

# SEISMIC EVALUATION OF IRREGULAR STRUCTURES

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**ABSTRACT:** *This paper is concerned with the effects of various vertical irregularities on the seismic response of a structure. Irregularity in plan shape which is due to the difference between the position of the center of stiffness and the mass center of a structure caused by architectural requirements is usually inevitable. The objective of the project is to carry out in dynamic analysis of vertically irregular RC building frames. Comparison of the results of analysis and design of irregular structures with regular structure was done. Many buildings in the present scenario have irregular configuration both in plan and elevation. This in future may subject to devastating earthquake.*

*In this paper an attempt is made to study the story drift, story shear, support reactions, building mode, section cut forces of RC building with plan irregularities in terms of performance point and the effect of earthquake forces on multi story building frame with the help of dynamic analysis. In the present study reinforced concrete framed buildings of irregular plan (according to IS 1893-2002) such as L and C shapes are analyzed and compared with regular plan (rectangular) with G+15 storied building in earth quack Zone V in medium soil by using ETABS software.*

**KEYWORDS:** *irregularities, IS 1893-2002, ETABS, Story drift, Story shear, Support reactions, Building mode, Section cut forces*

## INTRODUCTION

Natural disasters are inevitable and it is not possible to get full control over them. The history of human civilization reveals that man has been combating with natural disasters from its origin but natural disasters like floods, cyclones, earthquakes, volcanic eruptions have various times not only disturbed the normal life pattern but also caused huge losses to life and property and interrupted the process of development. With the technological advancement, man tried to combat with these natural disasters through various ways like developing early warning systems for disasters, adopting new prevention measures, proper relief and rescue measures. But unfortunately it is not true for all natural disasters. Earthquakes are one in all such disasters that's connected with in progress tectonic process; it suddenly comes for seconds and causes nice loss of life and property. So earthquake disaster prevention and reduction strategy is a global concern today. Hazard maps indicating seismic zones in seismic code are revised from time to time which leads to additional base shear demand on existing buildings.

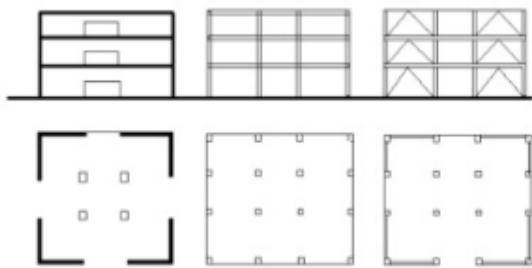
Building construction is that the engineering offers with the development of constructing akin to residential buildings in a really effortless constructing will probably be outline as an enclose area via

partitions with roof, food, fabric and accordingly the basic desires of contributors. Inside the early earlier interval people lived in caves, over bushes or beneath bushes, to safeguard themselves from wild animals, rain, sun, etc. Because the occasions handed as people being started dwelling in huts created from trees branches. The shelters of these previous are developed at the moment into wonderful residences. Rich individuals reside in sophisticated houses.

Structures are the primary indicator of social growth of the county. Every human has wished to possess cozy houses on an average most commonly one spends his two-third life occasions within the houses. The protection civic feel of the responsibility, These are the few motives which are accountable that the man or woman do utmost effort and pay tough-earned saving in owning houses.

#### REGULAR CONFIGURATION:

Regular configuration is seismically idea. These configurations have low heights to base ratio, symmetrical plane, uniform section and elevation and thus have balanced resistance. These configurations would have maximum torsional resistance due to locations of shear walls and bracings. Uniform floor heights, short spans and direct load path play a significant role in seismic resistance of the building.



Shear walls      Braced frames      Moment resistance frames

#### IRREGULAR CONFIGURATION:

Irregularity results from the uneven distribution of mass, strength or stiffness along the elevation of a building structure. Mass irregularity results from a sudden change in mass between adjacent floors, such as mechanical plant on the roof of a structure. Stiffness irregularity results from a sudden change in stiffness between adjacent floors, such as setbacks in the elevation of a building. Plan Irregularity Asymmetric or plan irregular structures are those in which seismic response is not only translational but also torsional, and is a result of stiffness and/or mass eccentricity in the structure. A regular structure may actually be asymmetric if the structure has masonry infill walls or stiffer lateral resisting systems on one side of the structure that has not been taken into consideration in the analysis.

#### THE PROCEDURES FOR THE SEISMIC ANALYSIS OF THE STRUCTURES:

- Linear Static Procedure
- Linear dynamic Procedure
- Response Spectrum method
- Time history method
- Nonlinear Static Procedure (Pushover analysis)
- Nonlinear dynamic procedure As per IS-1893:2002, Methods Adopted are
- Equivalent Static Lateral Force (or) Seismic Coefficient Method
- Response Spectrum Method
- Time history method

## LITERATURE REVIEW

**Rajeeva and Tesfamariam et al. (2012)** Fragility based seismic vulnerability of structures with consideration of soft -storey (SS) and quality of construction (CQ) was demonstrated on three, five, and nine storey RC building frames designed prior to 1970s. Probabilistic seismic demand model (PSDM) for those gravity load designed structures was developed, using non-linear finite element analysis, considering the interactions between SS and CQ. The response surface method is used to develop a predictive equation for PSDM parameters as a function of SS and CQ. Result of the analysis shows the sensitivity of the model parameter to the interaction of SS and CQ.

**Sarkar et al. (2010)** He proposed a new method of quantifying irregularity in vertically irregular building frames, accounting for dynamic characteristics (mass and stiffness). The salient conclusions were as follows:

(1) A measure of vertical irregularity, suitable for stepped buildings, called ‘regularity index’, is proposed, accounting for the changes in mass and stiffness along the height of the building.

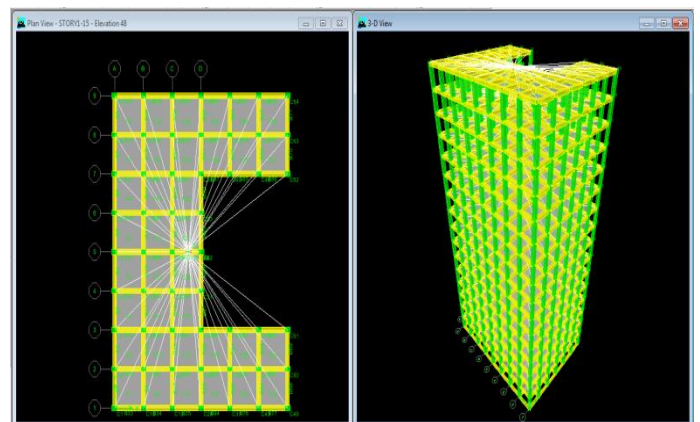
(2) An empirical formula is proposed to calculate the fundamental time period of stepped building, as a function of regularity index.

**Karavasilis et al. (2008)** this research studied the inelastic seismic response of plane steel moment-resisting frames with vertical mass irregularity. The analysis of the created response databank showed that the number of storeys, ratio of strength of beam and column and the location of the heavier mass influence the height-wise distribution and amplitude of inelastic deformation demands, while the response does not seem to be affected by the mass ratio.

**Athanassiadou et al. (2008)** This research concluded that the effect of the ductility class on the cost of buildings is negligible, while performance of all irregular frames subjected to earthquake appears to be equally satisfactory, not inferior to that of the regular ones, even for twice the design earthquake forces. DCM frames were found to be stronger and less ductile than the corresponding DCH ones. The over strength of the irregular frames was found to be similar to that of the regular ones, while DCH frames were found to dispose higher over strength than DCM ones. Pushover analysis seemed to underestimate the response quantities in the upper floors of the irregular frames.

## TYPES OF LOADS ACTING ON THE IRREGULAR BUILDINGS

- a. Dead loads
- b. Imposed loads
- c. Wind loads
- d. Snow loads
- e. Earthquake loads
- f. Special loads



**Model of the structure**

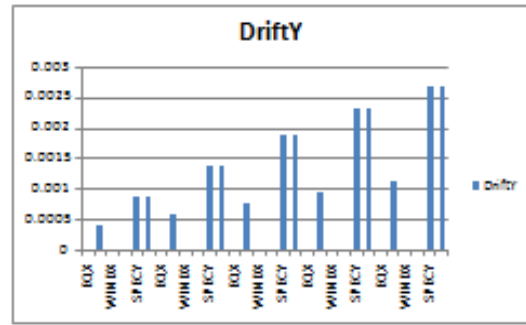
## RESULTS AND ANALYSIS

### I. General Building:

#### 1. Story Drift

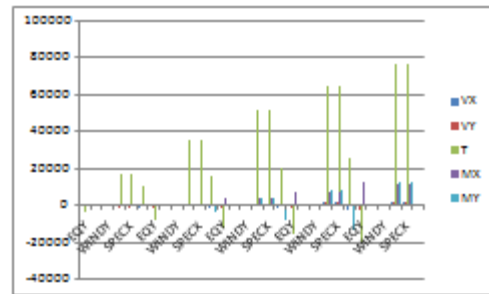
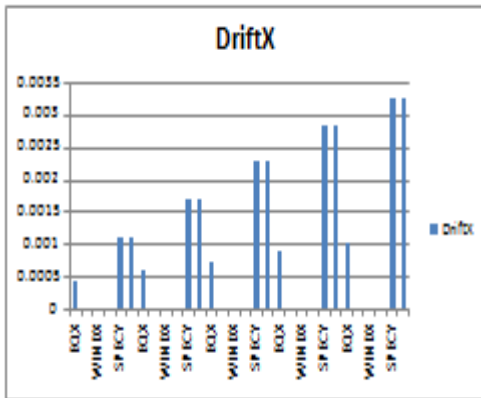
##### Drift X

Story	Item	Load	DriftX
STORY18	Max Drift X	EQX	0.000438
STORY18	Max Drift X	EQY	0
STORY18	Max Drift X	WINDX	0
STORY18	Max Drift X	WINDY	0
STORY18	Max Drift X	SPECX	0.001108
STORY18	Max Drift X	SPECY	0.001108
STORY13	Max Drift X	EQX	0.000371
STORY13	Max Drift X	EQY	0
STORY13	Max Drift X	WINDX	0
STORY13	Max Drift X	WINDY	0
STORY13	Max Drift X	SPECX	0.001893
STORY13	Max Drift X	SPECY	0.001893
STORY14	Max Drift X	EQX	0.000721
STORY14	Max Drift X	EQY	0
STORY14	Max Drift X	WINDX	0
STORY14	Max Drift X	WINDY	0
STORY14	Max Drift X	SPECX	0.002188
STORY14	Max Drift X	SPECY	0.002188
STORY13	Max Drift X	EQX	0.000872
STORY13	Max Drift X	EQY	0
STORY13	Max Drift X	WINDX	0
STORY13	Max Drift X	WINDY	0
STORY13	Max Drift X	SPECX	0.002811
STORY13	Max Drift X	SPECY	0.002811
STORY12	Max Drift X	EQX	0.001023
STORY12	Max Drift X	EQY	0
STORY12	Max Drift X	WINDX	0
STORY12	Max Drift X	WINDY	0
STORY12	Max Drift X	SPECX	0.003259
STORY12	Max Drift X	SPECY	0.003259



#### 2. STORY SHEAR

Story	Load	Loc	VX	VY	T	MX	MY
STORY18	EQX	Top	-432	0	3184	0	0
STORY18	EQY	Top	0	-432	-3888	0	0
STORY18	WINDX	Top	0	0	0	0	0
STORY18	WINDY	Top	0	0	0	0	0
STORY18	SPECX	Top	441.07	391.13	16943.01	0	0
STORY18	SPECY	Top	441.07	391.13	16943.01	0	0
STORY15	EQX	Top	-864	0	10368	0	-1128
STORY15	EQY	Top	0	-864	-7776	1296	0
STORY15	WINDX	Top	0	0	0	0	0
STORY15	WINDY	Top	0	0	0	0	0
STORY15	SPECX	Top	914.05	817.32	35152.89	1173.461	1325.198
STORY15	SPECY	Top	914.05	817.32	35152.89	1173.461	1325.198
STORY14	EQX	Top	-1296	0	15552	0	-3888
STORY14	EQY	Top	0	-1296	-11664	3888	0
STORY14	WINDX	Top	0	0	0	0	0
STORY14	WINDY	Top	0	0	0	0	0
STORY14	SPECX	Top	1331.26	1199.12	51291.87	3625.207	4085.017
STORY14	SPECY	Top	1331.26	1199.12	51291.87	3625.207	4085.017
STORY13	EQX	Top	-1728	0	20736	0	-7776
STORY13	EQY	Top	0	-1728	-15552	7776	0
STORY13	WINDX	Top	0	0	0	0	0
STORY13	WINDY	Top	0	0	0	0	0
STORY13	SPECX	Top	1679.89	1524.09	64987.37	7220.863	8036.43

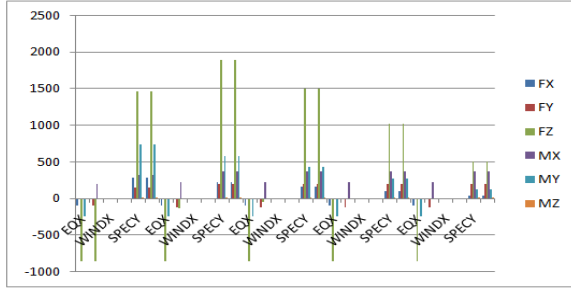


##### Drift Y

Story	Item	Load	DriftY
STORY18	Max Drift Y	EQX	0
STORY18	Max Drift Y	EQY	0.000339
STORY18	Max Drift Y	WINDX	0
STORY18	Max Drift Y	WINDY	0
STORY18	Max Drift Y	SPECX	0.000865
STORY18	Max Drift Y	SPECY	0.000865
STORY13	Max Drift Y	EQX	0
STORY13	Max Drift Y	EQY	0.000563
STORY13	Max Drift Y	WINDX	0
STORY13	Max Drift Y	WINDY	0
STORY13	Max Drift Y	SPECX	0.001367
STORY13	Max Drift Y	SPECY	0.001367
STORY14	Max Drift Y	EQX	0
STORY14	Max Drift Y	EQY	0.00075
STORY14	Max Drift Y	WINDX	0
STORY14	Max Drift Y	WINDY	0
STORY14	Max Drift Y	SPECX	0.001869
STORY14	Max Drift Y	SPECY	0.001869
STORY13	Max Drift Y	EQX	0
STORY13	Max Drift Y	EQY	0.000938
STORY13	Max Drift Y	WINDX	0
STORY13	Max Drift Y	WINDY	0
STORY13	Max Drift Y	SPECX	0.002309
STORY13	Max Drift Y	SPECY	0.002309
STORY12	Max Drift Y	EQX	0
STORY12	Max Drift Y	EQY	0.001121
STORY12	Max Drift Y	WINDX	0
STORY12	Max Drift Y	WINDY	0
STORY12	Max Drift Y	SPECX	0.002885
STORY12	Max Drift Y	SPECY	0.002885

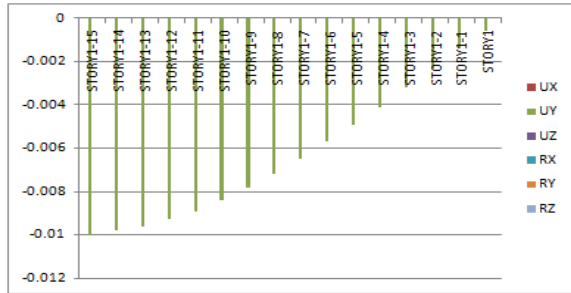
#### 3. SUPPORT REACTIONS

BASE	Point	Load	FX	FY	FZ	MX	MY	MZ
BASE 1	EQX	04.32	0	-830.92	0	-242.922	0	0
BASE 1	EQY	0	-92.32	-849.94	192.922	0	0	0
BASE 1	WINDX	-0.76	0	-0.38	0	-1.43	0	0
BASE 1	WINDY	0	-0.38	0	0	0	0	0
BASE 1	SPECX	28.789	149.07	1438.41	342.821	738.71	21.021	0
BASE 1	SPECY	28.789	149.07	1438.41	342.821	738.71	21.021	0
BASE 2	EQX	-94.32	0	-830.92	0	-242.922	0	0
BASE 2	EQY	0	-119.92	-121.24	220.392	0	0	0
BASE 2	WINDX	-0.76	0	-0.38	0	-1.43	0	0
BASE 2	WINDY	0	-0.38	0	0	0	0	0
BASE 2	SPECX	222.2	194.3	1992.06	370.798	330.334	21.021	0
BASE 2	SPECY	222.2	194.3	1992.06	370.798	330.334	21.021	0
BASE 3	EQX	-94.32	0	-830.92	0	-242.922	0	0
BASE 3	EQY	0	-119.92	-83.32	219.372	0	0	0
BASE 3	WINDX	-0.76	0	-0.38	0	-1.43	0	0
BASE 3	WINDY	0	-0.38	0	0	0	0	0
BASE 3	SPECX	183.4	198.92	1493.13	289.424	421.774	21.021	0
BASE 3	SPECY	183.4	198.92	1493.13	289.424	421.774	21.021	0
BASE 4	EQX	-94.32	0	-830.92	0	-242.922	0	0
BASE 4	EQY	0	-119.18	-11.88	219.321	0	0	0
BASE 4	WINDX	-0.76	0	-0.38	0	-1.43	0	0
BASE 4	WINDY	0	-0.38	0	0	0	0	0
BASE 4	SPECX	102.89	197.38	1013.08	289.88	274.76	21.021	0
BASE 4	SPECY	102.89	197.38	1013.08	289.88	274.76	21.021	0
BASE 5	EQX	-94.32	0	-830.92	0	-242.922	0	0
BASE 5	EQY	0	-119.2	0	219.322	0	0	0
BASE 5	WINDX	-0.76	0	-0.38	0	-1.43	0	0
BASE 5	WINDY	0	-0.38	0	0	0	0	0
BASE 5	SPECX	46	197.39	209.02	289.913	121.76	21.021	0
BASE 5	SPECY	46	197.39	209.02	289.913	121.76	21.021	0



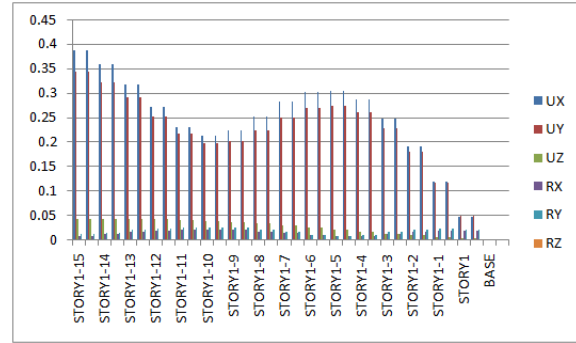
4. BUILDING MODE

Story	Diaphragm	Column	UX	UY	UZ	RX	RY	RZ
STORY16	D1		0	-0.01	0	0	0	0
STORY15	D1		0	-0.0098	0	0	0	0
STORY14	D1		0	-0.0096	0	0	0	0
STORY13	D1		0	-0.0093	0	0	0	0
STORY12	D1		0	-0.0089	0	0	0	0
STORY11	D1		0	-0.0084	0	0	0	0
STORY10	D1		0	-0.0078	0	0	0	0
STORY9	D1		0	-0.0072	0	0	0	0
STORY8	D1		0	-0.0065	0	0	0	0
STORY7	D1		0	-0.0057	0	0	0	0
STORY6	D1		0	-0.0049	0	0	0	0
STORY5	D1		0	-0.0041	0	0	0	0
STORY4	D1		0	-0.0032	0	0	0	0
STORY3	D1		0	-0.0023	0	0	0	0
STORY2	D1		0	-0.0014	0	0	0	0
STORY1	D1		0	-0.0006	0	0	0	0



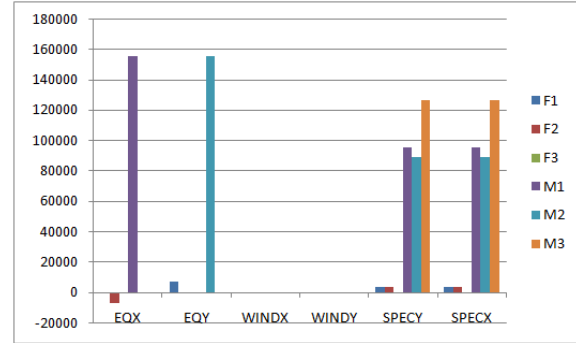
5. DIAPHRAGM ACCELERATION

Story	Diaphragm	Load	UX	UY	UZ	RX	RY	RZ
STORY16	D1	SPECY	0.3866	0.3429	0.0423	0.00709	0.00997	0
STORY16	D1	SPECX	0.3866	0.3429	0.0423	0.00709	0.00997	0
STORY15	D1	SPECY	0.3576	0.3221	0.0423	0.00992	0.01348	0
STORY15	D1	SPECX	0.3576	0.3221	0.0423	0.00992	0.01348	0
STORY14	D1	SPECY	0.3169	0.2897	0.042	0.01436	0.01874	0
STORY14	D1	SPECX	0.3169	0.2897	0.042	0.01436	0.01874	0
STORY13	D1	SPECY	0.2704	0.2509	0.0413	0.01756	0.02239	0
STORY13	D1	SPECX	0.2704	0.2509	0.0413	0.01756	0.02239	0
STORY12	D1	SPECY	0.2303	0.2157	0.0401	0.01948	0.02477	0
STORY12	D1	SPECX	0.2303	0.2157	0.0401	0.01948	0.02477	0
STORY11	D1	SPECY	0.2119	0.1967	0.0381	0.0199	0.02501	0
STORY11	D1	SPECX	0.2119	0.1967	0.0381	0.0199	0.02501	0
STORY10	D1	SPECY	0.2222	0.2013	0.0355	0.0188	0.0233	0
STORY10	D1	SPECX	0.2222	0.2013	0.0355	0.0188	0.0233	0
STORY9	D1	SPECY	0.251	0.2234	0.0323	0.01432	0.01983	0
STORY9	D1	SPECX	0.251	0.2234	0.0323	0.01432	0.01983	0
STORY8	D1	SPECY	0.2817	0.2494	0.0285	0.01272	0.01501	0
STORY8	D1	SPECX	0.2817	0.2494	0.0285	0.01272	0.01501	0
STORY7	D1	SPECY	0.3019	0.268	0.0243	0.0086	0.00967	0
STORY7	D1	SPECX	0.3019	0.268	0.0243	0.0086	0.00967	0
STORY6	D1	SPECY	0.3045	0.2723	0.02	0.00548	0.00637	0
STORY6	D1	SPECX	0.3045	0.2723	0.02	0.00548	0.00637	0
STORY5	D1	SPECY	0.2863	0.2589	0.0157	0.00659	0.00909	0
STORY5	D1	SPECX	0.2863	0.2589	0.0157	0.00659	0.00909	0
STORY4	D1	SPECY	0.2472	0.2272	0.0117	0.01042	0.01428	0
STORY4	D1	SPECX	0.2472	0.2272	0.0117	0.01042	0.01428	0
STORY3	D1	SPECY	0.1896	0.1786	0.0081	0.01424	0.01894	0
STORY3	D1	SPECX	0.1896	0.1786	0.0081	0.01424	0.01894	0
STORY2	D1	SPECY	0.1186	0.1168	0.005	0.01689	0.0216	0



6. SECTION CUT FORCES

Section	Load	F1	F2	F3	M1	M2	M3
SCUT1	EQX	0	-7164.16	0	155520	0	0
SCUT1	EQY	7142.99	0	0	0	155520	0
SCUT1	WINDX	0	-52.21	0	0	0	0
SCUT1	WINDY	39.16	0	0	0	0	0
SCUT1	SPECY	3275.13	3523.89	0	95502.44	88970.68	126068.2
SCUT1	SPECX	3275.13	3523.89	0	95502.44	88970.68	126068.2

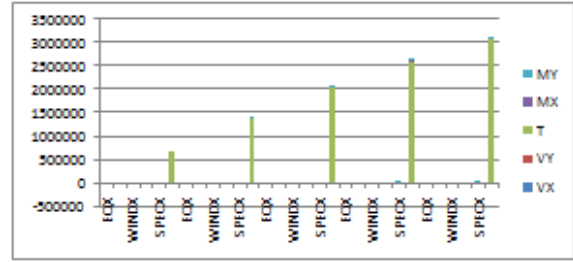
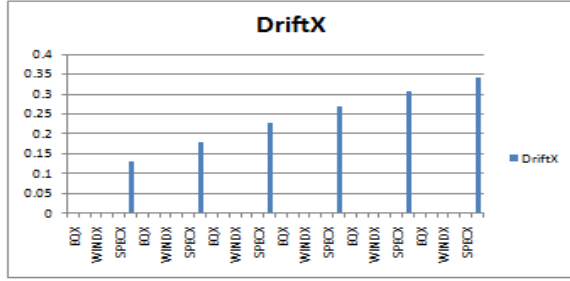


L-SHAPE BUILDING

1. STORY DRIFT

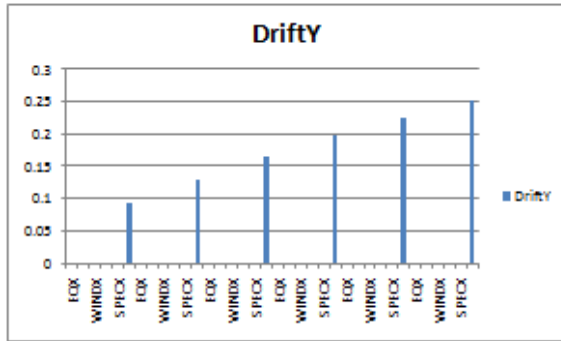
DRIFT X

Story	Item	Load	DriftX
STORY16	Max Drift X	EQX	0.00063
STORY16	Max Drift X	EQY	0.000066
STORY16	Max Drift X	WINDX	0
STORY16	Max Drift X	WINDY	0
STORY16	Max Drift X	SPECY	0.000513
STORY16	Max Drift X	SPECX	0.131806
STORY15	Max Drift X	EQX	0.000757
STORY15	Max Drift X	EQY	0.000068
STORY15	Max Drift X	WINDX	0
STORY15	Max Drift X	WINDY	0
STORY15	Max Drift X	SPECY	0.000663
STORY15	Max Drift X	SPECX	0.179301
STORY14	Max Drift X	EQX	0.000901
STORY14	Max Drift X	EQY	0.000069
STORY14	Max Drift X	WINDX	0
STORY14	Max Drift X	WINDY	0
STORY14	Max Drift X	SPECY	0.000818
STORY14	Max Drift X	SPECX	0.227823
STORY13	Max Drift X	EQX	0.001047
STORY13	Max Drift X	EQY	0.00007
STORY13	Max Drift X	WINDX	0
STORY13	Max Drift X	WINDY	0
STORY13	Max Drift X	SPECY	0.000953
STORY13	Max Drift X	SPECX	0.27041
STORY12	Max Drift X	EQX	0.001192
STORY12	Max Drift X	EQY	0.00007
STORY12	Max Drift X	WINDX	0
STORY12	Max Drift X	WINDY	0
STORY12	Max Drift X	SPECY	0.00106
STORY12	Max Drift X	SPECX	0.30727
STORY11	Max Drift X	EQX	0.001334
STORY11	Max Drift X	EQY	0.000071
STORY11	Max Drift X	WINDX	0
STORY11	Max Drift X	WINDY	0
STORY11	Max Drift X	SPECY	0.00114
STORY11	Max Drift X	SPECX	0.341269



**DRIFT Y**

Story	Item	Load	DriftX
STORY16	Max Drift Y	EQX	0.000699
STORY16	Max Drift Y	EQY	0.000458
STORY16	Max Drift Y	WINDX	0
STORY16	Max Drift Y	WINDY	0
STORY16	Max Drift Y	SPECX	0.000368
STORY16	Max Drift Y	SPECY	0.003359
STORY15	Max Drift Y	EQX	0.000697
STORY15	Max Drift Y	EQY	0.000626
STORY15	Max Drift Y	WINDX	0
STORY15	Max Drift Y	WINDY	0
STORY15	Max Drift Y	SPECX	0.000537
STORY15	Max Drift Y	SPECY	0.129235
STORY14	Max Drift Y	EQX	0.000098
STORY14	Max Drift Y	EQY	0.000803
STORY14	Max Drift Y	WINDX	0
STORY14	Max Drift Y	WINDY	0
STORY14	Max Drift Y	SPECX	0.000704
STORY14	Max Drift Y	SPECY	0.165785
STORY13	Max Drift Y	EQX	0.000098
STORY13	Max Drift Y	EQY	0.00098
STORY13	Max Drift Y	WINDX	0
STORY13	Max Drift Y	WINDY	0
STORY13	Max Drift Y	SPECX	0.000848
STORY13	Max Drift Y	SPECY	0.197871
STORY12	Max Drift Y	EQX	0.000098
STORY12	Max Drift Y	EQY	0.001156
STORY12	Max Drift Y	WINDX	0
STORY12	Max Drift Y	WINDY	0
STORY12	Max Drift Y	SPECX	0.000664
STORY12	Max Drift Y	SPECY	0.225661
STORY11	Max Drift Y	EQX	0.000097
STORY11	Max Drift Y	EQY	0.001331
STORY11	Max Drift Y	WINDX	0
STORY11	Max Drift Y	WINDY	0
STORY11	Max Drift Y	SPECX	0.001054
STORY11	Max Drift Y	SPECY	0.251327

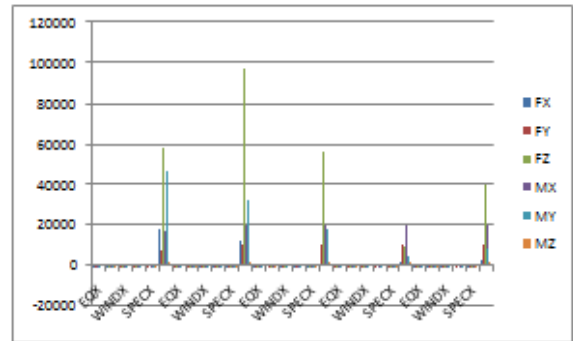


**2. STORY SHEAR**

Story	Load	Loc	VX	VY	T	MX	MY
STORY16	EQX	Top	-324	0	3240	0	0
STORY16	EQY	Top	0	-324	-2430	0	0
STORY16	WINDX	Top	0	0	0	0	0
STORY16	WINDY	Top	0	0	0	0	0
STORY16	SPECX	Top	315.08	290.14	4122.944	0	0
STORY16	SPECY	Top	315.08	290.14	684737	0	0
STORY15	EQX	Top	-648	0	6480	0	-972
STORY15	EQY	Top	0	-648	-4860	972	0
STORY15	WINDX	Top	0	0	0	0	0
STORY15	WINDY	Top	0	0	0	0	0
STORY15	SPECX	Top	656.91	611.18	8635.886	870.409	945.248
STORY15	SPECY	Top	656.91	611.18	1428165	870.409	945.248
STORY14	EQX	Top	-972	0	9720	0	-2916
STORY14	EQY	Top	0	-972	-7290	2916	0
STORY14	WINDX	Top	0	0	0	0	0
STORY14	WINDY	Top	0	0	0	0	0
STORY14	SPECX	Top	955.66	897.58	12805.23	2703.767	2915.706
STORY14	SPECY	Top	955.66	897.58	2081178	2703.767	2915.706
STORY13	EQX	Top	-1296	0	12960	0	-5832
STORY13	EQY	Top	0	-1296	-9720	5832	0
STORY13	WINDX	Top	0	0	0	0	0
STORY13	WINDY	Top	0	0	0	0	0
STORY13	SPECX	Top	1202.39	1140.09	15913.66	3395.158	3780.874
STORY13	SPECY	Top	1202.39	1140.09	2632877	3395.158	3780.874
STORY12	EQX	Top	-1820	0	18200	0	-9720
STORY12	EQY	Top	0	-1820	-12150	9720	0
STORY12	WINDX	Top	0	0	0	0	0
STORY12	WINDY	Top	0	0	0	0	0
STORY12	SPECX	Top	1394.48	1335.11	18325.15	8809.716	9380.73
STORY12	SPECY	Top	1394.48	1335.11	3098776	8809.716	9380.73

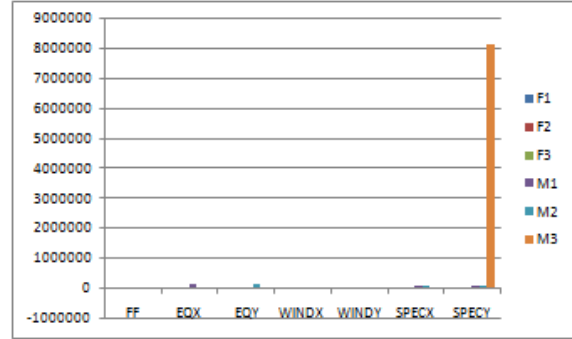
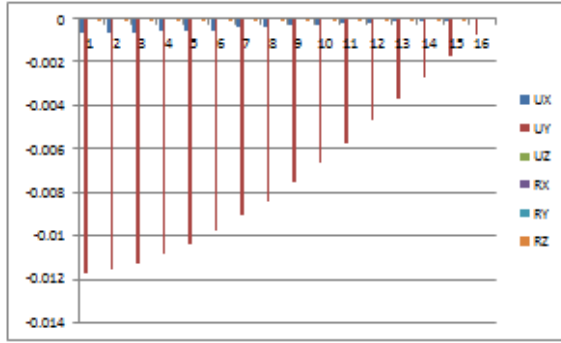
**3. SUPPORT REACTIONS**

Story	Point	Load	FX	FY	FZ	MX	MY	MZ
BASE 1	EQX	-90.01	0.35	-842.98	-0.227	-231.07	0.001	0
BASE 1	EQY	0.1	-86.62	-841.76	181.775	-0.884	-0.048	0
BASE 1	WINDX	-0.7	-0.09	-0.43	0.169	-1.345	0.015	0
BASE 1	WINDY	-0.14	-0.64	-0.43	1.124	-0.235	-0.009	0
BASE 1	SPECX	40.89	38.86	664.62	82.971	107.81	1.749	0
BASE 1	SPECY	18314.24	8103.25	38318.16	17679.9	46684.67	1918.309	0
BASE 2	EQX	-89.66	0.23	-827.67	-0.11	-230.745	0.001	0
BASE 2	EQY	0.07	-112.43	-152.28	206.921	-0.693	-0.048	0
BASE 2	WINDX	-0.78	-0.11	-0.39	0.184	-1.462	0.015	0
BASE 2	WINDY	-0.1	-0.73	-0.33	1.215	-0.189	-0.009	0
BASE 2	SPECX	40.19	31.05	466.75	94.346	108.424	1.749	0
BASE 2	SPECY	12694.24	10837.95	98899.39	20364.03	32370.83	1918.309	0
BASE 3	EQX	-89.29	0.2	-832.24	-0.074	-230.402	0.001	0
BASE 3	EQY	0.03	-111.46	-80.3	205.971	-0.514	-0.048	0
BASE 3	WINDX	-0.85	-0.11	-0.43	0.183	-1.618	0.015	0
BASE 3	WINDY	-0.08	-0.73	-0.33	1.207	-0.112	-0.009	0
BASE 3	SPECX	40.09	30.63	460.83	94.443	108.547	1.749	0
BASE 3	SPECY	7342.2	10793.8	36366.46	20301.5	18710.46	1918.309	0
BASE 4	EQX	-88.91	0.2	-839.8	-0.074	-230.052	0.001	0
BASE 4	EQY	-0.01	-111.7	-22.57	206.208	-0.335	-0.048	0
BASE 4	WINDX	-0.92	-0.11	-0.47	0.183	-1.755	0.015	0
BASE 4	WINDY	-0.02	-0.73	-0.01	1.208	-0.051	-0.009	0
BASE 4	SPECX	40.31	30.74	470.83	94.532	108.141	1.748	0
BASE 4	SPECY	2001.21	10818.9	9381.66	20324.08	4861.436	1918.309	0
BASE 5	EQX	-88.52	0.2	-845.85	-0.08	-229.691	0.001	0
BASE 5	EQY	-0.08	-111.72	-4.62	206.228	-0.158	-0.048	0
BASE 5	WINDX	-0.99	-0.11	-0.5	0.183	-1.891	0.015	0
BASE 5	WINDY	0.03	-0.73	0.01	1.208	0.05	-0.009	0
BASE 5	SPECX	41.59	30.75	488.08	94.562	111.14	1.748	0
BASE 5	SPECY	1419.15	10816.8	40279.8	20324.06	9205.381	1918.309	0



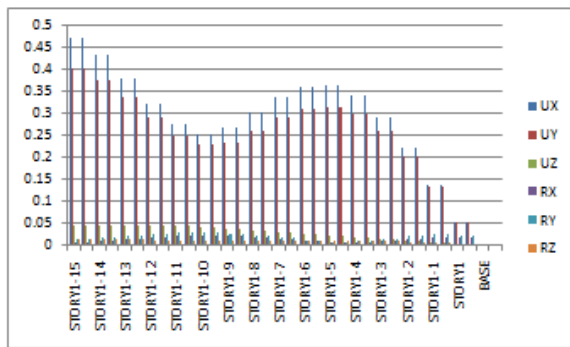
**4. BUILDING MODE**

Story	Diaphragm	UX	UY	UZ	RX	RY	RZ
STORY16	D1	-0.0006	-0.0118	0	0	0	-0.00011
STORY15	D1	-0.0006	-0.0116	0	0	0	-0.00011
STORY14	D1	-0.0006	-0.0113	0	0	0	-0.0001
STORY13	D1	-0.0005	-0.0109	0	0	0	-0.0001
STORY12	D1	-0.0005	-0.0104	0	0	0	-0.00008
STORY11	D1	-0.0005	-0.0098	0	0	0	-0.00008
STORY10	D1	-0.0004	-0.0091	0	0	0	-0.00008
STORY9	D1	-0.0004	-0.0084	0	0	0	-0.00007
STORY8	D1	-0.0003	-0.0075	0	0	0	-0.00007
STORY7	D1	-0.0003	-0.0066	0	0	0	-0.00006
STORY6	D1	-0.0002	-0.0057	0	0	0	-0.00005
STORY5	D1	-0.0002	-0.0047	0	0	0	-0.00004
STORY4	D1	-0.0001	-0.0037	0	0	0	-0.00003
STORY3	D1	-0.0001	-0.0027	0	0	0	-0.00002
STORY2	D1	-0.0001	-0.0017	0	0	0	-0.00001
STORY1	D1	0	-0.0007	0	0	0	0



### 5. DIAPHRAGM ACCELERATION

Story	Diaphragm	Load	UX	UY	UZ	RX	RY	RZ
STORY16	D1	SPECX	0.4701	0.4006	0.0463	0.00868	0.01357	0.01333
STORY16	D1	SPECY	0.4701	0.4006	0.0463	0.00868	0.01357	0.01333
STORY15	D1	SPECX	0.4302	0.3741	0.0462	0.01208	0.01772	0.01246
STORY15	D1	SPECY	0.4302	0.3741	0.0462	0.01208	0.01772	0.01246
STORY14	D1	SPECX	0.3781	0.3349	0.0459	0.01697	0.02348	0.01125
STORY14	D1	SPECY	0.3781	0.3349	0.0459	0.01697	0.02348	0.01125
STORY13	D1	SPECX	0.3209	0.2891	0.045	0.02052	0.02768	0.00986
STORY13	D1	SPECY	0.3209	0.2891	0.045	0.02052	0.02768	0.00986
STORY12	D1	SPECX	0.2733	0.2484	0.0436	0.0226	0.02989	0.00862
STORY12	D1	SPECY	0.2733	0.2484	0.0436	0.0226	0.02989	0.00862
STORY11	D1	SPECX	0.2532	0.2271	0.0414	0.02295	0.02985	0.00795
STORY11	D1	SPECY	0.2532	0.2271	0.0414	0.02295	0.02985	0.00795
STORY10	D1	SPECX	0.2672	0.2334	0.0385	0.02158	0.02756	0.00804
STORY10	D1	SPECY	0.2672	0.2334	0.0385	0.02158	0.02756	0.00804
STORY9	D1	SPECX	0.3019	0.2594	0.0348	0.01863	0.02326	0.00869
STORY9	D1	SPECY	0.3019	0.2594	0.0348	0.01863	0.02326	0.00869
STORY8	D1	SPECX	0.3377	0.2892	0.0307	0.01445	0.01746	0.00946
STORY8	D1	SPECY	0.3377	0.2892	0.0307	0.01445	0.01746	0.00946
STORY7	D1	SPECX	0.3604	0.31	0.0261	0.00971	0.01119	0.00997
STORY7	D1	SPECY	0.3604	0.31	0.0261	0.00971	0.01119	0.00997
STORY6	D1	SPECX	0.362	0.3141	0.0214	0.00627	0.0076	0.00997
STORY6	D1	SPECY	0.362	0.3141	0.0214	0.00627	0.0076	0.00997
STORY5	D1	SPECX	0.3392	0.2978	0.0168	0.00776	0.01103	0.00934
STORY5	D1	SPECY	0.3392	0.2978	0.0168	0.00776	0.01103	0.00934
STORY4	D1	SPECX	0.2918	0.2604	0.0124	0.01218	0.01711	0.00805
STORY4	D1	SPECY	0.2918	0.2604	0.0124	0.01218	0.01711	0.00805
STORY3	D1	SPECX	0.223	0.2038	0.0086	0.01651	0.0225	0.00619
STORY3	D1	SPECY	0.223	0.2038	0.0086	0.01651	0.0225	0.00619
STORY2	D1	SPECX	0.1388	0.1323	0.0053	0.01945	0.02549	0.0039
STORY2	D1	SPECY	0.1388	0.1323	0.0053	0.01945	0.02549	0.0039
STORY1	D1	SPECX	0.0522	0.0542	0.0025	0.0193	0.02291	0.0015
STORY1	D1	SPECY	0.0522	0.0542	0.0025	0.0193	0.02291	0.0015



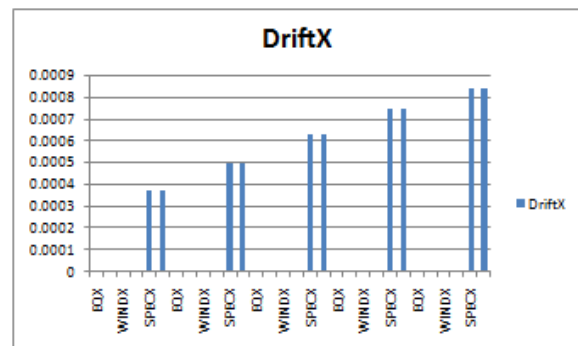
### C SHAPE BUILDING

#### 1. STORY DRIFT DRIFT X

STORY	ITEM	LOAD	DRIFTX
STORY16	Max Drift X	EQX	0
STORY16	Max Drift X	EQY	0
STORY16	Max Drift X	WINDX	0
STORY16	Max Drift X	WINDY	0
STORY16	Max Drift X	SPECX	0.000372
STORY16	Max Drift X	SPECY	0.000372
STORY15	Max Drift X	EQX	0
STORY15	Max Drift X	EQY	0
STORY15	Max Drift X	WINDX	0
STORY15	Max Drift X	WINDY	0
STORY15	Max Drift X	SPECX	0.0005
STORY15	Max Drift X	SPECY	0.0005
STORY14	Max Drift X	EQX	0
STORY14	Max Drift X	EQY	0
STORY14	Max Drift X	WINDX	0
STORY14	Max Drift X	WINDY	0
STORY14	Max Drift X	SPECX	0.000631
STORY14	Max Drift X	SPECY	0.000631
STORY13	Max Drift X	EQX	0
STORY13	Max Drift X	EQY	0
STORY13	Max Drift X	WINDX	0
STORY13	Max Drift X	WINDY	0
STORY13	Max Drift X	SPECX	0.000745
STORY13	Max Drift X	SPECY	0.000745
STORY12	Max Drift X	EQX	0
STORY12	Max Drift X	EQY	0
STORY12	Max Drift X	WINDX	0
STORY12	Max Drift X	WINDY	0
STORY12	Max Drift X	SPECX	0.000836
STORY12	Max Drift X	SPECY	0.000836

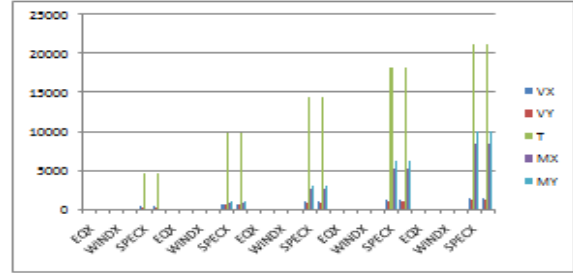
### 6. SECTION CUT FORCES

Section	Load	F1	F2	F3	M1	M2	M3
SCUT1	FF	0	0	-5184	-457.41	-1219.7	0
SCUT1	EQX	0	-5369.2	0	116640	0	1242.99
SCUT1	EQY	5357.72	0	0	0	116640	-466.38
SCUT1	WINDX	0	-52.21	0	0	0	-92.135
SCUT1	WINDY	39.16	0	0	0	0	55.281
SCUT1	SPECX	2439.41	2496.69	0	67108.2	66051.3	7294.41
SCUT1	SPECY	2439.41	2496.69	0	67108.2	66051.3	8180326



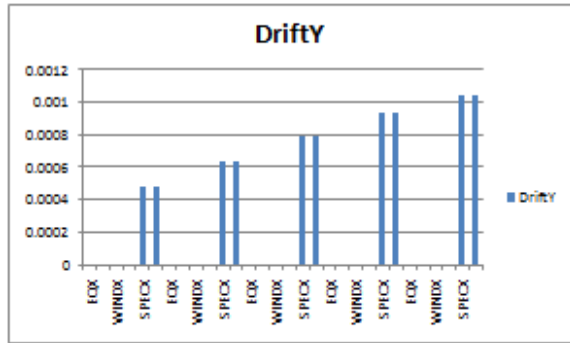
### DRIFT Y

Story	Item	Load	DriftX
STORY16	Max Drift Y	EQX	0
STORY16	Max Drift Y	EQY	0
STORY16	Max Drift Y	WINDX	0
STORY16	Max Drift Y	WINDY	0
STORY16	Max Drift Y	SPECX	0.000476
STORY16	Max Drift Y	SPECY	0.000476
STORY15	Max Drift Y	EQX	0
STORY15	Max Drift Y	EQY	0
STORY15	Max Drift Y	WINDX	0
STORY15	Max Drift Y	WINDY	0
STORY15	Max Drift Y	SPECX	0.000637
STORY15	Max Drift Y	SPECY	0.000637
STORY14	Max Drift Y	EQX	0
STORY14	Max Drift Y	EQY	0
STORY14	Max Drift Y	WINDX	0
STORY14	Max Drift Y	WINDY	0
STORY14	Max Drift Y	SPECX	0.000796
STORY14	Max Drift Y	SPECY	0.000796
STORY13	Max Drift Y	EQX	0
STORY13	Max Drift Y	EQY	0
STORY13	Max Drift Y	WINDX	0
STORY13	Max Drift Y	WINDY	0
STORY13	Max Drift Y	SPECX	0.000931
STORY13	Max Drift Y	SPECY	0.000931
STORY12	Max Drift Y	EQX	0
STORY12	Max Drift Y	EQY	0
STORY12	Max Drift Y	WINDX	0
STORY12	Max Drift Y	WINDY	0
STORY12	Max Drift Y	SPECX	0.001039
STORY12	Max Drift Y	SPECY	0.001039



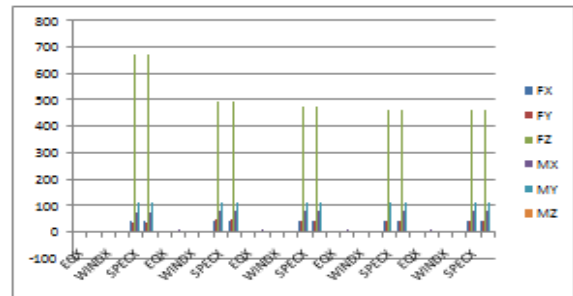
### 3. SUPPORT REACTONS

Story	Point	Load	FX	FY	FZ	MX	MY	MZ
BASE	1	EQX	-3.24	0	-1.62	0	-6.17	0
BASE	1	EQY	0.06	-2.83	-1.71	4.978	0.094	0.002
BASE	1	WINDX	-0.89	0	-0.45	0	-1.702	0
BASE	1	WINDY	-0.1	-0.65	-0.43	1.106	-0.198	-0.006
BASE	1	SPECX	42.82	33.28	673.83	71.222	113.78	1.083
BASE	1	SPECY	42.82	33.28	673.83	71.222	113.78	1.083
BASE	2	EQX	-3.24	0	-1.62	0	-6.17	0
BASE	2	EQY	0.05	-3.25	0.07	5.386	0.071	0.002
BASE	2	WINDX	-0.89	0	-0.45	0	-1.702	0
BASE	2	WINDY	-0.08	-0.72	-0.02	1.197	-0.148	-0.006
BASE	2	SPECX	42.07	43.76	494.01	81.439	111.884	1.083
BASE	2	SPECY	42.07	43.76	494.01	81.439	111.884	1.083
BASE	3	EQX	-3.24	0	-1.62	0	-6.17	0
BASE	3	EQY	0.03	-3.21	-0.05	5.349	0.047	0.002
BASE	3	WINDX	-0.89	0	-0.45	0	-1.702	0
BASE	3	WINDY	-0.05	-0.71	-0.04	1.189	-0.099	-0.006
BASE	3	SPECX	41.56	43.41	471.57	81.092	110.538	1.083
BASE	3	SPECY	41.56	43.41	471.57	81.092	110.538	1.083
BASE	4	EQX	-3.24	0	-1.62	0	-6.17	0
BASE	4	EQY	0.02	-3.22	-0.01	5.352	0.024	0.002
BASE	4	WINDX	-0.89	0	-0.45	0	-1.702	0
BASE	4	WINDY	-0.03	-0.72	-0.02	1.189	-0.049	-0.006
BASE	4	SPECX	41.24	43.5	461.83	81.188	109.714	1.083
BASE	4	SPECY	41.24	43.5	461.83	81.188	109.714	1.083
BASE	5	EQX	-3.24	0	-1.62	0	-6.17	0
BASE	5	EQY	0	-3.22	0	5.352	0	0.002
BASE	5	WINDX	-0.89	0	-0.45	0	-1.702	0
BASE	5	WINDY	0	-0.72	0	1.189	0	-0.006
BASE	5	SPECX	41.13	43.51	458.66	81.197	109.438	1.083
BASE	5	SPECY	41.13	43.51	458.66	81.197	109.438	1.083



### 2. STORY SHEAR

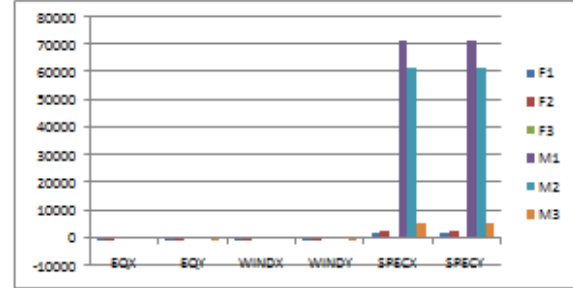
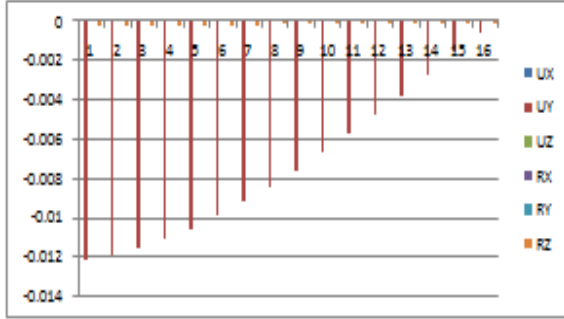
Story	Load	Loc	VX	VY	T	MX	MY
STORY16	EQX	Top	0	0	0	0	0
STORY16	EQY	Top	0	0	0	0	0
STORY16	WINDX	Top	0	0	0	0	0
STORY16	WINDY	Top	0	0	0	0	0
STORY16	SPECX	Top	327.88	273.53	4651.208	0	0
STORY16	SPECY	Top	327.88	273.53	4651.208	0	0
STORY15	EQX	Top	0	0	0	0	0
STORY15	EQY	Top	0	0	0	0	0
STORY15	WINDX	Top	0	0	0	0	0
STORY15	WINDY	Top	0	0	0	0	0
STORY15	SPECX	Top	693.35	580.62	9852.008	820.584	983.631
STORY15	SPECY	Top	693.35	580.62	9852.008	820.584	983.631
STORY14	EQX	Top	0	0	0	0	0
STORY14	EQY	Top	0	0	0	0	0
STORY14	WINDX	Top	0	0	0	0	0
STORY14	WINDY	Top	0	0	0	0	0
STORY14	SPECX	Top	1014.21	851.79	14421.98	2562.248	3063.408
STORY14	SPECY	Top	1014.21	851.79	14421.98	2562.248	3063.408
STORY13	EQX	Top	0	0	0	0	0
STORY13	EQY	Top	0	0	0	0	0
STORY13	WINDX	Top	0	0	0	0	0
STORY13	WINDY	Top	0	0	0	0	0
STORY13	SPECX	Top	1280.54	1078.54	18224.23	5116.223	6104.211



### 4. BUILDING MODE

Story	Diaphragm	UX	UY	UZ	RX	RY	RZ
STORY1	D1	0	-0.0122	0	0	0	-0.00024
STORY1	D1	0	-0.012	0	0	0	-0.00023
STORY1	D1	0	-0.0118	0	0	0	-0.00024
STORY1	D1	0	-0.0111	0	0	0	-0.00023
STORY1	D1	0	-0.0106	0	0	0	-0.00023
STORY1	D1	0	-0.0099	0	0	0	-0.00023
STORY1	D1	0	-0.0092	0	0	0	-0.00023
STORY1	D1	0	-0.0084	0	0	0	-0.00023
STORY1	D1	0	-0.0078	0	0	0	-0.00023
STORY1	D1	0	-0.0068	0	0	0	-0.00023
STORY1	D1	0	-0.0057	0	0	0	-0.00023
STORY1	D1	0	-0.0047	0	0	0	-0.00023
STORY1	D1	0	-0.0037	0	0	0	-0.00023
STORY1	D1	0	-0.0028	0	0	0	-0.00023
STORY1	D1	0	-0.0018	0	0	0	-0.00023
STORY1	D1	0	-0.0008	0	0	0	-0.00023

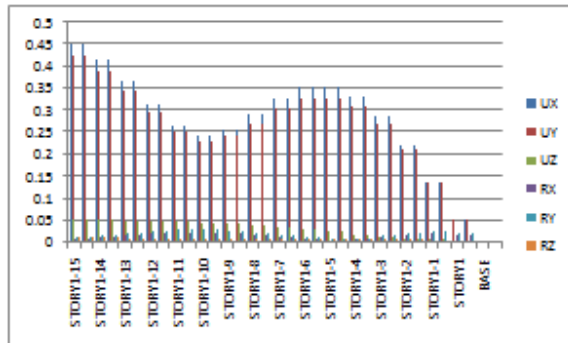




**CONCLUSIONS**

**5. DIAPHRAGM ACCELERATION**

Story	Diaphragm	Load	UX	UY	UZ	RX	RY	RZ
STORY16	D1	SPECX	0.4329	0.4236	0.0501	0.01079	0.01204	0.00874
STORY16	D1	SPECY	0.4329	0.4236	0.0501	0.01079	0.01204	0.00874
STORY15	D1	SPECX	0.4175	0.3908	0.05	0.01434	0.01614	0.00813
STORY15	D1	SPECY	0.4175	0.3908	0.05	0.01434	0.01614	0.00813
STORY14	D1	SPECX	0.3689	0.3438	0.0497	0.01913	0.02213	0.0074
STORY14	D1	SPECY	0.3689	0.3438	0.0497	0.01913	0.02213	0.0074
STORY13	D1	SPECX	0.3139	0.2933	0.0488	0.02355	0.0265	0.00661
STORY13	D1	SPECY	0.3139	0.2933	0.0488	0.02355	0.0265	0.00661
STORY12	D1	SPECX	0.2666	0.2522	0.0472	0.02441	0.02903	0.00593
STORY12	D1	SPECY	0.2666	0.2522	0.0472	0.02441	0.02903	0.00593
STORY11	D1	SPECX	0.2451	0.2319	0.0448	0.0245	0.02926	0.00553
STORY11	D1	SPECY	0.2451	0.2319	0.0448	0.0245	0.02926	0.00553
STORY10	D1	SPECX	0.2378	0.2417	0.0417	0.02283	0.02721	0.00554
STORY10	D1	SPECY	0.2378	0.2417	0.0417	0.02283	0.02721	0.00554
STORY9	D1	SPECX	0.2921	0.2713	0.0378	0.01955	0.02312	0.00578
STORY9	D1	SPECY	0.2921	0.2713	0.0378	0.01955	0.02312	0.00578
STORY8	D1	SPECX	0.3283	0.3035	0.0372	0.01505	0.01748	0.00608
STORY8	D1	SPECY	0.3283	0.3035	0.0372	0.01505	0.01748	0.00608
STORY7	D1	SPECX	0.352	0.3253	0.0383	0.01002	0.01121	0.00623
STORY7	D1	SPECY	0.352	0.3253	0.0383	0.01002	0.01121	0.00623
STORY6	D1	SPECX	0.355	0.3291	0.0352	0.00844	0.00737	0.00611
STORY6	D1	SPECY	0.355	0.3291	0.0352	0.00844	0.00737	0.00611
STORY5	D1	SPECX	0.3337	0.3113	0.0181	0.0081	0.01061	0.00565
STORY5	D1	SPECY	0.3337	0.3113	0.0181	0.0081	0.01061	0.00565
STORY4	D1	SPECX	0.2879	0.2716	0.0134	0.01273	0.01669	0.00483
STORY4	D1	SPECY	0.2879	0.2716	0.0134	0.01273	0.01669	0.00483
STORY3	D1	SPECX	0.2206	0.212	0.0093	0.01725	0.02211	0.00368
STORY3	D1	SPECY	0.2206	0.212	0.0093	0.01725	0.02211	0.00368
STORY2	D1	SPECX	0.1378	0.1371	0.0057	0.02028	0.02518	0.0023
STORY2	D1	SPECY	0.1378	0.1371	0.0057	0.02028	0.02518	0.0023
STORY1	D1	SPECX	0.0321	0.0337	0.0027	0.01998	0.02278	0.00087
STORY1	D1	SPECY	0.0321	0.0337	0.0027	0.01998	0.02278	0.00087



**6. SECTION CUT FORCES**

Section	Load	F1	F2	F3	M1	M2	M3
SCUT1	EQX	32.86	-186.37	0	0	0	0
SCUT1	EQY	163.06	28.75	0	0	0	-44.049
SCUT1	WINDX	9.07	-51.42	0	0	0	0
SCUT1	WINDY	38.56	6.8	0	0	0	39.158
SCUT1	SPECX	2291.96	2663.03	0	71674.17	61614.76	3477.288
SCUT1	SPECY	2291.96	2663.03	0	71674.17	61614.76	3477.288

In the present paper an analytical investigation of both regular and irregular shaped building is carried out using dynamic analysis. It is performed on the building model G+15 storeys to study and identify the seismic behavior of the building.

1. The stories drift values in X direction and Y direction increases for top to bottom story in all three cases.
2. By comparison in three cases the maximum value of story shear was observed for L-shape plan than Regular building and C-shape building. And the values are increases from top storey to bottom stories.
3. When earthquake load is applied in X direction, it is found that rectangular plan structure can resist more base shear than irregular plan structure.
4. When earthquake load is applied in Y direction, it is found that irregular plan structure can resist more base shear than rectangular plan structure .This is because the number of column are increased in y direction in order to stabilize the structure, when the plan is modified to irregular.
5. The building mode values are maximum for UY in all three cases.
6. Diaphragm values initially decreases from 15<sup>th</sup> story to 10<sup>th</sup> story and then increases to 5<sup>th</sup> story and finally decreases to bottom story.

7. The support reactions occur higher value for forces than moments.

By using above conclusions the Regular building and L-shape buildings give good results than C-shaped buildings in all aspects.

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