Effective Location of Shear Wall And Bracings For Multistoried Plus Shape Building

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Abstract- *Earthquake is a natural calamity and can occurs all around the globe. The Earthquake will affect the buildings. To overcome the Earthquake there is establishment of Shear wall and Bracings and they will increase the stiffness, ductility of a structure and also they decrease the storey drift and displacement. The structure is analyzed by Linear static method and Response spectrum method by using E-tab software.*

In present paper G+25 multistoried building is analyzed by insertion of Shear wall and bracing at Corners, End and central core of the structure. The responses like Displacement, Storey drift, Time period and Base shear is calculated and equated.

Keywords- E-TAB, Shear Wall, Bracings, Linear static method, Linear dynamic method.

I. INTRODUCTION

The mainaim of this paper is to locate the effective location of shear wall and bracings by placing them at corners, end and at central core of a structure when subjected to seismic forces. The structure is analyzed by linear static method and Response spectrum method by using E-tab software.

A. SHEAR WALL

Shear walls are vertical RCC members that resist the seismic forces. They experience the Earthquake and wind load. They minimize the storey displacement when Earthquake signals hits the structure. In a structure, the load is transferred to the wall through Diaphragm (the structural section which crosswise the lateral load to the upright resisting section of the structure. These are largely in straight but can be tilted for parking the vehicles). The width of the shear wall usually be around 150-200 or more according to the load capacity. Since, the structure may not have appealing presence if the structure is sealed with shear wall along the building. So, to overcome bracing is approved to decrease the lateral forces and wind forces along with the shear wall. Nowadays combination os shear wall and bracing are adopted for the structure at different location.

- In this paper the regular shear wall is used of thickness 230mm.

B. BRACINGS

The bracing is united along with the structure to resist the Earthquake and wind load acting on a structure. Bracing can absorb the large amount of energy occur during Earthquake. They can resist the lateral displacement and strong ground motion acting on a structure. They are having high flexibility, economical, easy to erect and provide large strength and stiffness to the structure.

- In this paper the bracing of ISA 100mm x 100mm x 10mm are used for analysis.

II. OBJECTIVES OF THE PROJECT

- **A.** To investigate the actual location of shear wall and bracing on the basis of story displacement under lateral loading.
- **B.** To determine the percentage reduction in story displacement with different location of shear wall and bracing and on different model when compared to without shear wall and bracing.
- **C.** Equivalent static method and Response Spectrum method are used to analyze the structure byusing E-tab software(2018).
- **D.** To investigate the responses like Displacement along X-direction, Story drift, Time period and Base shear are evaluated and compared with above two method.

III. METHODOLOGY

In this paper an attempt is taken to investigate the seismic effect on G+25 multistoried RCC building model with shear wall and bracing. The models of 26 storeyed RCC building is created and analyzed by ETAB (2018) software. After successfully completion of models, the finest position of shear wall and bracing is found out by changing the position of shear wall and bracing to minimize the seismic effect.

Different models were created and results are compared with additional models.

The height of each storey is maintained 3.2m. The considered seismic zone is V and soil is medium. In this paper the structure includes live load, earthquake load and dead load and these are accordingly to IS 875 part 1, IS 1893-2016, IS 875 part I respectively. The structure is analyzed by Linearstatic method and Linear dynamic method. The responses like Displacement, storey drift, Time period and Base shear are calculated. After analyzing the structure, the obtained values are used to form table, graphs and lastly the conclusion.

A. Linear static method

This method is used to find the crosswise(horizontal) signals. This method is simple and required less computational energy and that is calculated according to the IS code of practice. In this method firstly the design of Base shear is calculated for the whole building and then the obtained results of Base shear is circulated all along the height of the building. The crosswise signal of each floor is circulated to each horizontal resisting section.

B. Linear dynamic method

IS 1893(part 1): 2002 has recommended the method of dynamic analysis of buildings in case of (i) Regular buildings-those higher than 40 m in height in zones IV and V, and those higher than 90 m in height in zones II and III.(ii) Irregular buildings- all framed buildings higher more than 12m in height in zones IV and V and those higher than 40m in height in zones II and III. The main aim of dynamic analysis is to find the design seismic signals, which is circulated to various point along the height of the building and to the different crosswise load resisting section of the structure and the analysis is somewhat similar to linear static method. In case of dynamic analysis the whole masses are assumed to be lumped at the storey level and at each storey only sway displacement is permitted. The analysis of dynamic method, it is assumed that irregular type of building is based on 3D modelling of that building that will have adequate stiffness and mass circulation along the height of the building so that its responses could be predicted easily and with more accuracy.

IV. STRUCTURAL MODEL

The plan area of the structure is 60.22mx50.22m and height of the structure is 84.24m.The grouping of Shear wall and bracings are placed at different location of structure at corners, end and core of the structure. The crosswise displacement of the structure is calculated and compared.

A. Properties of members

Young's modulus of concrete	35355.33MPa
Poisson's ratio	0.2
Density 25 KN /m^3	
Thermal coefficient	0.0000055/^{o}C
Grade of concrete	M_{50}
Yield strength of steel	Fe_{500}

B. Seismic Parameter

Zone value	0.36
Response reduction factor	5
Importance factor	1.5
Damping ratio	0.05

C. Size Of Members

Column size	900mm x1200mm
Beam size	300mm x600mm
Slab thickness	150mm
Shear 300mm	
Bracings	ISA 100x100x10mm

D. Load Intensity

Live load on each floor	3 KN/m^2
Live load	1.5 KN/m^2
Floor finish	1 KN/m^2
Wall load	11.96 KN/m^2

E. Load Combinations

The load combination is itself calculated by the E-TAB software and the models are analyzed as the calculated load combination.

V. ABOUT E-TAB

ETABS is a delineating programming thing that obliges multi-story building examination and plan. Showing instruments and code-based load cures, examination methodology and approach systems, all make with the system like geometry rise to this class of structure. Fundamental or pushed structures under static or dynamic conditions may be inspected using ETABS. For a pushed evaluation of seismic execution, measured and plan joining time-history examinations may couple with P-Delta and Large Displacement impacts. Nonlinear affiliations and concentrated PMM or fiber turns may get material nonlinearity under monotonic or hysteretic arrange. Regular and supported parts make organizations of any versatile quality profitable to execute. Interoperability with an improvement of plan and documentation stages makes ETABS a sorted out and profitable contraption for outlines which keep running from clear 2D edges to increase current lifted structures.

The creative and dynamic new ETABS is a whole framed programming pack for the accomplice examination and plan of structures. Merging 40 years of persevering creative work, this latest ETABS offers unmatched 3D address based showing and portrayal instruments, blazingly savvy quick and nonlinear illustrative power, mind boggling and intensive game-plan limits in regards to a broad accumulation of materials, and skilled sensible introductions, reports, and schematic drawings that connect with customers to quickly and easily unravel and comprehend examination and setup happens.

Fig 1 shows the reference axis in E-TAB (2018) software. The X and Y co-ordinates indicates the horizontal direction parameter and Z co-ordinates referred as vertical direction parameter

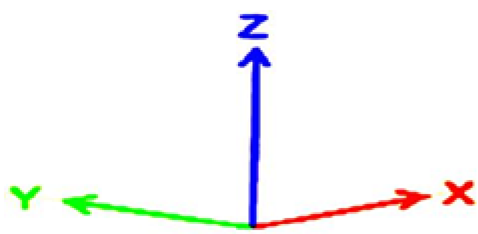


Fig 1: Generalized Coordinates in ETABS 2018

VI. PLAN AND 3D VIEW OF DIFFERENT MODELS

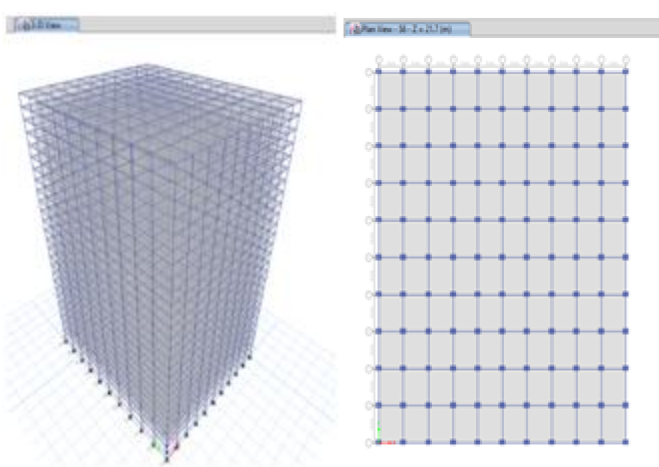


Fig 2: Regular building without shear wall and bracings

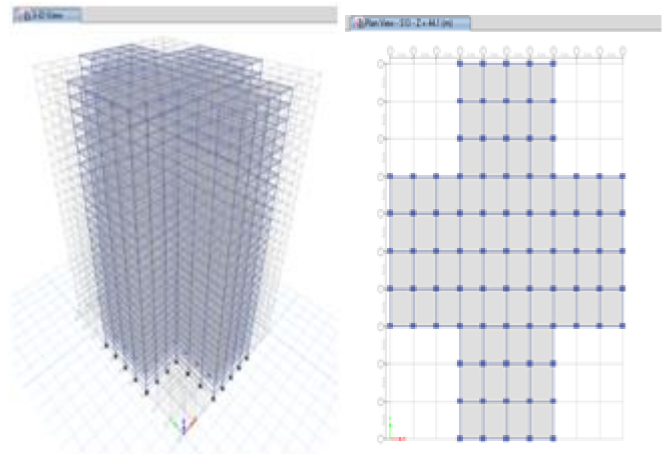


Fig 3: Regular PlusShape building without shear wall and bracings

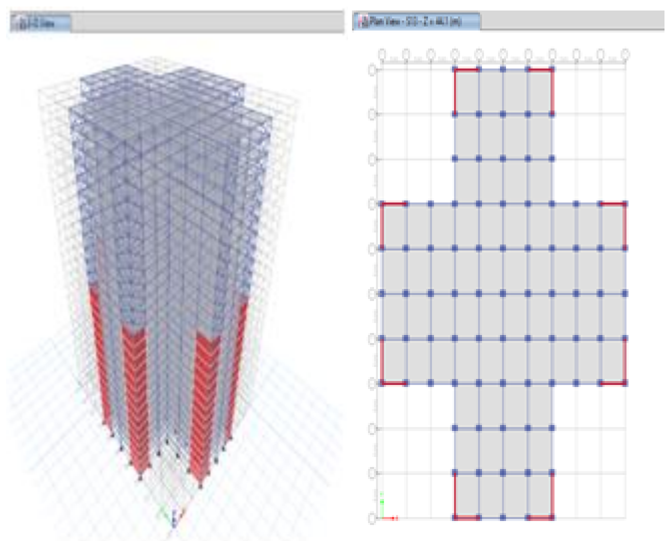


Fig 4: Plus shape building with shear wall and bracings @corners

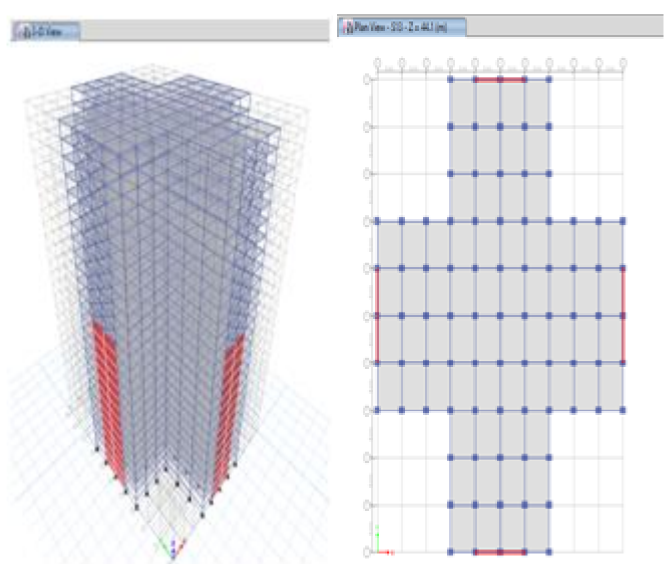


Fig 5: PlusShape building with shear wall and bracings @end

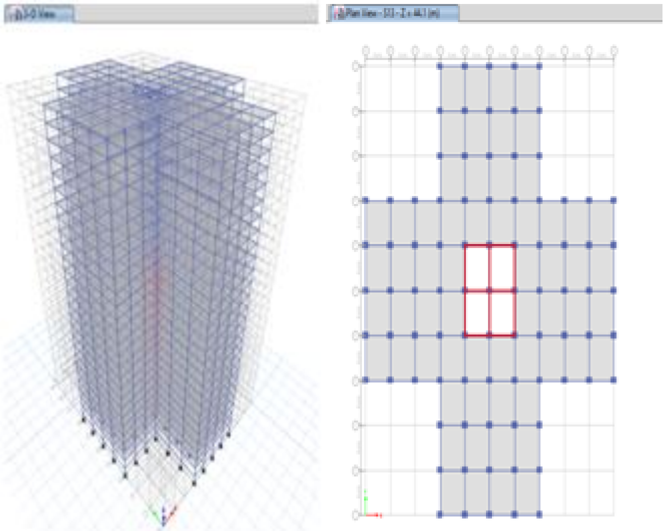


Fig 6: PlusShape building with shear wall and bracings @Central core

VII. RESULTS AND DISCUSSION

The results of lateral of Normal building and dual system building with combination of shear and bracings) placed at corners, end and central core of building. The lateral responses like displacement, storey drift, time period and base shear is evaluated and compared.

Table I. Displacement due to Equivalent Static Method

DISPLACEMENT DUE TO EQUIVALENT STATIC METHOD					
Storey	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5
	X-DIR	X-DIR	X-DIR	X-DIR	X-DIR
S26	114.046	132.21	113.881	115.886	104.595
S25	112.739	130.612	111.56	113.785	102.308
S24	111.149	128.696	108.835	111.287	99.667
S23	109.183	126.357	105.597	108.275	96.452
S22	106.807	123.548	101.808	104.706	92.619
S21	104.015	120.264	97.474	100.582	88.172
S20	100.819	116.517	92.622	95.93	83.151
S19	97.244	112.333	87.303	90.798	77.616
S18	93.317	107.744	81.583	85.248	71.657
S17	89.069	102.786	75.551	79.367	65.404
S16	84.532	97.496	69.338	73.269	59.037
S15	79.735	91.909	63.142	67.123	52.817
S14	74.711	86.061	57.284	61.19	47.238
S13	69.487	79.987	52.009	55.698	42.682
S12	64.093	73.72	46.843	50.322	38.361
S11	58.555	67.292	41.704	44.97	34.132
S10	52.9	60.735	36.626	39.662	29.977
S9	47.155	54.081	31.653	34.44	25.925
S8	41.348	47.364	26.828	29.35	22.011
S7	35.511	40.623	22.202	24.441	18.271
S6	29.683	33.903	17.826	19.77	14.744
S5	23.915	27.267	13.758	15.396	11.47
S4	18.284	20.805	10.06	11.384	8.491
S3	12.907	14.652	6.799	7.804	5.852
S2	7.971	9.025	4.053	4.735	3.595
S1	3.786	4.273	1.902	2.264	1.763
GR	0.867	0.976	0.507	0.699	0.559
BASE	0	0	0	0	0

Table II. Displacement due to Response Spectrum Method

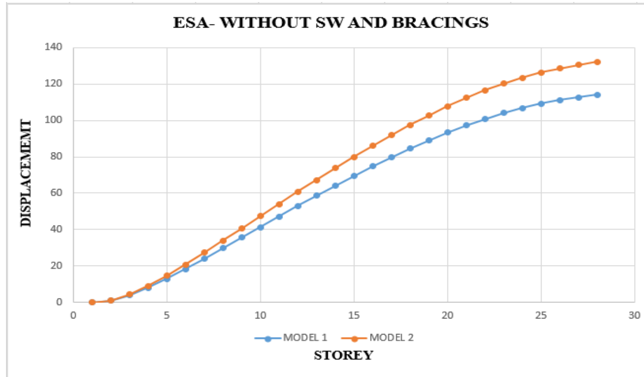
DISPACEMENT DUE RESPONSE SPECTRUM METHOD					
Storey	**MODEL 1**	**MODEL 2**	**MODEL 3**	**MODEL 4**	**MODEL 5**
	X-DIR	X-DIR	X-DIR	X-DIR	X-DIR
S26	102.777	103.832	83.463	85.59	76.576
S25	101.783	102.707	81.766	84.058	74.875
S24	100.579	101.376	79.793	82.258	72.928
S23	99.092	99.77	77.479	80.121	70.592
S22	97.296	97.86	74.812	77.629	67.851
S21	95.186	95.642	71.804	74.791	64.725
S20	92.764	93.118	68.478	71.627	61.247
S19	90.039	90.298	64.864	68.162	57.463
S18	87.019	87.188	61.002	64.429	53.434
S17	83.712	83.798	56.946	60.476	49.241
S16	80.129	80.139	52.765	56.363	44.993
S15	76.28	76.222	48.563	52.177	40.829
S14	72.177	72.057	44.497	48.04	36.999
S13	67.83	67.657	40.693	44.063	33.689
S12	63.251	63.031	36.907	40.097	30.5
S11	58.45	58.192	33.105	36.108	27.334
S10	53.439	53.151	29.309	32.113	24.192
S9	48.232	47.921	25.548	28.139	21.097
S8	42.843	42.519	21.855	24.218	18.076
S7	37.289	36.961	18.265	20.385	15.155
S6	31.594	31.274	14.82	16.681	12.364
S5	25.8	25.499	11.567	13.153	9.735
S4	19.983	19.715	8.56	9.857	7.305
S3	14.276	14.055	5.863	6.857	5.112
S2	8.91	8.751	3.548	4.23	3.198
S1	4.27	4.182	1.696	2.061	1.602
GR	0.985	0.962	0.468	0.651	0.52
BASE	0	0	0	0	0

Table III. Storey Drift due to Equivalent Static Method

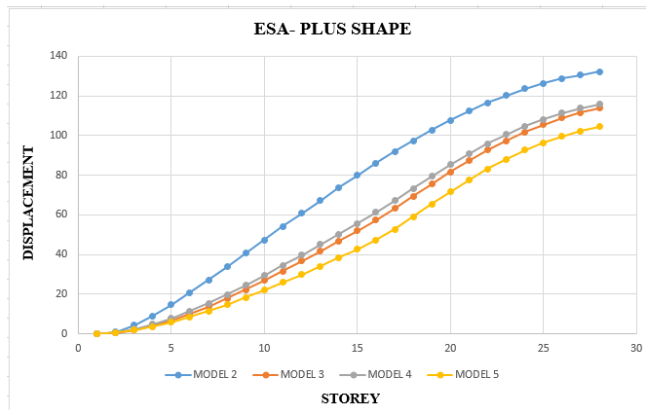
STOREY DRIFT DUE EQUIVALENT STATIC METHOD					
Storey	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5
	X-DIR	X-DIR	X-DIR	X-DIR	X-DIR
S26	0.000408	0.000499	0.000725	0.000657	0.000723
S25	0.000497	0.000599	0.000852	0.000781	0.000826
S24	0.000614	0.000731	0.001012	0.000941	0.001005
S23	0.000743	0.000878	0.001184	0.001115	0.001198
S22	0.000873	0.001026	0.001355	0.001289	0.00139
S21	0.000999	0.001171	0.001516	0.001454	0.001569
S20	0.001117	0.001307	0.001662	0.001604	0.00173
S19	0.001227	0.001434	0.001788	0.001734	0.001862
S18	0.001327	0.001549	0.001885	0.001838	0.001956
S17	0.001418	0.001653	0.001942	0.001906	0.001992
S16	0.001499	0.001746	0.001936	0.00192	0.001985
S15	0.00157	0.001827	0.001831	0.001854	0.001797
S14	0.001632	0.001898	0.001648	0.001716	0.001433
S13	0.001686	0.001959	0.001615	0.00168	0.00135
S12	0.001731	0.002009	0.001606	0.001673	0.001329
S11	0.001767	0.002049	0.001587	0.001659	0.001301
S10	0.001795	0.002079	0.001554	0.001632	0.001269
S9	0.001815	0.002099	0.001508	0.001591	0.001226
S8	0.001824	0.002107	0.001446	0.001534	0.001171
S7	0.001821	0.0021	0.001367	0.00146	0.001105
S6	0.001802	0.002074	0.001271	0.001367	0.001026
S5	0.00176	0.00202	0.001156	0.001254	0.000934
S4	0.00168	0.001923	0.001019	0.001119	0.000828
S3	0.001542	0.001759	0.000858	0.000959	0.000707
S2	0.001308	0.001485	0.000672	0.000772	0.000573
S1	0.000915	0.001034	0.00046	0.000546	0.000422
GR	0.000347	0.00039	0.000203	0.00028	0.000223
BASE	0	0	0	0	0

Table IV. Storey Drift due to Response Spectrum Method

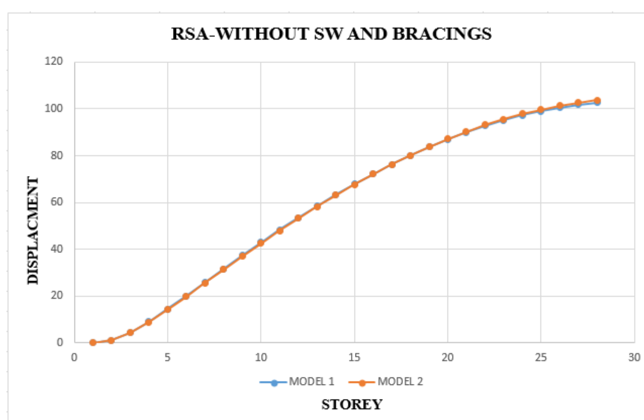
STOREY DRIFT DUE RESPONSE SPECTRUM METHOD					
Storey	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5
	X-DIR	X-DIR	X-DIR	X-DIR	X-DIR
S26	0.000438	0.000475	0.000637	0.000603	0.000644
S25	0.000542	0.000577	0.000764	0.00073	0.000768
S24	0.000671	0.000703	0.000913	0.000881	0.000933
S23	0.000798	0.000828	0.001053	0.001021	0.001087
S22	0.000911	0.00094	0.001172	0.001141	0.001222
S21	0.001008	0.001037	0.001274	0.001241	0.001335
S20	0.001093	0.001121	0.00136	0.001326	0.00143
S19	0.00117	0.001197	0.001431	0.001399	0.001503
S18	0.001244	0.00127	0.001481	0.001455	0.001544
S17	0.001316	0.001339	0.001498	0.001484	0.00154
S16	0.001385	0.001406	0.001468	0.001473	0.001507
S15	0.00145	0.001469	0.001367	0.001404	0.001342
S14	0.001511	0.001528	0.00123	0.001297	0.001072
S13	0.001569	0.001584	0.001214	0.00128	0.001021
S12	0.001624	0.001636	0.001216	0.001283	0.001014
S11	0.001675	0.001685	0.00121	0.001281	0.001001
S10	0.001722	0.001729	0.001196	0.00127	0.000984
S9	0.001763	0.001766	0.001171	0.001249	0.000959
S8	0.001796	0.001797	0.001135	0.001216	0.000926
S7	0.001823	0.00182	0.001086	0.001171	0.000883
S6	0.001837	0.001831	0.001023	0.001112	0.00083
S5	0.001832	0.001822	0.000944	0.001036	0.000766
S4	0.00179	0.001775	0.000845	0.000941	0.000691
S3	0.001679	0.00166	0.000725	0.000823	0.000601
S2	0.001451	0.001429	0.000579	0.000678	0.000499
S1	0.00103	0.001009	0.000408	0.000494	0.000381
GR	0.000394	0.000385	0.000187	0.000261	0.000208
BASE	0	0	0	0	0



Graph 1(a): Regular building without SW and bracings (ESA)

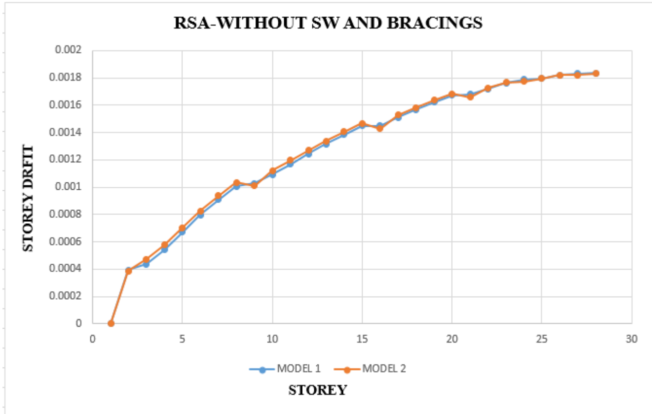


Graph 1(b): Plus shape building with SW and bracings (ESA)

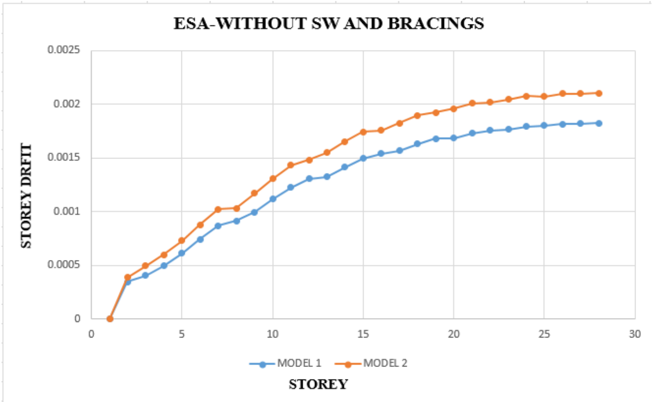


Graph 2(a): Regular building without SW and bracings (RSA)

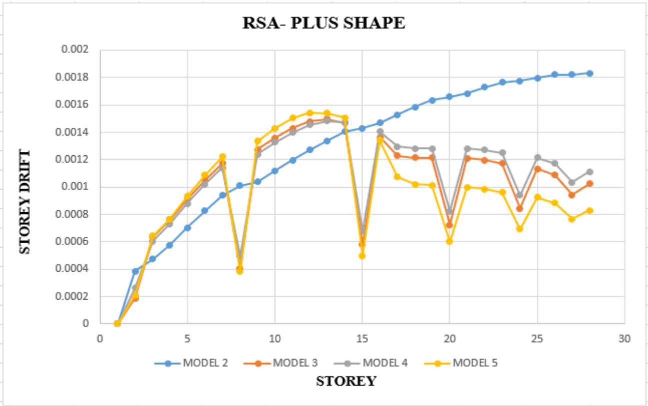
Graph 2(b): Plus shape building SW and bracings (RSA)



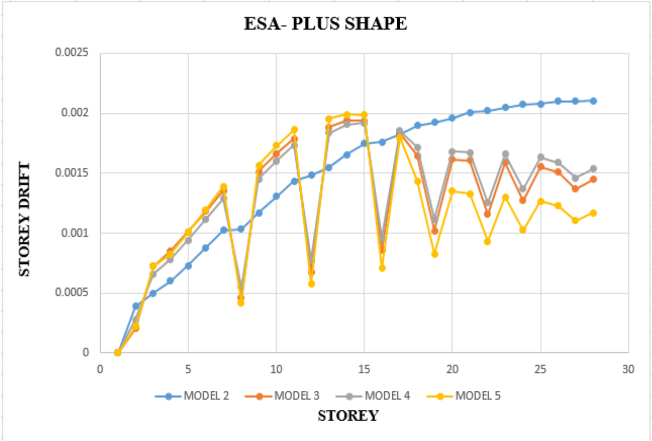
Graph 4(a): Regular building without SW and bracings (RSA)



Graph 3(a): Regular building without SW and bracings (ESA)



Graph 4(b): Plus shape building with SW and bracings (RSA)



Graph 3(b): Plus shape building with SW and bracings (ESA)

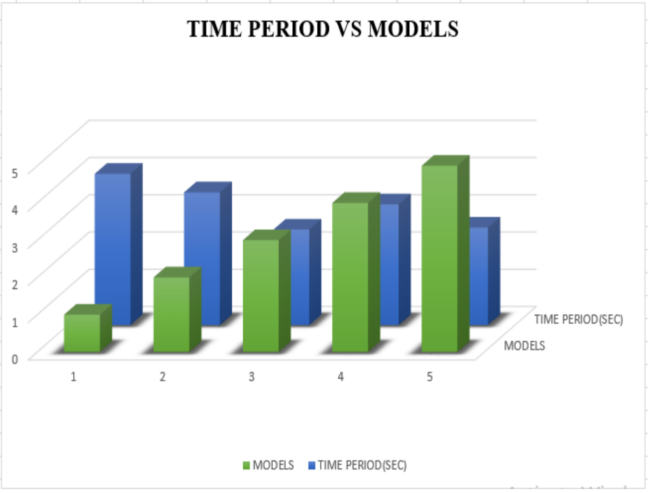


Fig 7: Time Period vs.Storey

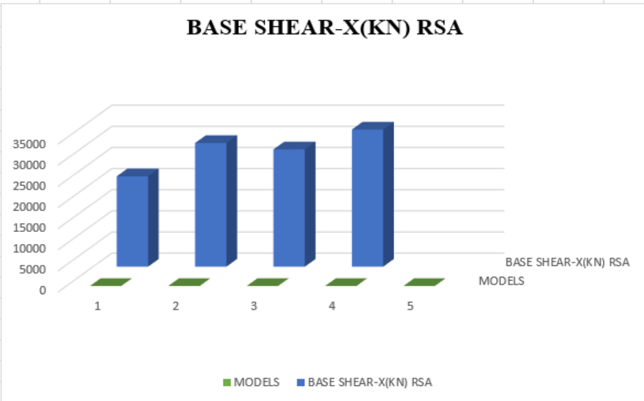


Fig 8: Base Shear of Response Spectrum Method

DISCUSION:

1. The Displacement, Storey drift, Time Period and Base Shear of regular building and Plusshape building models are compared. The variation is less in these models because of the same stiffness and corresponding loads.
2. Plus shape models are considered with shear wall and bracing at different location, the models without shear wall and bracing has the higher displacement value because of absence of stiffeners.
3. The shear wall and bracing(combination) plays an important role in reducing the lateral load. Among all the models the shear wall with bracing @central core proves to be more effective than shear wall with bracing at other location.
4. The graph 2(a) shows the highest displacement because of absence of shear wall and bracing(stiffeners)
5. The graph 2(b) shows displacement of all plus shape models with shear wall and bracing. Among all the models the shear wall and bracing @central core proves to be effective than shear wall with bracing at other locations.
6. The graph 4(a) shows the highest storey drift because of increase in displacement value
7. The graph 4(b) shows the storey drift of all the Plusshape models with shear wall and bracing. Among all the models the shear wall with bracing @central core has the lesser storey drift because of decrease in displacement value.
8. The fig 7 shows Time Period vs. different models, the model i.e.Plusshape with SW wall bracing @central core has lowest time period because of decrease in displacement.
9. The fig 8 shows the Base Shear vs. different models, the model i.e.Plusshape regular has the lowest Base Shear value because of absence of stiffeners.
10. The variation in displacement is found to be 19.77% reduction in model i.e.Plus shape with SW & bracings @corners, 17.56% reduction in model i.e.Plusshape with SW & bracings @end, 26.26% reduction in model i.e.Plusshape with SW and bracings @core when compared to the model i.e.Plus- shape regular.
11. The variation in time period is found to be 33.35% reduction in model i.e.Plus shape with SW & bracings @corners, 29.88% reduction in model i.e.Plusshape with SW & bracings @end, 37.17% reduction in model i.e.Plusshape with SW and bracings @core.

VIII. CONCLUSION

Equivalent Static Method

1. The displacement for model i.e.Plus shape with SW and bracing @central corei.e.is lowest when compared to all other models because of presence of stiffeners.
2. The displacement in model i.e. Plus shape regularis highest compared to model i.e.Plusshape with SW and bracing @ corners, model i.e.Plusshape with SW and bracings @end and model i.e.Plusshape with SW and bracings @core.
3. In Plusshape models the SW with bracings @central core prove to be more effective than SW with bracings @ end and corners.
4. The time period for models i.e. Plus shape regular is highest among the model i.e.Plus shape with SW and bracings @corners, plusshape with SW and bracings @end,Plus shape with SW and bracings @core.
5. In Plus shape models the base shear value is more in plus shape with SW and bracings @corners compared to all others plusshape models.

Response Spectrum Method

1. The displacement of model i.e.Plusshape with SW and bracings @central core is lowest when compared to all others models because of presence of stiffeners.
2. The displacement in model i.e.Plus shape regular is highest compared to model i.e.Plusshape with SW and bracing @ corners, model i.e.Plusshape with SW and bracings @end and model i.e.Plus shape with SW and bracings @core.
3. In plusshape models the SW with bracings@ central core prove to be more effective than SW with bracings @ end and corners.
4. The time period for models i.e.Plusshape regular is highest among the model i.e.Plus shape with SW and bracings@corners, Plus-shape with SW and bracings @end,plus- shape with SW and bracings @core.
5. In Plus shape models the base shear value is more inplus shape with SW & bracings @corners

compared to all others plus- shape models because of presence of stiffeners.

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