4 model and 18% in M7 model.

5.9.2 Storey stiffness along Y – direction

Model	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11
Storey stiffness ratio	1.16	0.97	0.94	1.14	0.97	0.94	1.12	0.92	0.89	0.55	0.54

Table 19– storey stiffness along Y-direction

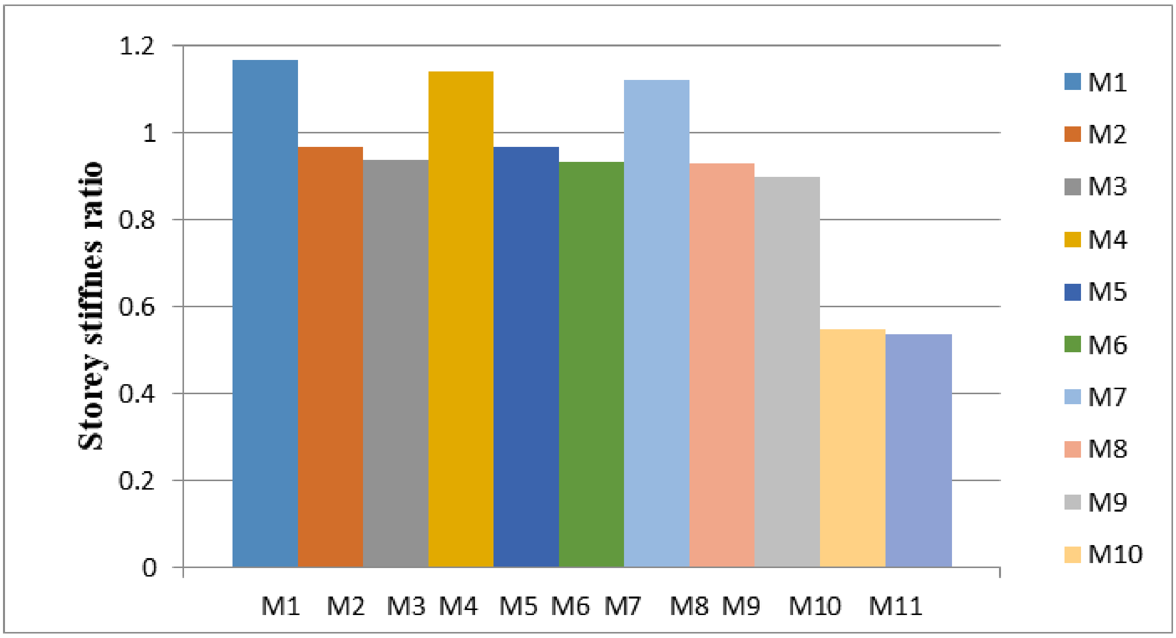

Fig 29: Storey stiffness comparison graph at ground floor level

- The variation of the storey stiffness from ground floor to first floor is 46% for M11 model, 45% for M10 model , 11% for M9 model, 8% for M8 model , 6%lfor M3 and M6 models , 3% for M2 and M5 models.
- The comparison of the storey stiffness from first floor to ground floor is 16% more in M1 model, 14% in M4 model and 12% in M7 model.

5.10 Fundamental time period from model analysis

Table 20 Fundamental time period from model analysis

MODEL	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11
Time period (sec)	2.97	1.84	1.52	2.26	1.35	1.20	2.54	1.29	1.17	1.84	1.69

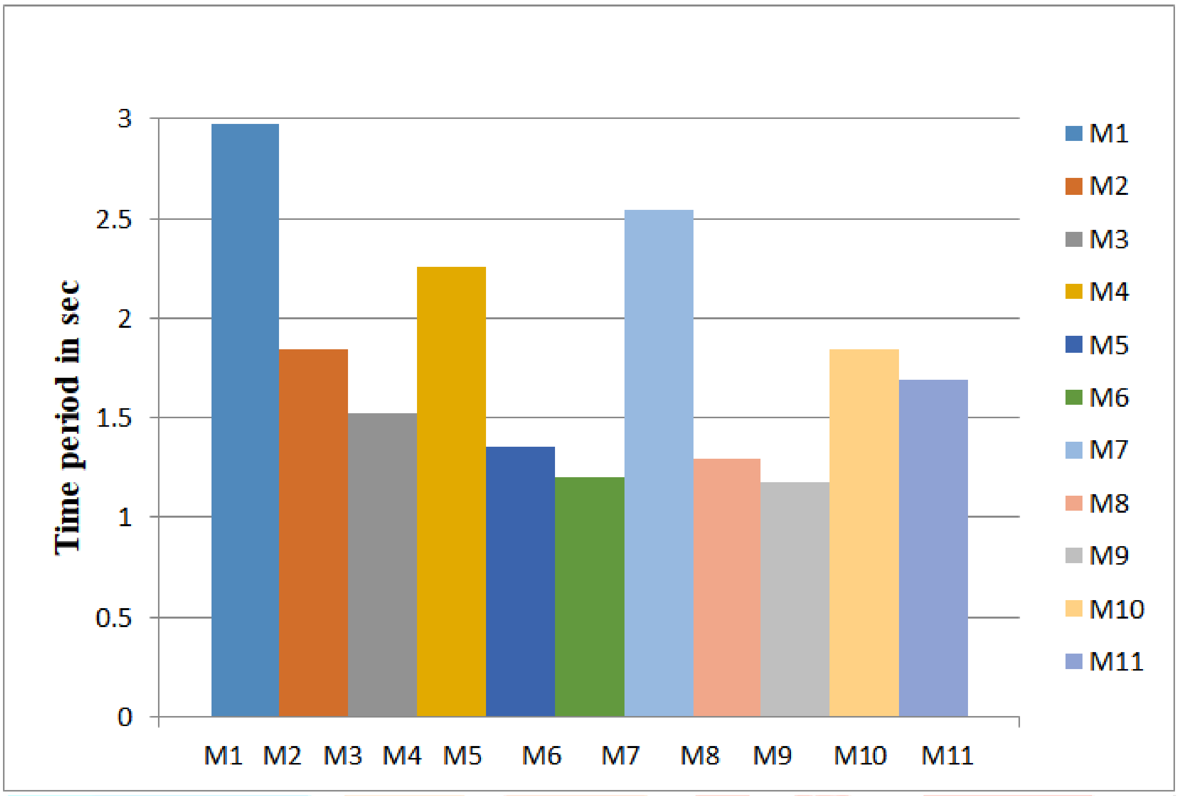

Fig 30: Graph for fundamental time period

Following are the results obtained for time period at 1st mode.

- From the chart we got most extreme time span in M1 model and least in M9 model.
- Time span of M9 model is 60% lesser contrasted with M1 model , M6 model is 58% less, M8 is 55% lesser , M5 is 53% lesser , M3 is 48% lesser , M11 is 42% lesser , M2 and M10 models are 37% lesser, M4 is 22% lesser and M7 is 7% lesser individually

SCOPE FOR FURTHER STUDY

The findings of this study have been summarized within confines of this paper. However, the following areas need more investigation.

- Into current research all building models are analysed utilising Equivalent static & response spectrum analyzing, moreover it maybe analysed using time history and push over analysis.
- In the present study size of columns & beams have been unaltered. Optimizing the dimensions of beams and columns is possible.
- Impact of opening infilled frame may be studied in same way.
- Similar study can be performed by using different types of infill walls.

VI. CONCLUSION

The present study can be concluded as:

1) The relocation of infilled outlines are radically diminished when contrast with exposed outlines both in Hendry & Mainstone technique because of its high overt repetitiveness with occurrence of corner to corner swagger and furthermore in the event of customary and sporadic structure models.
2) Entomb story float are decreased in infilled outline models as contrast with uncovered outline models because of its high solidness with occurrence of infills.
3) Entomb story float got at delicate story higher contrast level with other individual stories that depicts bury story float is additionally amongst significant boundary for checking delicate story impact.
4) The entomb Story float values for all models are inside passable restriction of h/250 according to IS 1893(part-1):2002.
5) Both for Hendry & Mainstone strategies, the base shear obtained from craftmanship infill outlining models is greater than the base shear obtained from exposed outline models due of the additional mass of infill.
6) The soft storey effect can be checked based on the storey stiffness ratio between two consecutive stories.
7) In the present study storey stiffness results shows infill with stilt storey have soft storey effect and that should be take care while designing the vertical members of respective storey.
8) The fundamental time period obtained from IS 1893(part-1):2002 provisions do not match with modal analysis results both in the case of bare frames and infill frame models. Hence importance has to be given for masonry infill and soft storey conditions.
9) The fundamental time period of bare frame models are more comparing with infilled frame models because of high stiffness in case of infilled frames.
10) Time period of soft storey models are more compare to infilled models due to its reduction in stiffness.
11) The fundamental time period obtained in Mainstone method is more compare to Hendry method due to its less equivalent diagonal strut width.
12) The fundamental natural time period obtained using empirical formula is not matching with modal analysis. Hence response spectrum analysis should be performed for infilled frames.

REFERENCES

1. Jebin james /IRJET/ (2016) " seismic analysis of Rcc frame with masonry infill walls using ETABS"
2. Bhnaupratap R Mehadia Dr. U. P. Waghe | IJSTE (2016) "Comparative Studies in Analysis and Design of RCC Structures with and without Infill Wall under Seismic Effect"
3. Haroon Rasheed Tamboli and Umesh.N.Karadi/ IJONS (2012) "Seismic Analysis of RC Frame Structure with and without Masonry Infill Wall "
4. Arulmozhi.N , Jegidha.K, Srinivasan.R , Dr.Sureshbabu (2015) "Analytical Study on Seismic Performance Of Rc Frames In-Filled With Masonry Walls Using E-Tabs.
5. K. H. Abdelkareem, F. K. Abdel Sayed, M. H. Ahmed, N. AL-Mekhlafy (2013) "equivalent strut width for modelling R.c infilled frames"
6. Shobha. L1, Lakshmikantha. B. A2, R. Prabhakara (2016) "Analytical review on the variation of equivalent diagonal strut while modelling the masonry infill's"
7. S.K.Duggal, "Earthquake resistance design of structures"
8. Pankaj Agarwal, "Earthquake resistance design of structures"