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Seismic Analysis of RC Irregular Building Using Different Types of Slab in Zone-V

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A B S T R A C T

The selection of the type of structure for a specific function is becoming increasingly crucial for design engineers. In some cases, slab structures and grid structures are more advantageous than traditional RC Framed Structures. Architectural elements, such as the flexibility of space usage within structures, ease of form work, and so on, have a significant effect in the selection of design criteria, even though the conventional approach naturally delivers higher seismic protection. The purpose of this project work is to investigate and compare the technique and performance of the conventional RC frame slab, flat slab, and grid slab. Under seismic zone IV, these are being examined and analyzed. E-Tabs 2015 IS Code 456-2000 is used to create the models. G+20 storey buildings are selected and designed, and gravity (D.L and L.L) and lateral (earthquake) loads are analyzed. The equivalent static approach and the response spectrum method are used to design and analyze earthquake resistant structures as defined by the Indian Standard Code. The study contains useful information about storey drift, displacement, base shear, storey shear, and time period. The seismic performance of the grid slab structure was found to be superior to that of the flat slab construction.

Keywords: Base shear, displacement, storey drift, time period,

1. INTRODUCTION

Due to fast growing population and limited space available in locality made an impact on the development of vertical increase together with low upward thrust, medium upward push and excessive upward push homes. Generally strengthened concrete is the primary creation fabric applies for this type of homes and this is used for constructing construction considering nineteenth century. RC structures were subjected to self-weight and lateral load, which might be live load, superimposed load, and horizontal load are those which include earth quake load and wind load. Earlier structure was designed forr simplest gravity loads that may not have ability to bear lateral loads. The failure of buildings happens frequently within the seismic susceptible regions wherein the structures are not properly designed for earthquake load and wind load. Hence it was very much essential to design the structures to have enough stiffness to withstand the horizontal forces. For this motive an earthquake resistant layout of RC structures is a cutting-edge part of research internationally. The main explanation of this seismic tremor safe design of reinforced substantial exploration is to format underlying donors of building like beam, column, and slab withstand against the dynamic forces and ensure the structure must be secure and firm under impact of most noticeably awful circumstance. Usually in strengthened concrete buildings to withstand towards lateral load, now and again structural contributors are changed that may be column, beam and slab, but in this assignment is extra issue approximately slabs. Usually, there may be such a lot of kinds of slab however right here will speak about 3 different forms of slabs that are conventional, grid and flat slab.

Conventional slab: *The slab which is resting on walls/beams is known as normal slab. They are commonly in square or in rectangular form. But some time due to irregular room the slab will also in irregular form like triangle, trapezoidal, circular etc.*

Flat Slab: *The way of construction of slab without beams is normally referred as flat slab. The flat slab may be with drop or without drop.*

Grid floor Slab: Grid floor slab is a slab having beams spaced at regular intervals and it is monolithic with slab. Where column free area is required their grid floor will be hired for architectural point of view for maximum rooms which include auditoriums, theatre halls, and display rooms of stores. The rectangular or rectangular void fashioned within the ceiling is advantageously utilized for architectural lighting fixtures.

2. LITERATURE REVIEW:

1. **Paritosh Singh, Rajesh Joshi:** In this study they review the past researches and publications explaining regarding efficiency of different type of slab among different structures. This paper will help in understanding the capability of other types of slab and their usage in analysis and designing.

2. **Dr Ramakrishna Hedge, Chethana, Nanditha Vinod Kumar:** In this task work an endeavor is made to study and look at the method and exhibitions of the Conventional RC outline piece, Flat Slab and Grid section. These are examined & investigated, underr seismic zone II. The models are finished utilizing E-Tabs 2015, IS Code 456-2ooo. G+14 story structures are taken and planned and examination is finished for both Gravity (D.L and L.L) and horizontal (earth tremor and wind) loads. The same static technique is utilized to plan what's more, break down the constructions, as arranged by Indian Standard Code for quake safe constructions. Study gives great data about story float, story relocation, base shear, story shear, and time-period. It is seen that the seismic execution of network piece structure was better as contrasted with that of level section structure. It is tracked down that the story float of traditional piece is 10% higher than level chunk furthermore, lattice piece. The base ṣhear of regular section is 44% higher than flat slab and 37% higher contrasted with grid slab.

3. **Thummala, Spoorthy, S. Ramesh Reddy:** here current work was assessment of Conventional building and flat slab with Drop in separate zoneṣ, adopting EṬABS program. Accordingly, the attributes of a seismic direct of Flat section and Conventional RC body developing measures for controlling the idea and plan of those frameworks and for working on the general presentation of structures all through seismic load. In Present work, a generally excellent number of measurements concerning boundaries which incorporate Story Displacement, Story shear, Overturning Moment, and Story Drift for Flat slab and Conventional Slab are outfitted & its variety of these boundaries in stand-out zones is likewise precise.

4. **Reshma R, Arunima V R:** The study shows that regarding how to concentrate about multi-story ṣstructures having level sections with drops network piece framework under direct effective examination (Response spectrum research) in seismic zoneṣ i.e, zone 3 & 5 with medium ṣoil conditions. For this software Etabs were used. The analysis was done to study the nature of base shear.

5. **Sudhir Singh Bhaduria, Nitin Chhugani:** This review shows that comparative analysis& layout of flat slab and grid slab device with normal slab system evaluation of parameters like concrete quantity, steel quantity, BM, SF and deflection of flat slab and grid slab system with normal ṣlab. In this case, analysis for G+20 building for seismic zone II & IV was done through the usage of ETAB, the evaluation & design of slab system is performed by IS 456-2ooo and IS 1893-2oo2. Design of the slab is finished for one-of-a-kind spacing/grid size of column to discover which grid length of the column or plan location which slab is giving better result. Finally, they conclude that flat slab is most economical among other slab.

6. **Paritosh Singh, Rajesh Joshi:** The results of this analysis demonstrate, with regards to the performance of standard slab, flat slab, and grid slab individually. The best block method is determined after exhaustive research. Staad.pro was used for rendering, and it took into account square, hexagonal, & octagonal shapes for buildings. The models were created with a variety of floor plans, including 10, 20, and 30-story buildings. Twenty-seven examples were subjected to earthquake loadings, & results were analyzed to determine optimal faming method. Cost-benefit analyses of each of these buildings are incorporated into design of this construction.

7. **Ravi Kumar Makode, Saleem Akhtar, Geeta Batha:** They studied that population is increasing day to day and the space in locality is limited. They thought of constructing multistoried building. These building can be constructed in various structural forms. Based on arrangement of column, beam, slab the structure is divided in to two groups namely flat slab structure and framed structure. In case 0f flat slab where slab is resting on column has been adopted in too many buildings because of advantage of reduction in floor-to-floor height to get the architectural and economical demands.

8. **Muniraju K.S, Subramanya K.G:** The analysis is accomplished with both methods. Analytical software is used to calculate parameters such as horizontal displacement, narrative drift, & base stress; these are then compared and contrasted between two structures; & results, along with steady method and reaction spectrum, are provided to both.

3. Aim and scope of study:

3.1 Aim of Present Study:

1. Detailed examination of G+20 buildings with Zone-IV and their comparative study for different seismic parameters.

2. To know the highest base shear of the entire slab i.e conventional, Flat & grid floor slab of RC structures for zone-IV.

3. To know the cause of seismic level among intensity of several parameters like displacement, base shear, story drift, Time period.

4. To recognize the accomplish of response spectrum analysis level over the intensities of several parameter as displacement, base shear, storey drift, Time period.

5. To read and estimate the actual behavior of conventional R.C structure, grid floor ṣlab & flat slab R.C.C.

3.2 Scope of Present study:

By using Etabs software a total of twelve -3D modeled was prepared, usually the work consists of 21 storey RC frame building present in earth quake zone-IV, as per IS code. The total building height is 72 m. Load considered for analysis is dead load, live load, earth quake load; the analysis was done for complete 12 models having conventional slab, grid floor slab, and flat slab. Complete 12 models were analyze by ESA and RS method and find the base shear, time period, story drift, storey displacement. This work will help greatly in getting best result like protection, cost minimize, and easy feel in design of multistoried building.

4. Methodology:

This particular study begins with development of 3D model of RC structure. The analysis & designing of this building was taken up with considering DL, LL, &earth quake loads for the proposed structure. And the entire load will be designed by Indian standard codes with aid of design software **Etabs.**

4.1 Models description:

MODEL	DESCRIPTION	TYPE OF SLAB
model-1	RC framed building of L-Shape	CONVENTIONAL SLAB
model-2	RC framed building of T-Shape	
model-3	RC framed building of C-Shape	
model-4	RC framed building of U-Shape	
model-5	RC framed building of L-Shape	GRID FLOOR SLAB
model-6	RC framed building of T-Shape	
Model-7	RC framed building of C-Shape	
model-8	RC framed building of U-Shape	
model-9	RC framed building of L-Shape	FLAT SLAB
model-10	RC framed building of T-Shape	
model-11	RC framed building of C-Shape	
model-12	RC framed building of U-Shape	

4.2 Details of Structures:

Building type	Commercial Building
Frame type	Reinforced Concrete moment resisting fame
Total storey	21
Each storey ht	3.5 m
Bottom storey ht	2.0m
Total building ht	72m
Wall thickness	230mm
LL	4KN/m^2(As per IS-875-Part-II)
FF	1.0 KN/m^2
Concrete grade	M40,
Steel grade	Fe-500N/mm^2
Brick masonry density	18 KN/m^3
Size of column	C-800 x 1000 mm
Beam size	300 x 650mm
Slab thickness	150mm
Seismic Zone	IV
Soil type	medium
Response reduction factor	5 (SMRF)
Importance factor	1.5
Damping ratio	5%

4.3 Load Analysis:

4.3.1 Dead load: It consists of the weight of all material and fixed equipment's incorporated into the structure

4.3.2 Live load: All weights acting on a building other apart from dead loads constitute what are called live or forced loads.

4.3.3 Earth quake load: The technique for discovering the design force is otherwise called identical static strategy or seismic coefficient technique or direct static strategy.

5. Methods of seismic analysis:

These days, the constructions are intended to oppose in a tremor as indicated by horizontal power plan. Seismic create waves moving from beginning of its area with speeds relying upon the force and greatness of tremor. Effect of seismic upon designs relies upon firmness of construction, solidness of the dirt media, stature and area of the construction, and so forth quake powers are endorsed in IS 1893:2016 (part-I).

Methods for Seismic analysis of structure can be given as:

a. Equivalent Linear static Analysis

b. Response Spectrum Analysis

c. Time History Analysisş

d. Pushover Analysis.

6. Results and Discussion

6.1 General:

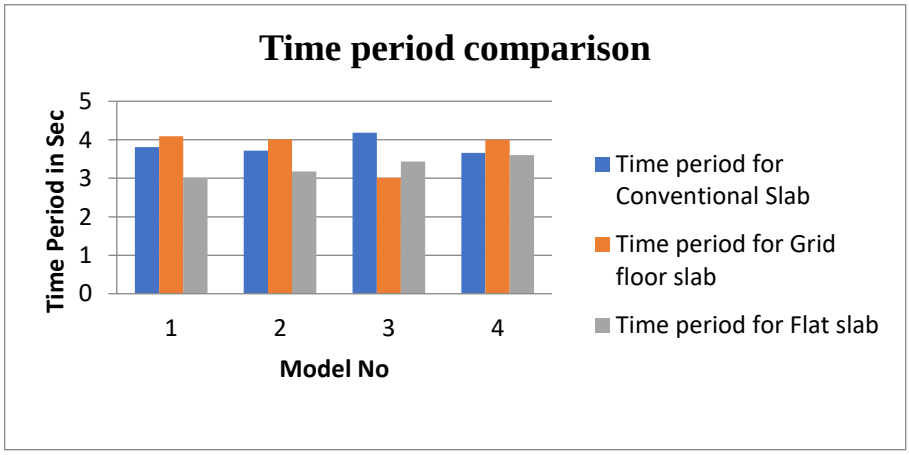
For the evaluation of full ten building models seismic load is applied. The analysis of the all the distinct building fashions is finished via the usage of ETABs 2015 software program. The evaluation effects along with displacements, storey drifts and term, base shear of all constructing fashions are supplied and as compared.

6.2 Time Period:

It is time required for completing one cycle of vibrations to pass in a given point.

Table 6.2.1: Below table shows time period for all different models.

Model No	Description of Slab	Time Period in Sec
1	**Conventional Slab**	3.808
2		3.718
3		4.18
4		3.66
5	**Grid Floor Slab**	4.092
6		4.012
7		3.012
8		4.001
9	**Flat Slab**	3.002
10		3.179
11		3.435
12		3.598



Graph 6.1: Maximum time period for all models

The above graph represents that the natural time period in model-01 (L-type building) with Conventional slab is 3.808 second, to the same model when conventional slab is replaced by Grid floor slab the time period increases by 6.94% and when conventional slab is replaced by Flat slab the time period decreases by 21.16%.

The above graphs represent that the natural time period in model-02 (T-type building) with Conventional slab is 3.718 second, to the same model when conventional slab is replaced by Grid floor slab the time period increases by 7.32 % and when conventional slab is replaced by Flat slab the time period decreases by 14.49 %.

From the graph it was seen that the natural time period in model-03 (C-type building) with Conventional slab is 4.18 second, to the same model when conventional slab is replaced by Grid floor slab the time period decreases by 27.94 % and when conventional slab is replaced by Flat slab the time period decreases by 17.82 %.

The above graph represent that the time period in model-04 (U-type building) with Conventional slab is 3.66 second, to the same model when conventional slab is replaced by Grid floor slab the time period increases by 8.52 % and when conventional slab is replaced by Flat slab the time period decreases by 1.693 %.

6.3 Displacement:

Storey displacement is defined as it is the displacement of considered floor with reference to the base of a structure, usually the base of a building being aground.

Deflection limit is H/500 where H-is height of structure as perclause5.6 Indian standard -800:2007

Allowable deflection is 72/500 = 0.144m = 144mm

Table 6.3.1: Below table shows displacement in mm of various models due to ESA along x and y-direction for **Conventional Slab**

Story No	**model 1 L-type**	**model 2 T-type**	**model 3 C-type**	**model 4 U-type**	**model 1 L-type**	**model 2 T-type**	**model-3 C-type**	**model 4 U-type**
	Along –X				**Along -Y**			
21	110.85	83.425	101.927	103.55	109.047	99.204	118.034	89.116
20	108.78	82.218	100.531	101.59	107.213	97.775	116.115	87.987
19	106.23	80.593	98.625	99.172	104.844	95.824	113.613	86.361
18	103.06	78.457	96.084	96.18	101.826	93.25	110.4	84.149
17	99.26	75.797	92.89	92.60	98.156	90.052	106.468	81.358
16	94.85	72.641	89.073	88.45	93.872	86.27	101.861	78.029
15	89.87	69.03	84.688	83.79	89.034	81.962	96.644	74.217
14	84.40	65.014	79.796	78.67	83.707	77.187	90.889	69.979
13	78.49	60.644	74.46	73.16	77.956	72.009	84.667	65.37
12	72.22	55.969	68.741	67.30	71.845	66.485	78.05	60.444
11	65.63	51.038	62.701	61.16	65.435	60.672	71.104	55.251
10	58.80	45.894	56.394	54.79	58.784	54.622	63.891	49.837
9	51.78	40.58	49.874	48.25	51.945	48.382	56.472	44.244
8	44.63	35.138	43.192	41.6	44.97	41.999	48.903	38.513
7	37.40	29.609	36.401	34.878	37.911	35.518	41.24	32.682
6	30.18	24.044	29.563	28.158	30.825	28.988	33.545	26.789
5	23.05	18.509	22.759	21.527	23.788	22.472	25.898	20.885
4	16.16	13.106	16.117	15.121	16.914	16.07	18.425	15.049
3	9.77	8.023	9.867	9.169	10.42	9.97	11.358	9.436
2	4.34	3.615	4.446	4.088	4.735	4.571	5.165	4.393
1	0.7	0.593	0.73	0.664	0.778	0.756	0.849	0.745
Base	0	0	0	0	0	0	0	0

From the table it is noticed that the displacement is highest for model-01 (L-type building) with conventional slab, if we go with model-02 (T- type building) the displacement decreases by 24.74%, when we go with model-03 (C-type building) the displacement decreases by 8.05%, when we go with model-04 (U-type building) the displacement decreases by 6.58% compare to model-01 along **X-direction**.

From the table it is noticed that the displacement along Y-direction is 109.047 mm for model-01 (L-type building) with conventional slab, if we go with model-02 (T-type building) the displacement decreases by 9.026 %, when we go with model-03 (C-type building) the displacement increases by 7.613 %, when we go with model-04 (U-type building) the displacement decreases by 18.27% compare to model-01 along Y-direction.

Table 6.3.2: Below table shows displacement in mm of various models due to ESA along x and y-directions for **Grid floor Slab**

Story No	**model 5 L-type**	**model 6 T-type**	**model 7 C-type**	**model 8 U-type**	**model 5 L-type**	**model 6 T-type**	**model 7 C-type**	**model 8 U-type**
	Along –X				**Along -Y**			
21	118.548	90.888	108.104	109.407	119.959	106.928	129.335	94.733
20	116.294	89.554	106.558	107.288	117.882	105.349	127.167	93.487
19	113.506	87.758	104.474	104.686	115.207	103.202	124.363	91.715
18	110.062	85.405	101.728	101.487	111.822	100.385	120.789	89.329
17	105.945	82.485	98.3	97.673	107.73	96.903	116.439	86.335
16	101.188	79.031	94.224	93.272	102.977	92.802	111.363	82.778
15	95.847	75.09	89.554	88.333	97.631	88.144	105.628	78.714
14	89.989	70.715	84.356	82.916	91.762	82.995	99.314	74.203
13	83.681	65.963	78.694	77.085	85.443	77.421	92.499	69.304
12	76.992	60.885	72.635	70.9	78.743	71.484	85.258	64.072
11	69.987	55.534	66.239	64.423	71.727	65.242	77.663	58.56
10	62.728	49.956	59.566	57.711	64.456	58.752	69.782	52.817
9	55.276	44.198	52.67	50.821	56.989	52.064	61.679	46.887
8	47.689	38.302	45.607	43.807	49.381	45.227	53.415	40.812
7	40.028	32.313	38.432	36.729	41.686	38.287	45.052	34.632
6	32.365	26.282	31.21	29.656	33.963	31.294	36.656	28.39
5	24.796	20.276	24.026	22.678	26.287	24.312	28.313	22.138
4	17.466	14.403	17.017	15.938	18.775	17.442	20.161	15.959
3	10.631	8.858	10.424	9.674	11.645	10.875	12.449	10.017
2	4.764	4.02	4.707	4.324	5.35	5.027	5.684	4.677
1	0.777	0.666	0.775	0.705	0.891	0.84	0.939	0.796
Base	0	0	0	0	0	0	0	0

From the table it is seen that the displacement is highest for model-05 (L-type building) with Grid floor slab, if we go with model-06 (T-type building) the displacement decreases by 10.86%, when we go with model-07 (C-type building) the displacement increases by 8.80%, when we go with model-08 (U-type building) the displacement decreases by 7.71 % compare to model-05 along **X-direction**.

From the table it is noticed that the displacement along Y-direction is 119.959 mm for model-05 (L-type building) with Grid floor slab, if we go with model-06 (T-type building) the displacement decreases by 9.026 %, when we go with model-07 (C-type building) the displacement increases by 7.24 %, when we go with model-08 (U-type building) the displacement decreases by 21.02% compare to model-05 along **Y-direction**.

Table 6.3.3: Below table shows displacement in mm of various models due to ESA along x and y-direction for **Flat Slab**

Story No	**model 09 L-type**	**model 10 T-type**	**model 11 C-type**	**model 12 U-type**	**model 9 L-type**	**model 10 T-type**	**model 11 C-type**	**model 12 U-type**
	Along -X				**Along -Y**			
21	107.255	105.235	101.25	107.539	107.005	77.111	117.25	70.385
20	104.501	101.79	98.25	104.566	104.257	74.837	114.35	69.031
19	101.394	98.044	94.35	101.269	101.158	72.34	111.35	67.383

18	97.821	93.911	90.25	97.536	97.593	69.544	106.25	65.361
17	93.739	89.363	85.45	93.322	93.521	66.419	102.39	62.945
16	89.149	84.407	81.25	88.619	88.94	62.963	96.25	60.145
15	84.075	79.071	75.35	83.45	83.879	59.195	91.25	56.987
14	78.561	73.397	70.28	77.852	78.378	55.141	87.35	53.506
13	72.657	67.433	63.26	71.872	72.488	50.838	82.35	49.738
12	66.42	61.234	59.35	65.567	66.265	46.325	76.38	45.724
11	59.907	54.858	50.24	58.997	59.768	41.644	69.28	41.501
10	53.182	48.367	42.39	52.225	53.059	36.838	63.28	37.11
9	46.31	41.827	39.36	45.323	46.202	31.957	56.25	32.587
8	39.36	35.313	31.25	38.368	39.268	27.053	42.25	27.974
7	32.414	28.91	23.24	31.45	32.339	22.185	39.35	23.316
6	25.573	22.723	20.25	24.681	25.513	17.429	30.25	18.667
5	18.965	16.892	17.39	18.203	18.921	12.879	22.15	14.105
4	12.795	11.5	11.25	12.207	12.764	8.663	15.28	9.742
3	7.347	6.693	6.89	6.962	7.329	4.962	10.25	5.761
2	3.023	2.822	2.82	2.844	3.015	2.121	5.23	2.465
1	0.463	0.489	0.42	0.431	0.462	0.36	0.968	0.394
Base	0	0	0	0	0	0	0	0

The above table represent that the displacement is highest in model-09 (L-type building) with Flat slab, if we go with model-10 (T-type building) the displacement decreases by 1.88%, when we go with model-11 (C-type building) the displacement decreases by 5.60%, when we go with model-12 (U-type building) the displacement increases by 0.264 % compare to model-09 along **X-direction**.

The above table represent that the displacement along Y-direction is 107.005 mm for model-09 (L-type building) with Flat slab, if we go with model-10 (T-type building) the displacement decreases by 27.93 %, when we go with model-11 (C-type building) the displacement increases by 8.73 %, when we go with model-12 (U-type building) the displacement decreases by 34.22% compare to model-09 along Y-direction.

Table 6.3.4: Below table shows displacement in mm of various m0deĺs due to **RSA** long x and y-direction for **Conventional Slab**

Story No	**model 1 L-type**	**model 2 T-type**	**model 3 C-type**	**model 4 U-type**	**model-1 L-type**	**model 2 T-type**	**model-3 C-type**	**model 4 U-type**
	Along -X				**Along -Y**			
21	103.399	137.716	101.927	95.151	79.775	66.888	94.72	70.505
20	101.759	135.476	100.531	93.593	78.632	66.075	93.373	69.75
19	99.72	132.724	98.625	91.68	77.178	64.97	91.644	68.677
18	97.2	129.334	96.084	89.324	75.339	63.517	89.444	67.228
17	94.191	125.282	92.89	86.51	73.098	61.715	86.761	65.4
16	90.709	120.582	89.073	83.248	70.46	59.578	83.61	63.208
15	86.768	115.257	84.688	79.555	67.435	57.121	80.01	60.668
14	82.381	109.331	79.796	75.453	64.039	54.358	75.986	57.796
13	77.566	102.836	74.46	70.964	60.292	51.306	71.563	54.608
12	72.346	95.802	68.741	66.112	56.215	47.979	66.766	51.119
11	66.745	88.264	62.701	60.916	51.83	44.394	61.618	47.347
10	60.789	80.251	56.394	55.396	47.159	40.563	56.137	43.306
9	54.504	71.798	49.874	49.571	42.223	36.499	50.343	39.009
8	47.917	62.941	43.192	43.463	37.048	32.216	44.259	34.472

7	41.05	53.719	36.401	37.101	31.664	27.729	37.911	29.709
6	33.923	44.184	29.563	30.523	26.149	23.052	31.335	24.735
5	26.581	34.424	22.759	23.792	20.638	18.21	24.581	19.575
4	19.137	24.625	16.117	17.037	15.008	13.263	17.756	14.291
3	11.878	15.177	9.867	10.522	9.448	8.368	11.093	9.048
2	5.403	6.853	4.446	4.77	4.384	3.892	5.099	4.23
1	0.888	1.12	0.73	0.785	0.736	0.655	0.845	0.714
Base	0	0	0	0	0	0	0	0

From the above table it is noticed that the displacement is 103.399 mm for model-01 (L-type building) with conventional slab, if we go with model-02 (T-type building) the displacement increases by 24.91%, when we go with model-03 (C-type building) the displacement decreases by 1.42%, when we go with model-04 (U-type building) the displacement decreases by 7.97 % compare to model-01 along **X-direction**.

From the above table it is noticed that the displacement along Y-direction is 79.755 mm for model-01 (L-type building) with conventional slab, if we go with model-02 (T-type building) the displacement decreases by 16.15%, when we go with model-03 (C-type building) the displacement increases by 15.77 %, when we go with model-04 (U-type building) the displacement decreases by 11.62 % compare to model-01 along Y-direction.

Table 6.3.5: Below table shows displacement in mm of various models due to **RSA** along x and y-direction for **Grid floor Slab**

Story No	**model 5 L-type**	**model 6 T-type**	**model 7 C-type**	**model 8 U-type**	**model 5 L-type**	**model 6 T-type**	**model-7 C-type**	**model 8 U-type**
	Along -X				**Along -Y**			
21	115.138	148.757	117.721	99.722	138.099	74.757	103.981	77.911
20	113.256	146.276	116.32	98.046	135.869	73.817	102.469	77.044
19	110.927	143.238	114.433	95.999	133.085	72.551	100.541	75.831
18	108.067	139.517	111.945	93.495	129.644	70.902	98.104	74.207
17	104.676	135.092	108.837	90.52	125.547	68.866	95.142	72.17
16	100.771	129.978	105.119	87.083	120.821	66.458	91.666	69.736
15	96.366	124.2	100.813	83.2	115.497	63.693	87.699	66.919
14	91.479	117.789	95.945	78.893	109.607	60.589	83.265	63.736
13	86.131	110.778	90.541	74.184	103.181	57.163	78.393	60.206
12	80.349	103.203	84.628	69.098	96.254	53.435	73.112	56.346
11	74.159	95.098	78.235	63.657	88.854	49.423	67.446	52.175
10	67.586	86.492	71.384	57.879	81.001	45.14	61.417	47.708
9	60.652	77.419	64.1	51.786	72.72	40.601	55.047	42.961
8	53.387	67.915	56.411	45.403	64.035	35.824	48.363	37.951
7	45.817	58.024	48.353	38.758	54.977	30.828	41.398	32.696
6	37.961	47.797	39.968	31.892	45.575	25.632	34.195	27.215
5	29.854	37.32	31.328	24.869	35.88	20.264	26.812	21.535
4	21.603	26.779	22.584	17.818	26.024	14.786	19.367	15.725
3	13.501	16.577	14.064	11.016	16.338	9.363	12.111	9.964
2	6.202	7.534	6.443	5.006	7.561	4.385	5.586	4.671
1	1.031	1.241	1.073	0.827	1.265	0.739	0.93	0.792
Base	0	0	0	0	0	0	0	0

From the above table it is noticed that the displacement is 115.138 mm for model-05 (L-type building) with Grid floor slab, if we go with model-06 (T-type building) the displacement increases by 22.60%, when we go with model-07 (C-type building) the displacement increases by 2.194 %, when we go with model-08 (U-type building) the displacement decreases by 13.38 % compare to model-05 along **X-direction**.

From the above table it is seen that the displacement along Y-direction is 138.099 mm for model-05 (L-type building) with Grid floor slab, if we go with model-06 (T-type building) the displacement decreases by 45.86 %, when we go with model-07 (C-type building) the displacement decreases by 24.70 %, when we go with model-08 (U-type building) the displacement decreases by 43.58 % compare to model-05 along **Y-direction**.

Table 6.3.6: Below table shows displacement in mm of various models due to **RSA** along x and y-direction for **Flat Slab**

Story No	**model 09 L-type**	**model 10 T-type**	**model 11 C-type**	**model 12 U-type**	**model 9 L-type**	**model 10 T-type**	**model 11 C-type**	**model 12 U-type**
	Along -X				**Along -Y**			
21	84.04	99.127	93.28	85.771	82.377	89.535	92.35	50.387
20	82.086	96.692	90.25	83.579	80.465	87.009	90.35	49.529
19	79.899	93.976	89.25	81.178	78.325	84.271	86.35	48.498
18	77.402	90.894	86.25	78.492	75.88	81.245	82.35	47.244
17	74.564	87.422	82.35	75.483	73.1	77.904	79.35	45.752
16	71.377	83.564	79.29	72.139	69.979	74.244	76.45	44.02
15	67.846	79.335	73.25	68.455	66.519	70.269	72.25	42.053
14	63.98	74.754	69.36	64.438	62.731	65.991	68.35	39.86
13	59.796	69.842	65.36	60.099	58.63	61.426	65.25	37.452
12	55.309	64.619	61.25	55.457	54.233	56.593	58.36	34.837
11	50.54	59.101	55.25	50.535	49.559	51.512	53.25	32.027
10	45.511	53.309	50.36	45.362	44.629	46.209	49.69	29.032
9	40.246	47.264	42.39	39.971	39.468	40.712	42.35	25.863
8	34.779	40.998	37.23	34.403	34.108	35.058	38.25	22.535
7	29.154	34.559	30.25	28.71	28.594	29.295	33.25	19.071
6	23.437	28.026	24.28	22.963	22.987	23.497	26.35	15.502
5	17.729	21.53	19.28	17.275	17.39	17.777	20.35	11.886
4	12.211	15.168	13.25	11.821	11.977	12.272	15.35	8.32
3	7.163	9.158	7.36	6.877	7.027	7.224	9.36	4.977
2	3.017	4.033	3.25	2.867	2.96	3.069	5.36	2.149
1	0.471	0.68	0.93	0.442	0.462	0.514	0.985	0.347
Base	0	0	0	0	0	0	0	0

The above table represent that the displacement is minimum for model-09 (L-type building) with Flat slab, if we go with model-10 (T-type building) the displacement increases by 15.21%, when we go with model-11 (C-type building) the displacement increases by 9.90 %, when we go with model-12 (U-type building) the displacement increases by 2.02 % compare to model-09 along **X-direction**.

The above table represent that the displacement along y-direction is 82.377 mm for model-09 (L-type building) with Flat slab, if we go with model-10 (T-type building) the displacement increases by 7.99 %, when we go with model-11 (C-type building) the displacement increases by 10.80 %, when we go with model-12 (U-type building) the displacement decreases by 38.83 % compare to model-09 along Y-direction.

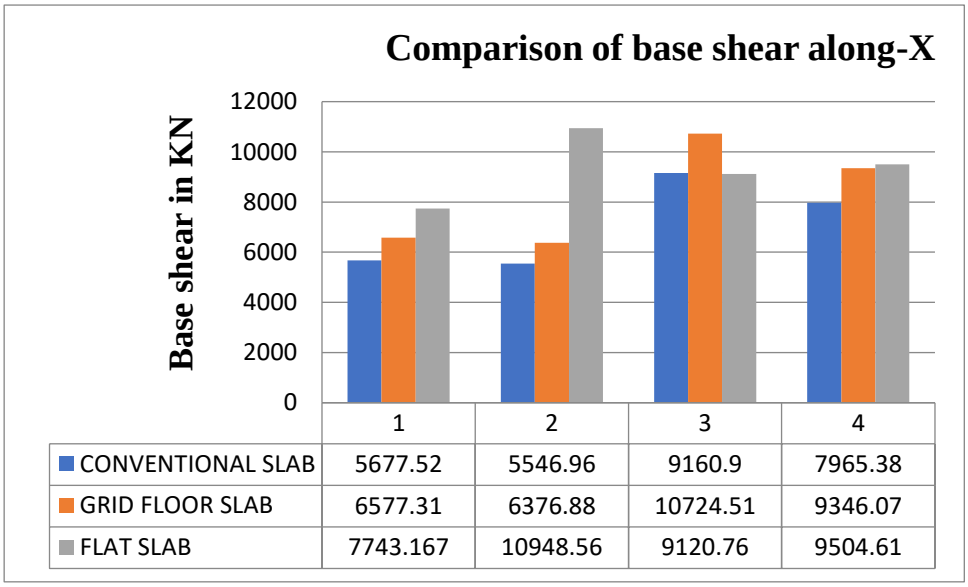
6.4 Base Shear:

It is the calculation of highest occurred/expected horizontal forces which will occur due to earth quake ground motion at

the base of a structure.

Table 6.4.1: Below table shows base shear in KN of various models due to **seismic** along x & y - directions

Model no	Base shear along-X	Base shear along-Y	Description of slab
1	5677.52	5415.43	**Conventional slab**
2	5546.96	5604.1	
3	9160.9	8874.3	
4	7965.38	8410.6	
5	6577.31	6449.87	**Grid floor slab**
6	6376.88	6386.3	
7	10724.51	10724.51	
8	9346.07	9801.08	
9	7743.167	7743.168	**Flat slab**
10	10948.56	6662.92	
11	9120.76	9120.72	
12	9504.61	12704.73	



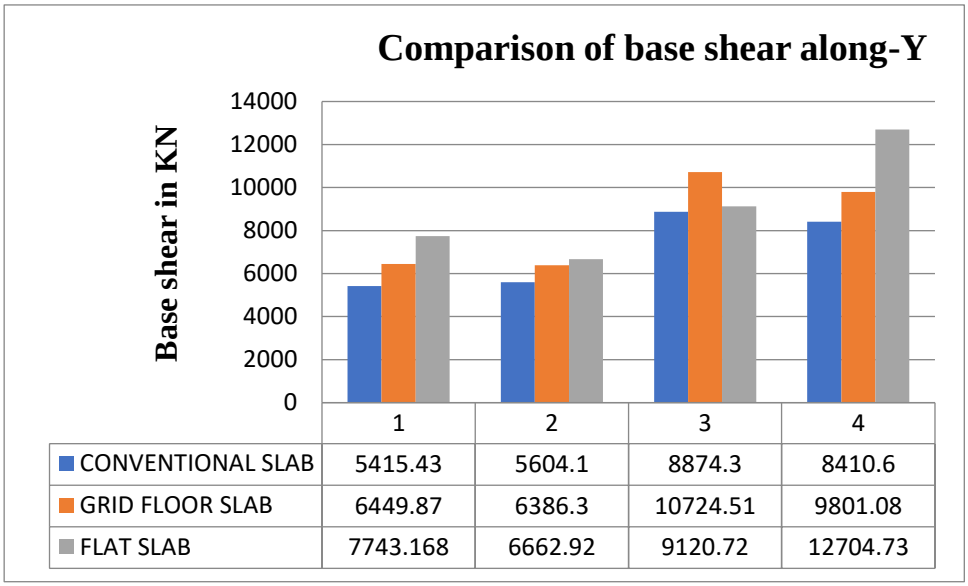
Graph: Comparison of Base shear along-X direction for Conventional, Grid floor, & Flat slab

The above graph represent that the base shear in model (L-type building) with conventional slab is 5677.52 KN, as the conventional slab is replace by Grid floor slab the base shear increases by 13.68%, and when the conventional slab is replace by Flat slab the base shear increases by 26.67% compare to model with L-type building along-X direction.

The above graph represent that the base shear in model (T-type building) with conventional slab is 5546.96 KN, as the conventional slab is replace by Grid floor slab the base shear increases by 13.01%, and when the conventional slab is replace by Flat slab the base shear increases by 49.33 % compare to model with T-type building along-X direction.

The above graph represent that the base shear in model (C-type building) with conventional slab is 9160.9 KN, as the conventional slab is replace by Grid floor slab the base shear increases by 14.57 %, and when the conventional slab is replace by Flat slab the base shear decreases by 0.438% compare to model with C-type building along-X direction.

The above graph represent that the base shear in model (U-type building) with conventional slab is 7965.38 KN, as the conventional slab is replace by Grid floor slab the base shear increases by 14.77 %, and when the conventional slab is replace by Flat slab the base shear increases by 16.19 % compare to model with U-type building along-X direction.



Graph: Comparison of Base shear along-Y direction for Conventional, Grid floor, & Flat slab

The above graph represent that the base shear for model (L-type building) with conventional slab is 5415.43 KN, as the conventional slab is replace by Grid floor slab the base shear increases by 16.03%, and when the conventional slab is replace by Flat slab the base shear increases by 30.06 % compare to model with L-type building along-Y direction.

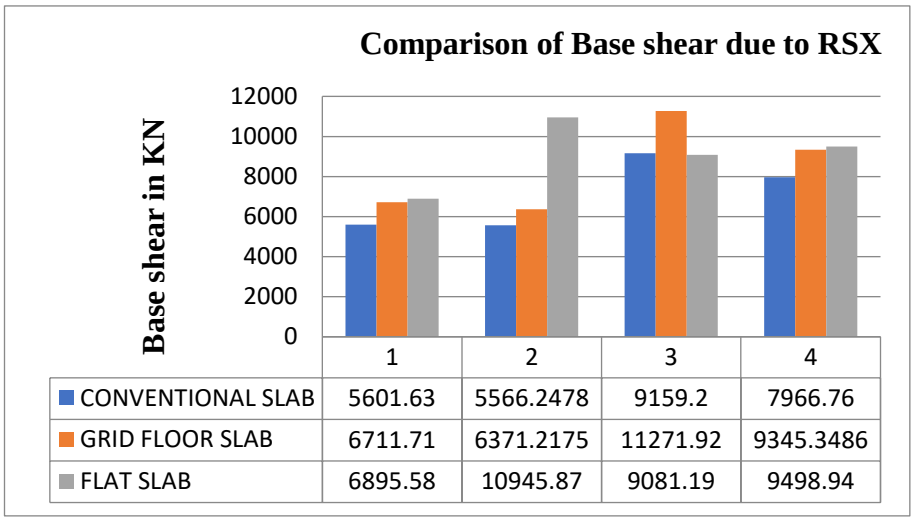
From the graph it was noticed that the base shear for model (T-type building) with conventional slab is 5604.1 KN, as the conventional slab is replace by Grid floor slab the base shear increases by 12.24%, and when the conventional slab is replace by flat slab the base shear increases by 15.89 % compare to model with T-type building along-Y direction.

The above graph represent that the base shear for model (C-type building) with conventional slab is 8874.3 KN, as the conventional slab is replace by Grid floor slab the base shear increases by 17.25 %, and when the conventional slab is replace by Flat slab the base shear increases by 2.7 % compare to model with C-type building along-y direction.

The above graph represent that the base shear for model (U-type building) with conventional slab is 8410.6 KN, as the conventional slab is replace by Grid floor slab the base shear increases by 14.18 %, and when the conventional slab is replace by Flat slab the base shear increases by 33.80 % compare to model with U-type building along-y direction.

Table 6.4.2: Below table shows base shear in KN of various models due to RSA along x & y- directions

Model No	**Base shear along-x**	**Base shear along-y**	**Description of slab**
1	5601.63	5404.52	**Conventional slab**
2	5566.2478	5601.01	
3	9159.2	8873.5	
4	7966.76	8365.41	
5	6711.71	6598.75	**Grid floor slab**
6	6371.2175	6345.5211	
7	11271.92	10683.98	
8	9345.3486	9795.8653	
9	6895.58	6861.3	**Flat slab**
10	10945.87	6661.36	
11	9081.19	9301.87	
12	9498.94	12704.04	



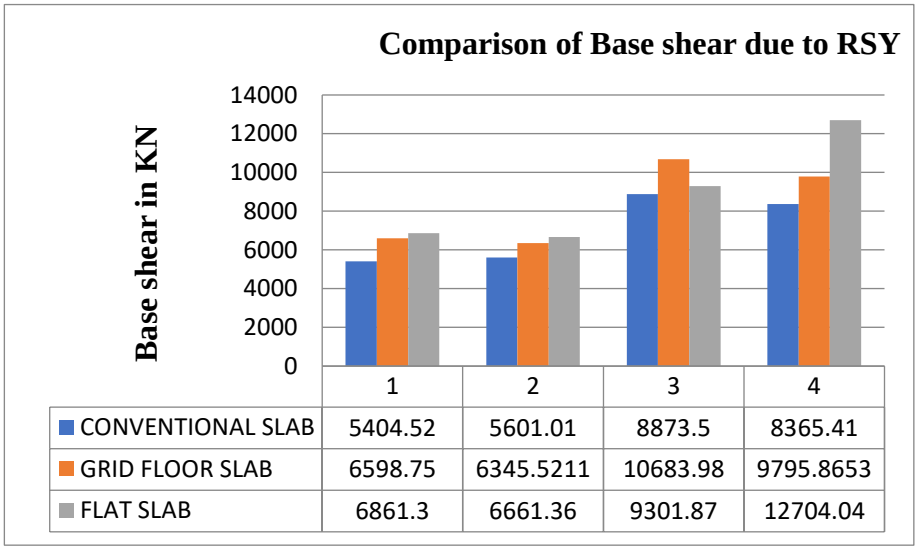
Graph: Comparison of Base shear along-X direction for Conventional, Grid floor, & Flat slab due to RSX

The above graph represent that the base shear for model (L-type building) with conventional slab is 5601.63 KN, as the conventional slab is replace by Grid floor slab the base shear increases by 16.53%, and when the conventional slab is replace by Flat slab the base shear increases by 18.76% compare to model with L-type building along-X direction.

The above graph represent that the base shear for model (T-type building) with conventional slab is 5566.247 KN, as the conventional slab is replace by Grid floor slab the base shear increases by 12.63%, and when the conventional slab is replace by Flat slab the base shear increases by 49.14 % compare to model with T-type building along-X direction.

The above graph represent that the base shear for model (C-type building) with conventional slab is 9159.2 KN, as the conventional slab is replace by Grid floor slab the base shear increases by 18.74 %, and when the conventional slab is replace by Flat slab the base shear decreases by 0.851% compare to model with C-type building along-X direction.

From the above graph it was noticed that the base shear for model (U-type building) with conventional slab is 7966.76 KN, as the conventional slab is replace by Grid floor slab the base shear increases by 14.75 %, and when the conventional slab is replace by Flat slab the base shear increases by 16.13 % compare to model with U-type building along-X direction.



Graph: Comparison of Base shear along-Y direction for Conventional, Grid floor, & Flat slab due to RSY

The above graph represent that the base shear for model (L-type building) with conventional slab is 5404.52 KN, as the conventional slab is replace by Grid floor slab the base shear increases by 18.09%, and when the conventional slab is replace by Flat slab the base shear increases by 21.23 % compare to model with L-type building along-Y direction.

The above graph represent that the base shear for model (T-type building) with conventional slab is 5601.01 KN, as the conventional slab is replace by Grid floor slab the base shear increases by 11.73%, and when the conventional slab is replace by Flat slab the base shear increases by 15.91 % compare to model with T-type building along-Y direction.

The above graph represent that the base shear for model (C-type building) with conventional slab is 8873.5 KN, as the conventional slab is replace by Grid floor slab the base shear increases by 16.94 %, and when the conventional slab is replace by Flat slab the base shear increases by 4.6 % compare to model with C-type building along-Y direction.

The above graph represent that the base shear for model (U-type building) with conventional slab is 8365.41 KN, as the conventional slab is replace by Grid floor slab the base shear increases by 14.60 %, and when the conventional slab is replace by Flat slab the base shear increases by 34.15 % compare to model with U-type building along-Y direction.

6.5 Storey drift:

Storey drift means the difference of horizontal displacements of one story/floor relative to the other story/floor. Here story ht was 3.5m. Hence permissible story drift is calculated as: storey drift / 3.5 =0.004 Therefore, storey drift = 0.014m

Table 6.5.1: Storey Drift of various models due to ESA along X and Y-direction for **Conventional Slab**

Story No	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 1**	**Model 2**	**Model 3**	**Model 4**
	Along -X				**Along -Y**			
21	0.000589	0.000426	0.000399	0.000544	0.000524	0.000408	0.000548	0.000311
20	0.00073	0.00052	0.000545	0.000672	0.000677	0.000557	0.000715	0.00045
19	0.000905	0.000637	0.000726	0.000831	0.000862	0.000735	0.000918	0.000614
18	0.001087	0.000761	0.000913	0.000995	0.001049	0.000914	0.001123	0.000775
17	0.001261	0.000902	0.00109	0.00115	0.001224	0.001081	0.001316	0.000925
16	0.001421	0.001032	0.001253	0.001292	0.001382	0.001231	0.001491	0.001059
15	0.001563	0.001147	0.001398	0.001418	0.001522	0.001364	0.001644	0.001177
14	0.001687	0.001249	0.001525	0.001527	0.001643	0.00148	0.001778	0.00128
13	0.001793	0.001336	0.001634	0.00162	0.001746	0.001578	0.001891	0.001368
12	0.001881	0.001409	0.001726	0.001696	0.001831	0.001661	0.001985	0.001442
11	0.001952	0.00147	0.001802	0.001758	0.0019	0.001729	0.002061	0.001503
10	0.002006	0.001518	0.001863	0.001805	0.001954	0.001783	0.00212	0.001553
9	0.002044	0.001555	0.001909	0.001837	0.001993	0.001824	0.002163	0.001591
8	0.002065	0.001579	0.00194	0.001854	0.002017	0.001852	0.002189	0.001619
7	0.002064	0.00159	0.001954	0.001854	0.002024	0.001866	0.002199	0.001636
6	0.002037	0.001582	0.001944	0.001831	0.002011	0.001862	0.002185	0.00164
5	0.001967	0.001544	0.001898	0.001772	0.001964	0.001829	0.002135	0.001623
4	0.001825	0.001452	0.001786	0.001651	0.001856	0.001743	0.002019	0.001564
3	0.001554	0.001259	0.001549	0.001417	0.001624	0.001542	0.001769	0.001411
2	0.001042	0.000865	0.001064	0.000965	0.001132	0.001091	0.001234	0.001032
1	0.00035	0.000297	0.000365	0.00033	0.000389	0.000378	0.000424	0.000371
Base	0	0	0	0	0	0	0	0

The above table represent that the story drift is highest in model-01 (L-type building) with conventional slab, if we go with model-02 (T-type building) the storey drift decreases by 27.67%, when we go with model-03 (C-type building) the storey drift decreases by 32.25 %, when we go with model-04 (U-type building) the storey drift decreases by 7.64 % compare to model-01 along **X-direction**.

The above table represent that the story drift is 0.000524 in model-01 (L-type building) with conventional slab, if we go with model-02 (T-type building) the storey drift decreases by 22.13%, when we go with model-03 (C-type building) the storey drift increases by 4.38 %, when we go with model-04 (U-type building) the storey drift decreases by 40.64 % compare to model-01 along Y-direction.

Table 6.5.2: Storey Drift of various models due to **ESA** along X and Y-direction for **Grid floor Slab**

Story No	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
	Along -X				**Along -Y**			
21	0.000644	0.000471	0.000442	0.000605	0.000593	0.000451	0.000619	0.000356
20	0.000797	0.000573	0.000595	0.000743	0.000764	0.000614	0.000801	0.000506
19	0.000984	0.0007	0.000785	0.000914	0.000967	0.000805	0.001021	0.000682
18	0.001176	0.000834	0.000979	0.00109	0.001169	0.000995	0.001243	0.000855
17	0.001359	0.000987	0.001165	0.001258	0.001358	0.001172	0.001451	0.001016
16	0.001526	0.001126	0.001334	0.001411	0.001528	0.001331	0.001638	0.001161
15	0.001674	0.00125	0.001485	0.001548	0.001677	0.001471	0.001804	0.001289
14	0.001802	0.001358	0.001618	0.001666	0.001805	0.001593	0.001947	0.0014
13	0.001911	0.001451	0.001731	0.001767	0.001914	0.001696	0.002069	0.001495
12	0.002001	0.001529	0.001827	0.001851	0.002005	0.001783	0.00217	0.001575
11	0.002074	0.001594	0.001907	0.001918	0.002077	0.001854	0.002252	0.001641
10	0.002129	0.001645	0.00197	0.001969	0.002133	0.001911	0.002315	0.001694
9	0.002168	0.001685	0.002018	0.002004	0.002174	0.001954	0.002361	0.001736
8	0.002189	0.001711	0.00205	0.002022	0.002199	0.001983	0.00239	0.001766
7	0.002189	0.001723	0.002064	0.002021	0.002207	0.001998	0.002399	0.001783
6	0.002163	0.001716	0.002053	0.001994	0.002193	0.001995	0.002383	0.001786
5	0.002094	0.001678	0.002003	0.001926	0.002146	0.001963	0.002329	0.001765
4	0.001953	0.001585	0.001884	0.001789	0.002037	0.001876	0.002203	0.001698
3	0.001676	0.001382	0.001633	0.001529	0.001798	0.001671	0.001933	0.001526
2	0.001141	0.00096	0.001126	0.001036	0.001276	0.001198	0.001357	0.001112
1	0.000388	0.000333	0.000387	0.000352	0.000445	0.00042	0.00047	0.000398
Base	0	0	0	0	0	0	0	0

The above table represent that the story drift is highest in model-05 (L-type building) with Grid floor slab, if we go with model-06 (T-type building) the storey drift decreases by 26.83 %, when we go with model-07 (C-type building) the storey drift decreases by 31.36 %, when we go with model-08 (U-type building) the storey drift decreases by 6.05 % compare to model-05 along **X-direction**.

The above table represent that the story drift is 0.000593 in model-05 (L-type building) with Grid floor slab, if we go with model-06 (T-type building) the storey drift decreases by 23.94%, when we go with model-07 (C-type building) the storey drift increases by 4.2 %, when we go with model-08 (U-type building) the storey drift decreases by 39.96 % compare to model-05 alonġ **Y-direction**.

Table 6.5.3: Storey Drift of various models due to **ESA** along X and Y-direction for **Flat Slab**

Story No	**Model 9**	**Model 10**	**Model 11**	**Model12**	**model 9**	**Model 10**	**Model 11**	**Model 12**
	Along -X				**Along -Y**			
21	0.000376	0.000240	0.000230	0.000386	0.000396	0.000298	0.000336	0.000188
20	0.000517	0.000334	0.000376	0.000514	0.000549	0.000447	0.000503	0.000327
19	0.000692	0.000451	0.000557	0.000673	0.000734	0.000625	0.000706	0.000491
18	0.000874	0.000575	0.000744	0.000837	0.000921	0.000804	0.000911	0.000652
17	0.001048	0.000716	0.000921	0.000992	0.001096	0.000971	0.001104	0.000802
16	0.001208	0.000846	0.001084	0.001134	0.001254	0.001121	0.001279	0.000936
15	0.00135	0.000961	0.001229	0.00126	0.001394	0.001254	0.001432	0.001054
14	0.001474	0.001063	0.001356	0.001369	0.001515	0.00137	0.001566	0.001157

13	0.00158	0.00115	0.001465	0.001462	0.001618	0.001468	0.001679	0.001245
12	0.001668	0.001223	0.001557	0.001538	0.001703	0.001551	0.001773	0.001319
11	0.001739	0.001284	0.001633	0.0016	0.001772	0.001619	0.001849	0.00138
10	0.001793	0.001332	0.001694	0.001647	0.001826	0.001673	0.001908	0.00143
9	0.001831	0.001369	0.00174	0.001679	0.001865	0.001714	0.001951	0.001468
8	0.001852	0.001393	0.001771	0.001696	0.001889	0.001742	0.001977	0.001496
7	0.001851	0.001404	0.001785	0.001696	0.001896	0.001756	0.001987	0.001513
6	0.001824	0.001396	0.001775	0.001673	0.001883	0.001752	0.001973	0.001517
5	0.001754	0.001358	0.001729	0.001614	0.001836	0.001719	0.001923	0.0015
4	0.001612	0.001266	0.001617	0.001493	0.001728	0.001633	0.001807	0.001441
3	0.001341	0.001073	0.00138	0.001259	0.001496	0.001432	0.001557	0.001288
2	0.000829	0.000679	0.000895	0.000807	0.001004	0.000981	0.001022	0.000909
1	0.000137	0.000111	0.000196	0.000172	0.000261	0.000268	0.000212	0.000248
Base	0	0	0	0	0	0	0	0

The above table repesent that the story drift is 0.000376 in model-09 (L-type building) with Falt slab, if we go with model-10 (T-type building) the storey drift decreases by 36.17%, when we go with model-11 (C-type building) the storey drift decreases by 38.82 %, when we go with model-12 (U-type building) the storey drift increases by 2.59 % compare to model-09 along **X-direction**.

The above table represent that the story drift is 0.000396 in model-09 (L-type building) with Falt slab, if we go with model-10 (T-type building) the storey drift decreases by 24.74%, when we go with model-07 (C-type building) the storey drift decreases by 15.15 %, when we go with model-08 (U-type building) the storey drift decreases by 52.52 % compare to model-05 along **Y-direction.**

Table 6.5.4: Storey Drift of various models due to **RSA** along X and Y-direction for **Conventional Slab**

Story No	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 1**	**Model 2**	**Model 3**	**Model 4**
	Along -X				**Along -Y**			
21	0.000675	0.000852	0.000499	0.000541	0.000750	0.000327	0.000486	0.000350
20	0.000865	0.001075	0.000691	0.000684	0.000976	0.000456	0.000647	0.000503
19	0.001064	0.001321	0.000906	0.000842	0.001215	0.000592	0.000825	0.000665
18	0.001228	0.001538	0.001096	0.000982	0.001414	0.000708	0.000985	0.000804
17	0.001352	0.001718	0.001255	0.0011	0.001567	0.000801	0.001119	0.000916
16	0.001454	0.001872	0.001391	0.001202	0.001692	0.00088	0.001236	0.001011
15	0.001548	0.002014	0.001516	0.001295	0.001805	0.000952	0.001344	0.001099
14	0.001643	0.00215	0.001635	0.001381	0.001914	0.001022	0.001444	0.001185
13	0.001736	0.002276	0.001746	0.00146	0.002017	0.001086	0.001535	0.001266
12	0.001823	0.002392	0.001848	0.001531	0.00211	0.001146	0.001616	0.001342
11	0.001903	0.002498	0.001944	0.001597	0.002197	0.001201	0.00169	0.001413
10	0.001976	0.002596	0.002034	0.001658	0.002277	0.001253	0.00176	0.00148
9	0.002038	0.002682	0.002117	0.001712	0.00235	0.001301	0.001825	0.001541
8	0.002087	0.002753	0.00219	0.001759	0.00241	0.001344	0.001883	0.001594
7	0.002124	0.002806	0.00225	0.001794	0.002459	0.00138	0.001928	0.00164
6	0.00215	0.002836	0.002293	0.001816	0.002494	0.00141	0.001959	0.001678
5	0.00215	0.002822	0.002303	0.001809	0.002503	0.001425	0.001964	0.0017
4	0.002082	0.002707	0.002235	0.00174	0.002437	0.001402	0.001908	0.001677
3	0.001851	0.00238	0.001996	0.001539	0.002187	0.001279	0.001713	0.001536

2	0.001292	0.00164	0.001405	0.001075	0.001546	0.000927	0.001217	0.001121
1	0.000444	0.00056	0.000489	0.000373	0.000535	0.000327	0.000422	0.000398
Base	0	0	0	0	0	0	0	0

The above table represent that the story drift is 0.000675 in model-01 (L-type building) with conventional slab, if we go with model-02 (T-type building) the storey drift increases by 20.77%, when we go with model-03 (C-type building) the storey drift decreases by 26.07 %, when we go with model-04 (U-type building) the storey drift decreases by 19.85 % compare to model-01 along **X-direction**.

The above table represent that the story drift is 0.000750 in model-01 (L-type building) with conventional slab, if we go with model-02 (T-type building) the storey drift increases by 56.4%, when we go with model-03 (C-type building) the storey drift decreases by 35.20 %, when we go with model-04 (U-type building) the storey drift decreases by 53.33 % compare to model-01 along Y-direction.

Table 6.5.5: Storey Drift of various models due to **RSA** along X and Y-direction for **Grid floor Slab**

Story No	**Model 5**	**Model 6**	**Model7**	**Model 8**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
	Along -x				**Along -y**			
21	0.000783	0.000946	0.00058	0.000634	0.000850	0.000368	0.000542	0.000363
20	0.001001	0.001189	0.000788	0.000793	0.001105	0.00051	0.000711	0.000514
19	0.001221	0.001452	0.001016	0.000966	0.001371	0.000656	0.000898	0.00067
18	0.001395	0.001679	0.001217	0.001117	0.001594	0.00078	0.001066	0.000803
17	0.001524	0.001867	0.001385	0.001244	0.00177	0.000881	0.001209	0.00091
16	0.001631	0.002029	0.001531	0.001356	0.001916	0.000969	0.001338	0.001002
15	0.001736	0.002182	0.001668	0.00146	0.00205	0.001052	0.001459	0.00109
14	0.001840	0.002326	0.001798	0.001557	0.002177	0.001131	0.001571	0.001174
13	0.001939	0.002458	0.001918	0.001646	0.002291	0.001204	0.001672	0.001253
12	0.002029	0.002577	0.002029	0.001725	0.002393	0.00127	0.001762	0.001325
11	0.002112	0.002687	0.002132	0.001798	0.002487	0.001331	0.001844	0.001393
10	0.002189	0.002789	0.00223	0.001866	0.002577	0.001389	0.001922	0.001457
9	0.002259	0.002881	0.00232	0.001928	0.00266	0.001444	0.001995	0.001517
8	0.002314	0.002958	0.0024	0.00198	0.002732	0.001492	0.002058	0.00157
7	0.002354	0.003015	0.002464	0.002019	0.00279	0.001532	0.002108	0.001615
6	0.002382	0.003048	0.002509	0.002041	0.002832	0.001563	0.002139	0.001652
5	0.002388	0.003037	0.002517	0.00203	0.002845	0.001578	0.002142	0.001673
4	0.002325	0.002923	0.00244	0.001949	0.002777	0.001554	0.002078	0.00165
3	0.002087	0.002585	0.002178	0.001718	0.002509	0.001423	0.001865	0.001513
2	0.00148	0.0018	0.001538	0.001197	0.001801	0.001043	0.001332	0.001111
1	0.000516	0.00062	0.000536	0.000413	0.000633	0.00037	0.000465	0.000396
Base	0	0	0	0	0	0	0	0

The above table represent that the stòrey drift is 0.000783 in model-05 (L-type building) with Grid floor slab, if we go with model-06 (T-type building) the storey drift increases by 17.23%, when we go with model-07 (C-type building) the storey drift decreases by 25.92 %, when we go with model-08 (U-type building) the storey drift decreases by 19.02 % compare to model-05 along **X-direction**.

From the above table it is noticed that the storey drift is 0.000850 for model-05 (L-type building) with Grid floor slab, if we go with model-06 (T-type building) the storey drift decreases by 56.7%, when we go with model-07 (C-type building) the storey drift decreases by 36.23 %, when we go with model-08 (U-type building) the storey drift decreases by 57.29 % compare to model-05 along **Y-direction**.

Table 6.5.6: Storey Drift of various models due to **RSA** along X and Y-direction for **Flat Slab**

Story No	**Model-9**	**Model-1o**	**Model-11**	**Model-12**	**Model-9**	**Model-10**	**Model-11**	**Model-12**
	Along -X				**Along -Y**			
21	0.00061	0.000792	0.000476	0.000401	0.00055	0.000168	0.000268	0.00023
20	0.000712	0.001015	0.000668	0.000544	0.000776	0.000297	0.000429	0.000383
19	0.000892	0.001261	0.000883	0.000702	0.001015	0.000433	0.000607	0.000545
18	0.001052	0.001478	0.001073	0.000842	0.001214	0.000549	0.000767	0.000684
17	0.001126	0.001658	0.001232	0.00096	0.001367	0.000642	0.000901	0.000796
16	0.001256	0.001812	0.001368	0.001062	0.001492	0.000721	0.001018	0.000891
15	0.001345	0.001954	0.001493	0.001155	0.001605	0.000793	0.001126	0.000979
14	0.001435	0.00209	0.001612	0.001241	0.001714	0.000863	0.001226	0.001065
13	0.001546	0.002216	0.001723	0.00132	0.001817	0.000927	0.001317	0.001146
12	0.001625	0.002332	0.001825	0.001391	0.00191	0.000987	0.001398	0.001222
11	0.001752	0.002438	0.001921	0.001457	0.001997	0.001042	0.001472	0.001293
10	0.001852	0.002536	0.002011	0.001518	0.002077	0.001094	0.001542	0.00136
9	0.001925	0.002622	0.002094	0.001572	0.00215	0.001142	0.001607	0.001421
8	0.001975	0.002693	0.002167	0.001619	0.00221	0.001185	0.001665	0.001474
7	0.002012	0.002746	0.002227	0.001654	0.002259	0.001221	0.00171	0.00152
6	0.0021	0.002776	0.00227	0.001676	0.002294	0.001251	0.001741	0.001558
5	0.0021	0.002762	0.00228	0.001669	0.002303	0.001266	0.001746	0.00158
4	0.001982	0.002647	0.002212	0.0016	0.002237	0.001243	0.00169	0.001557
3	0.001758	0.00232	0.001973	0.001399	0.001987	0.00112	0.001495	0.001416
2	0.001128	0.00158	0.001382	0.000935	0.001346	0.000768	0.000999	0.001001
1	0.000343	0.0005	0.000466	0.000233	0.000335	0.000168	0.000204	0.000278
Base	0	0	0	0	0	0	0	0

The above table represent that the storey drift is 0.000610 in model-09 (L-type building) with Flat slab, if we go with model-10 (T-type building) the storey drift increases by 22.97%, when we go with model-11 (C-type building) the storey drift decreases by 28.15 %, when we go with model-12 (U-type building) the storey drift decreases by 34.26 % compare to model-09 along **X-direction**.

The above table represent that the storey drift is 0.000550 in model-09 (L-type building) with Flat slab, if we go with model-10 (T-type building) the storey drift decreases by 69.45%, when we go with model-11 (C-type building) the storey drift decreases by 51.27 %, when we go with model-12 (U-type building) the storey drift decreases by 58.18 % compare to model-09 along Y-direction.

7. OBSERVATION AND CONCLUSION:

1. As the height of structure increases the time period also increases.
2. Time period for model with different type of slab will not remain same this was noticed here.
3. The time period for model with Grid floor slab is more than the model with conventional slab (L-type building).
4. The time period for model with Flat slab is lesser than the model with conventional slab and grid floor slab (L-type building).
5. The Base shear for model with different type of slab will not remain same.
6. The base shear due to Equivalent static analysis for a model with flat slab is higher than the model with conventional slab and grid floor slab (L, T and U-type building).
7. It is noticed that the displacement for model L-type building with conventional slab is higher than the model for other shape of building along X-direction due to ESA.

8. Similarly, it is noticed that the displacement for model L-type building with Grid floor slab is higher than the model for other shape of building along X-direction due to ESA.
9. But it is noticed that the displacement for model T-type building with conventional slab is higher than the model for other shape of building along X-direction, due to RSA.
10. It is noticed that the displacement forr m0del T-type building with Grid floor slab and Flat slab is higher than the model for other shape of building along X-direction, due to RSA.
11. In model L-type building with conventional slab the story drift is higher than the model for other shape of building along-X
12. Whereas the storey drifts for model C-type building with convention slab is higher than the model for other shapes of building along-Y direction.
13. The storey drift for model L-type building with grid floor slab is higher than the model for other shapes of building along-X- direction.
14. The drift values are within the limit in seismic zone-4 and soil type-2 for normal, flat and grid floor slab along x and y directions.

7.1 The work may extend for:

1. By adopting shear wall, bracing, and damper in a building which give the least displacement can be studied.
2. Further work can be taken up by applying wind load with different intensities.
3. The present work is accomplished for G+ 20 storeys, the work may extend for G+30 or even higher storey.
4. The behaviour of the building can be studied by providing core/shear wall.
5. The layout and evaluation of constructing structures can be executed by means of the usage of Push over analysis or Time history strategies.
6. Analysis may be achieved for buildings with vertical irregularity.

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