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SEISMIC ANALYSIS OF REGULAR AND IRREGULAR MULTI-STOREY BUILDINGS BY USING STAAD-PRO

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ABSTRACT

The behaviour of the G+7 multi-storey building of regular and irregular design under earthquake is problematical, and the variations of wind loads are implicit to act consecutively with earthquake loads. In this paper, a multi-storey residential building studied for earthquake and wall loads using response spectrum method and STADD PRO. For performing dynamic analysis, a material having linear static property as assumed. These analysis are carried out by considering different seismic zones, and for each zone, the behaviour assesses by taking the Soft Soil. A different response for displacements of base shear, storey drift is plotted for different zones for different types of soils.

Key words: Multi-storey building, wind loads, STADD.PRO, Response spectrum method.

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1. INTRODUCTION

Buildings are structures formed by combing roofs, walls with different sizes and shapes. They are constructed from tiny scale to large. Buildings serve quite a lot of needs primarily as a haven from the weather, living space, security, privacy, and are comfortable for living and also to work. Buildings can be classified as different types as residential and commercial. Residential buildings are those most commonly known as homes or houses for families to live. Residential buildings have various names depending upon their use. Commercial buildings are those known as offices etc., where the public will do their professional works. Building type varies from small huts to million-dollar high-rise apartments. Increasing of settlement density is a response to high view prices consequential from many people wanting to construct their own homes near to office work area or similar attractors.

Care has to take for each step of construction of a building from foundation part. When earthquakes take place, a building undergoes dynamic motion. Because of subjected to inertia forces that may act in the opposite direction to speeding up of earthquake excitations. These inertia forces normally called seismic loads deal by assuming forces external to the building. The most critical factors are ductility of a structure which affects its seismic performance has noticeably observed that reinforced structures which are designed to behave well during earthquakes. The Present research focused on various techniques used to study the seismic demands of vertical irregular R.C buildings with different seismic zones of India. The design also involves vertical irregularities such as stiffness irregularity. The whole design was carried out in STAAD.Pro software which covers all aspects of structural engineering.

2. OBJECTIVES

- Using response spectrum analysis, the behaviour of regular and irregular buildings compared.
- Comparison of base shear, period, node displacement and frequencies of different irregular buildings are carried out.

3. MODELING ANALYSIS

Structure type: Residential Building
Number of stories: 6
Floor height: 3m
size of the column: 300 mmX550 mm
Size of the beam: 300 mmX450 mm
Thickness of slab: 152 mm
Masonry wall thickness: 220 mm
Live load: 2.5 KN/m^2
Floor finish: 1.5 KN/m^2
Types of soil considered: type II – Medium soil.
All the columns are assumed to fix at base
Characteristic compressive strength, f_{ck}: 20 N/mm^2
Steel grade: 500N/mm^2
Modulus elasticity: 2000N/mm^2
Concrete density: 26N/mm^2
Density of brick masonry, ρ: 19.4 KN/m^3
Poison's ratio of concrete, μ: 0.3
Modulus of elasticity of brick masonry: 14100 N/mm^2
Poison's ratio of brick masonry: 0.2
Damping ratio: 5%

3.1. Plan of Regular Multi-Story Building

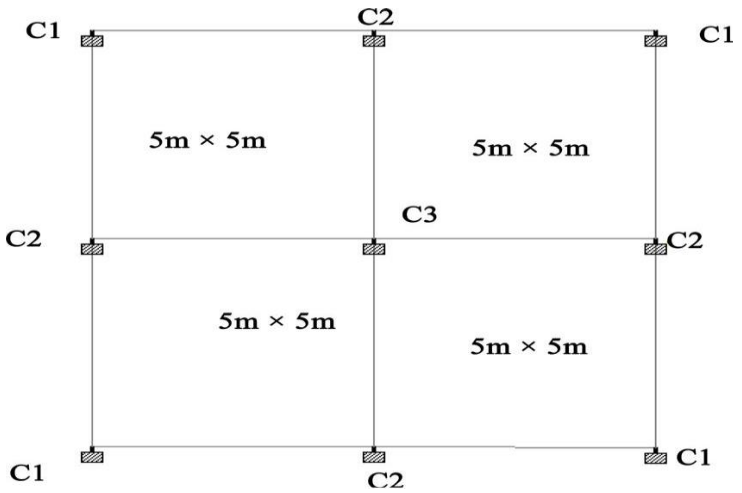

Figure 1 Regular Structure

3.2. Plan of Irregular Multi-Story Building

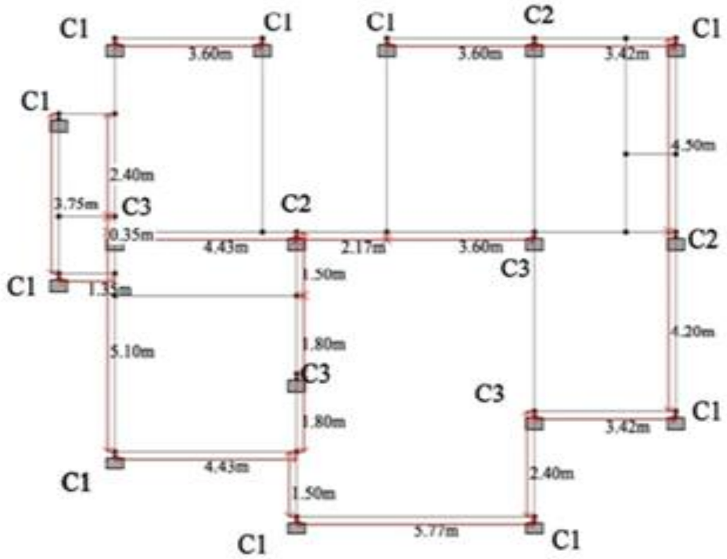

Figure 2 Irregular Structure

3.2. Seismic Calculations

Seismic Calculations of all Zones

Table 1 Seismic Calculations

Characteristics	ZONE 2	ZONE 3	ZONE 4	ZONE 5
Number of Storey	6	6	6	6
Typical Storey height m	3	3	3	3
Seismic Zone	0.10	0.16	0.24	0.36
Response Reduction Factor	3	3	3	3
Soil type	II	II	II	II

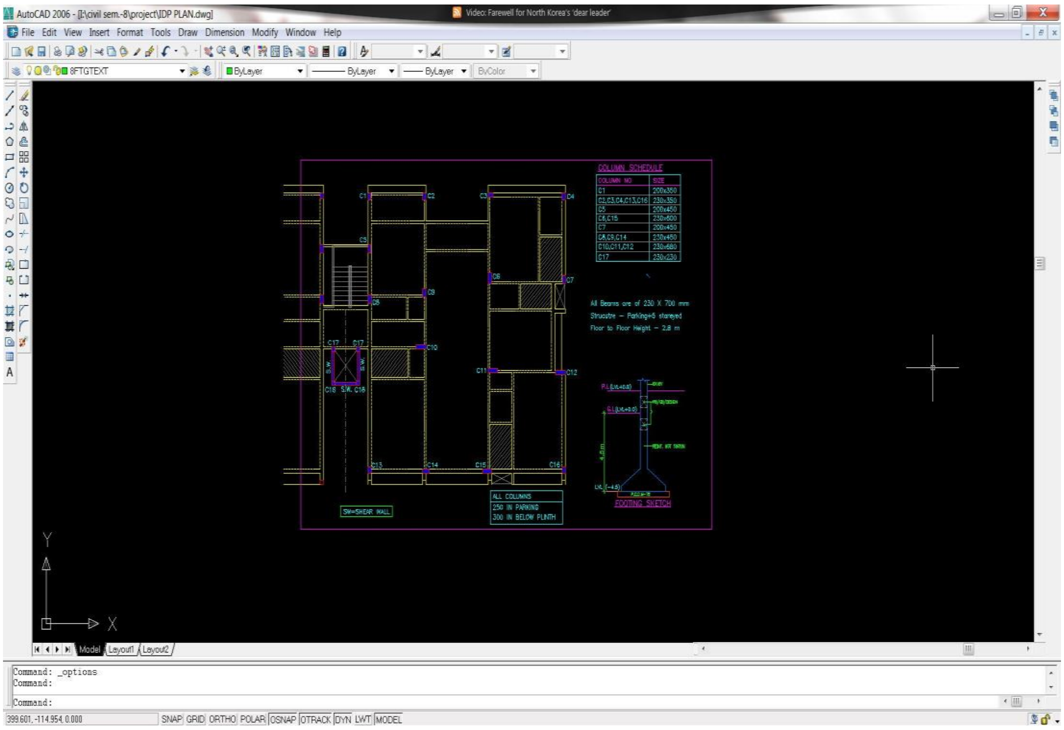

Figure 3 Drawing in Auto Cad 2D

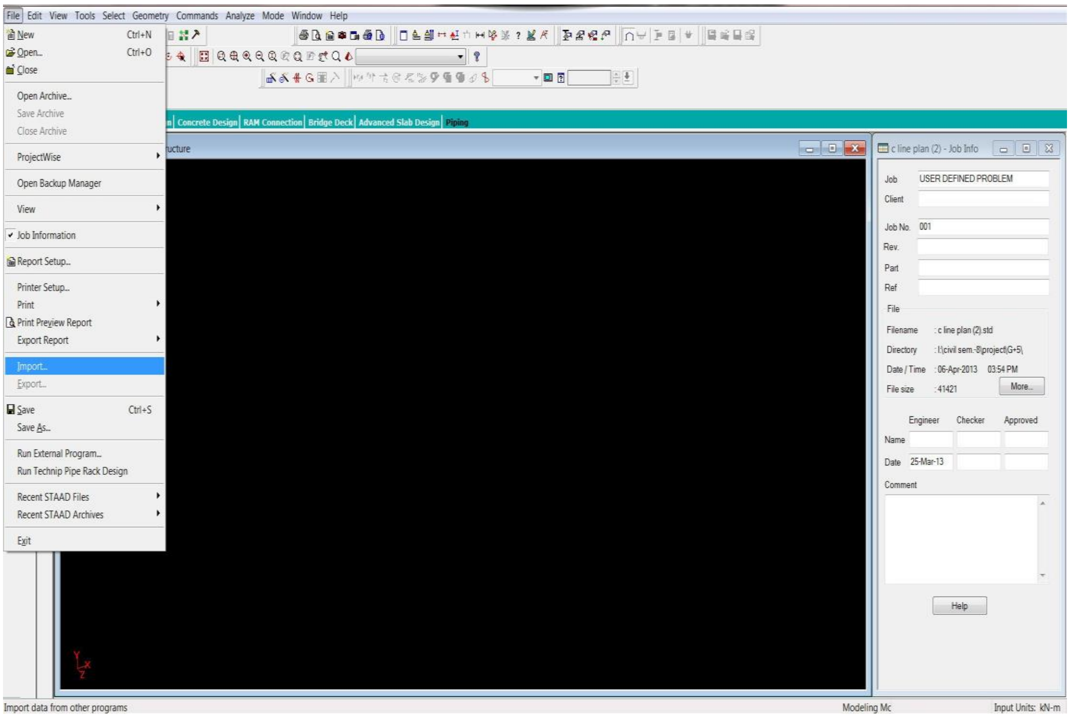

Figure 4 Importing Drawing

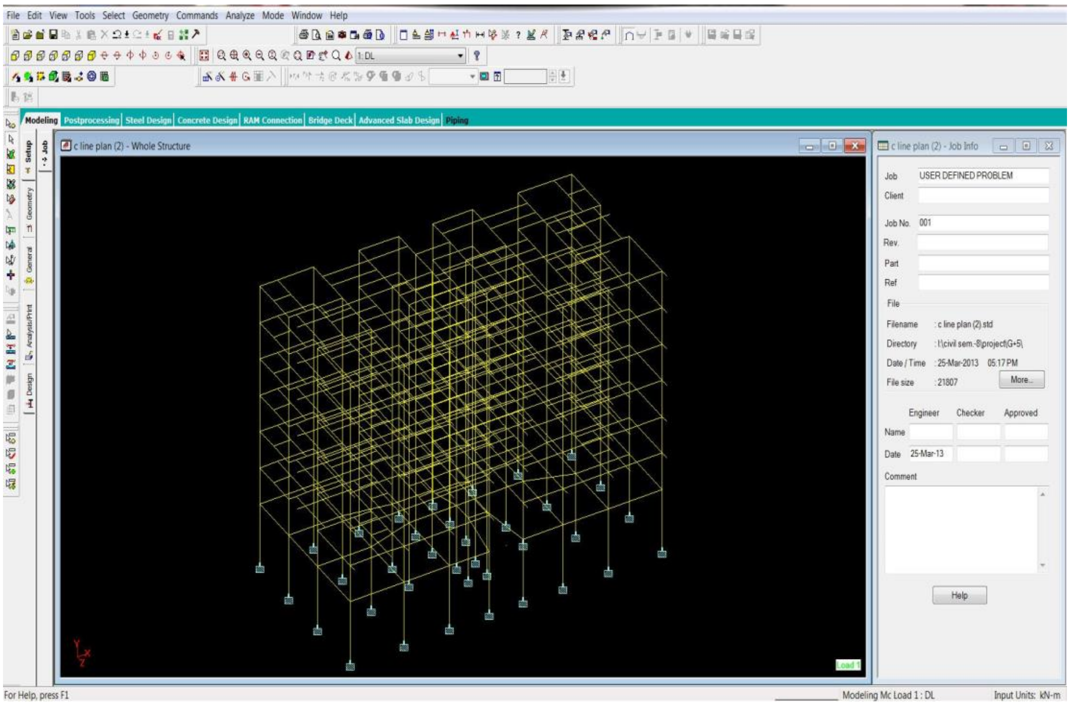

Figure 5 G+7 Building modelling

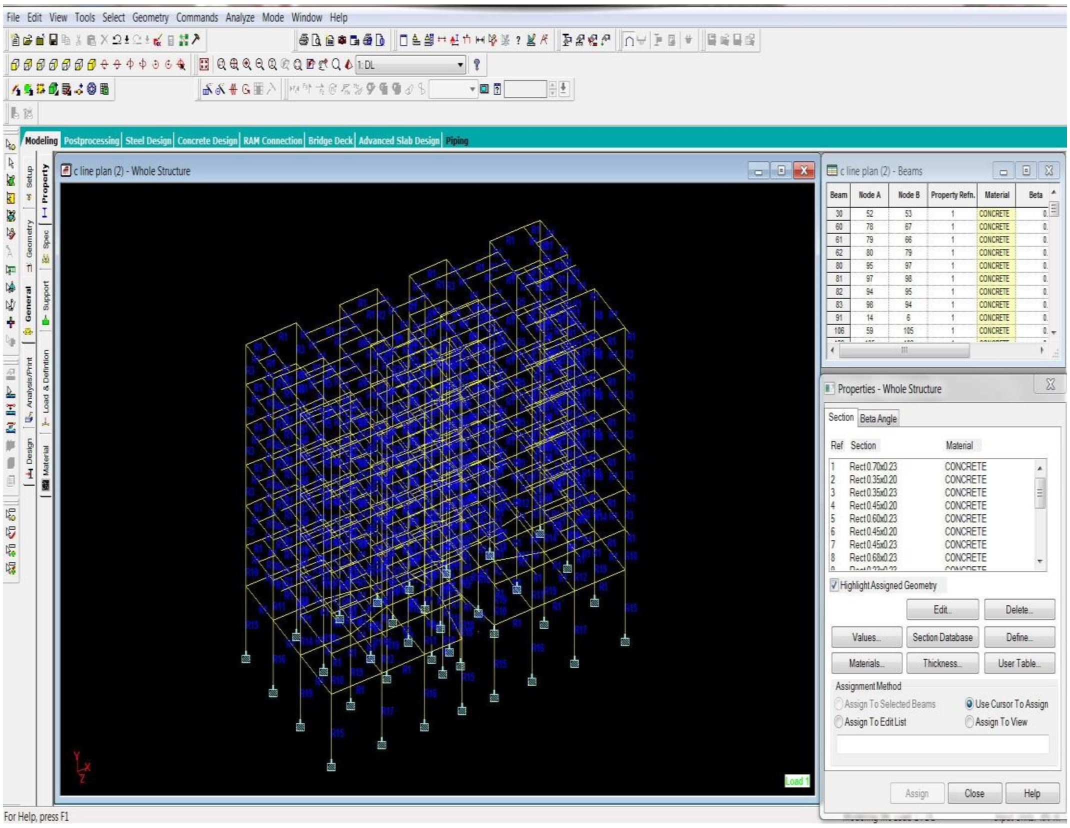

Figure 6 Nodes and Material Defining in STAAD. PRO

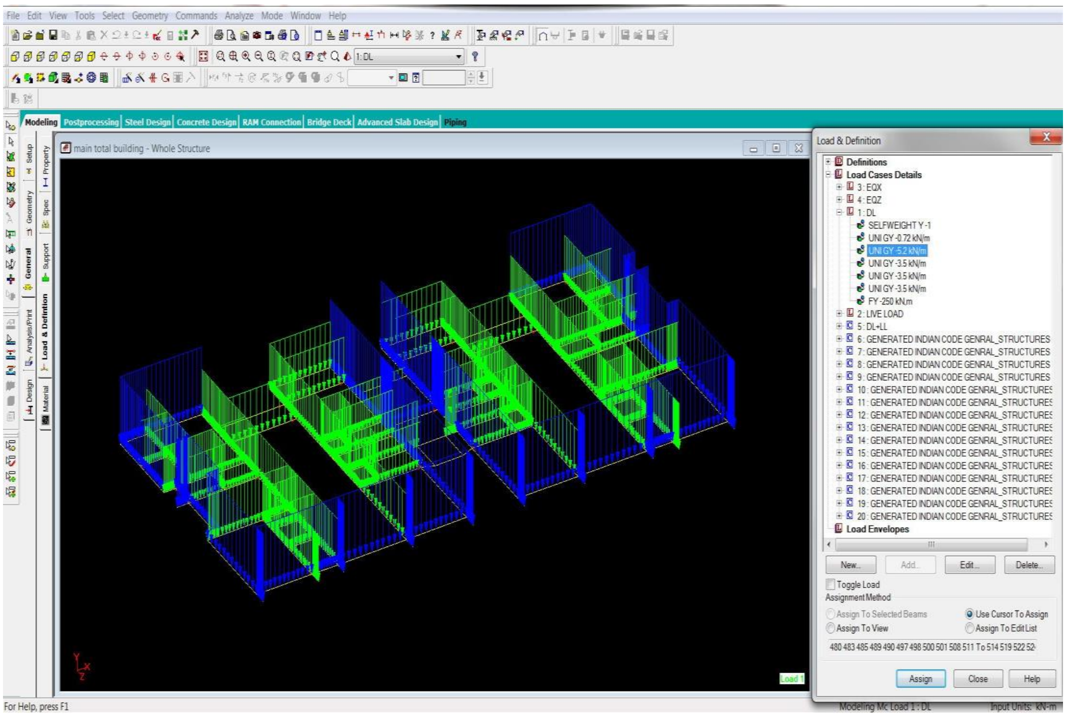

Figure 7 Applying Loads like Earthquake Loads and Wind Loads

4. RESULTS AND DISCUSSIONS

4.1. Comparison of Base Shear in Regular and Irregular model

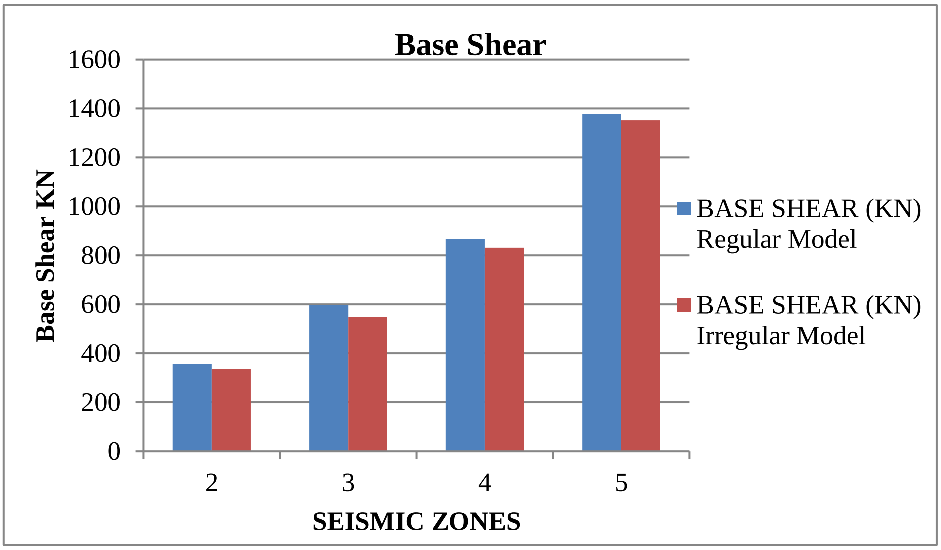

Figure 8 Graph for Base Shears of regular and irregular models

Figure 8 shows the base shear is high at Zone 5 and is most vulnerable seismic zone one compared to other zones.

4.2. Results of Story Drift

Storey drift is the drift of one level of a multi-storey building relative to the level below. Inter story drift is the difference between the roof and floor displacements of any given story as the building sways during the earthquake, normalised by the story height

Table 3 Results of Story Drift

Number of Storey	Storey Drift ZONE II	Storey Drift ZONE III	Storey Drift ZONE IV	Storey Drift ZONE V
1	0.000126	0.000234	0.000279	0.0004869
2	0.0001645	0.000357	0.000434	0.0006332
3	0.0002657	0.0004577	0.0005667	0.0007456
4	0.0002857	0.000563	0.000745	0.001445
5	0.0002185	0.000739	0.000864	0.001678
6	0.00014678	0.0004744	0.000455	0.000734
7	0.00014367	0.0003647	0.000421	0.000482

4.3. Results of Shear and Moment due Earthquake Loads

4.3.1. Regular Multistorey

Table 4 Square corner column C1

ANGLE	SHEAR+	SHEAR-	My	Mz
0	970.012	22.407	30.192	35.383
10	970.387	25.826	30.063	35.243
20	970.579	28.443	29.726	34.869
30	970.568	30.167	29.002	34.663
40	970.338	30.956	28.069	33.125
50	970.335	30.95	28.042	33.125
60	970.571	30.157	29.004	34.114
70	970.574	28.436	29.726	34.85
80	970.362	25.829	30.079	35.307
90	970.012	22.407	30.192	35.383

Table 5 Square corner column C2

ANGLE	SHEAR+	SHEAR-	My	Mz
0	1800	36.428	57.846	70.539
10	1800	35.861	57.845	70.538
20	1800	34.187	57.844	70.539
30	1800	31.502	57.846	71.822
40	1800	27.906	57.845	70.539
50	1800	27.915	57.845	70.539
60	1800	31.509	57.845	70.539
70	1800	34.178	57.846	70.539
80	1800	35.856	57.846	70.539
90	1800	36.428	57.846	70.539

Table 6 Square Middle column C3

ANGLE	SHEAR+	SHEAR-	My	Mz
0	2630	0	34.007	76.776
10	2630	0.013	33.435	77.903
20	2630	0.026	31.826	83.024
30	2630	0.035	32.734	88.858
40	2630	0.038	48.696	90.263
50	2630	0.034	61.298	78.24
60	2630	0.024	64.879	55.101
70	2630	0.012	63.401	41.277
80	2630	0.003	61.659	42.388
90	2630	0	60.996	42.68

4.3.2. Irregular Multistory

Table 7 Irregular corner column C1

ANGLE	SHEAR+	SHEAR-	My	Mz
0	1490	498.005	113.578	151.874
10	1510	449.561	111.365	150.096
20	1500	462.702	106.863	145.736
30	1480	467.989	100.753	152.748
40	1530	460.181	92.826	146.705
50	1560	437.8	93.146	144.016
60	1570	435.481	102.2	141.085
70	1560	414.88	108.509	147.596
80	1520	373.862	111.489	151.09
90	1490	388.607	113.578	151.874

Table 8 Irregular Side column C2

ANGLE	SHEAR+	SHEAR-	My	Mz
0	2130	304.889	208.223	212.46
10	2170	294.171	208.431	210.068
20	2200	273.37	202.316	202.152
30	2210	281.698	190.323	188.827
40	2200	313.914	172.83	170.256
50	2200	375.673	194.204	167.194
60	2180	424.402	175.391	186.58
70	2140	459.777	189.406	200.649
80	2100	482.009	201.666	209.302
90	2130	491.464	208.223	212.46

Table 9 Irregular Middle column C3

ANGLE	SHEAR+	SHEAR-	My	Mz
0	2360	327.852	263.663	310.705
10	2340	337.015	261.208	307.573
20	2320	339.325	250.968	296.569
30	2290	334.766	233.18	278.177
40	2240	322.064	208.368	252.987
50	2280	299.139	204.524	244.832
60	2320	264.573	228.088	272.289
70	2340	269.179	247.877	292.813
80	2360	275.786	259.901	305.753
90	2360	275.524	263.662	310.705

5. CONCLUSIONS

- Compared to vertical irregular model lateral displacement is less in regular model.
- Almost the base shear is same in regular and irregular models, max base shear in zone 5 in regular is 1372.3 KN and in irregular 1349.5 KN.
- Compare to irregular model the regular model shows less displacement with a max displacement of 55.16mm in zone 5.
- The behaviour of the structure is different for the different shape of the structure. Thus, the structure should be analyzed for each particular angle, and it should be intended for the maximum value of shear force and maximum moments.

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