# SEISMIC ANALYSIS OF PLAN IRREGULAR MULTI-STORIED BUILDING WITH AND WITHOUT SHEAR WALLS

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**Abstract -** *Now a days because of heavy lateral loads most of the buildings are failing in stability ( due to lateral forces,because of parallel strengths), for defeat this Shear walls are most normally utilized. These walls can be used for giving more quality and security to the structure. At the point when the structures are subjected to outside burdens, for example, seismic loads, wind loads and so forth, the Shear walls are assume real part to oppose lateral loads on structures and are at the same time oppose gravity stacks and stays away from the failure of structure. Shear walls additionally limits the torsional impact and gives firmness. In this thesis work three states of structures are considered are I-shape, L-shape, C-shape all are of ten stories, add up to six models are taken three models of bare frame and three models with shear walls all are often storied, the area of Shear walls are at corners of the structures and L-segment Shear walls are utilized. The seismic tremor zone of the structures considered is V (exceptionally extreme) and soil II sort. The examination of structures are finished by Equivalent static technique with the assistance of E-tabs V 15.0.0 programming. From examination parameters like story displacement, story drift and base shear of structure are resolved and compared with and without shear wall structures. The extent of work is to concentrate the impact of seismic effect on plan irregularity in that exceptionally re-entrant corner case structures.*

***Key Words***: **Shear walls, E-tabs 2015, Plan irregularity**

## 1.INTRODUCTION

In present simplicity of development it is necessary to build multi-storied structures, because of shortage of space and by this sort development work advance will be quick.

India is having diverse seismic zones in dis join and exceptionally extreme zones it is fundamental to develop earth tremor safe or horizontal constrain opposing structures. Since earth shake causes enormous loss of human life and property. Sooner or later it is necessary to develop arrange irregular structures because of lacking space or to spare space, tasteful reason, due to not accessibility of uniform ground condition, in such circumstance it is necessary to each outline specialist to accomplish development of multi-storied working by giving adequate quality and dependability for structure against lateral forces, for elevated structures which are at disjoin earth shake zones enhancing firmness is basic.

Shear walls are most normal auxiliary component to make a building earth shudder safe. Fortified solid Shear walls are utilized as a part of normal, the outline and specifying is very simple and not that much trouble feels to a plan build. By giving Shear walls building discovered powerful unbending nature, enhanced pliability, firmness and furthermore practical. For tall structures the section and shaft sizes are very substantial and the joints are conjusted, story uprooting is overwhelming by giving Shear walls story displacement is diminished and add up to fall is kept away from and shear walls guarantees sufficient firmness to elevated structures.

## 1.1 OBJECTIVES OF STUDY

1.To create 3D model of working with unpredictable arrangement and Shear walls utilized E-tabs V 15.0.0 programming.
2.In demonstrating I-shape, L-shape, C-shape working with and without Shear walls models are utilized.
3.To examination of structures with and without Shear walls the static method that is Equivalent static lateral force method is utilized.
4.To concentrate the basic conduct at extreme seismic tremor zones and looking at estimations of base shear, story displacement, story drift of structures with and without shear wall.

## 1.2 SHEAR WALL

Shear walls is an auxiliary part used to oppose horizontal constrain i.e parallel to the plane of shear wall. For thin dividers where the bowing misshaping is more,Shear walls opposes stacks because of Cantilever activity. At the end of the day Shear walls are vertical components of the even constrain opposing framework.

In the building development, an inflexible vertical diaphragm fit for exchanging sidelong strengths from outside shear walls, floors, and rooftops to the ground establishment toward a path parallel to their plane. Illustrations are the fortified solid walls. Horizontal strengths brought about by seismic tremor, wind and uneven settlement loads, in extra to the heaviness of structure and tenants, make capable curving powers. This prompts the disappointment of the structure by shear.Shear walls are particularly critical in tall structures subjected to sidelong wind and seismic strengths. For the most part, Shear walls are plane or flanged in segment, while center walls comprises of channel area. They likewise give sufficient quality and firmness to control horizontal removals.

The shape and plan position of the Shear walls impacts the conduct of the structure extensively. Basically, the best position for the Shear walls is in the focal point of every 50% of the building and at corner of the building. This is once in a while down to earth, since it additionally uses space a considerable measure, so they are situated at closures. It is ideal to utilize shear walls without any openings in them. So for the most part, the dividers around lift shafts and stairwells are utilized. Additionally, shear walls on the sides of the structures that have no windows can be utilized.

**Shear Building :** Where there is no horizontal moment than it is named as Shear building. Shear buildings have specially designed shear walls provided along both width length of the building to resist the wind seismic loads exerted on the building.

By late reviews it demonstrates that always the incredible execution of working with Shear walls under seismic strengths. A hefty portion of codes made the Shear walls plan for elevated structures a Mandatory. What's more, the support detail of shear walls is moderately straight forward as simple to actualize.

### 1.3 IRREGULARITIES OF BUILDINGS

There are two types of irregularities are

1. Plan Irregularities
2. Vertical Irregularities

PLAN IRREGULARITY: Is the even inconsistency in the design of vertical parallel drive opposing components, in this way creating a differential between the focal point of mass and focus of Inflexibility, that ordinarily result in huge torsional requests on structure. In other word the state of being no uniform, or quickly fluctuating, rather than steady.

1) Torsional Irregularity: It to be considered when floor diaphragms are inflexible in their own arrangement in connection to the vertical auxiliary components that oppose the parallel strengths. Torsional irregularity considered to exist when the maximum story drift computed with design eccentricity.

2)Re-entrant corners: Configuration of plan of a structure and its parallel constrain opposing framework contain re-entrant corners, where both projections of the structure past the re- entrant corner are 15 percent more noteworthy than its arrangement measurements in the provided guidance.
3)Diaphragm Discontinuity : Diaphragm with unexpected discontinuities in solidness, are including those having removed.
4)Out of Plane offsets : its offsets of vertical elements.
5)Non parallel system : The vertical elements which are resisting the lateral force are not parallel to lateral force resisting elements.

## 2.METHEDOLOGY

### 2.1 STRUCTURAL FORM

Horizontal burdens can grow high anxieties, produces influence minutes and causes to vibration of structures, Earthquake and wind are the real wellsprings of parallel strengths that effect to structures. The fundamental capacity of horizontal load opposing framework is to ingest vitality instigated on the structure by these sidelong constrain by moving or distorting without crumple. For structural form a perfect structural arrangement is needed and those structural elements are efficient to resist various combination of lateral and gravity loads.

At the point when a structure taller and more slender. The components affecting to outline of structure is imperative here.

### 2.2 METHOD USED FOR ANALYSIS

For earthquake analysis of building the method used is
1. Static Method

i) Equivalent Static Lateral Force Method (Pseudo static technique).

EQUIVALENT STATIC LATERAL FORCE METHOD :

The equivalent static lateral force method is a simplified technique to substitute the effect of dynamic loading of an unexpected earthquake by a static force distributed laterally on a structure for design purpose. The total applied seismic force is generally evaluated in two horizontal directions parallel to the main axes of the building , It assumes that the building responds in its fundamental lateral mode.

To design and analysis of a structure capable to withstand the effect of earthquake, the forces upon the structure must be first specified. This method is simplest one and it requires less computational attempts and based on the formula given in the code of practice.

## 3.MODELING

### 3.1 STRUCTURAL SPECIFICATION

For modeling of structures E- Tabs V 15.0.0 is used, for analysis purpose Equivalent static method is used.
The Properties of the models are given below

Material Properties :

Grade of concrete : M25
Grade of Steel : Fe500
Modulus of Elasticity of Steel, Es : 20,0000 Mpa
Modulus of Elasticity of Concrete Ec : 25000 Mpa

Building Geometrical Properties :

Height of typical story : 3 m
Height of ground story : 3 m
Height of building : 30 m
Span in X - direction : 4 m
Span in Y - Direction : 5 m
Number of stories : G+9
Column Size : 450 mm x 450 mm
Beam Size : 230 mm x 450mm
Thickness of Slab : 125 mm
Thickness of Wall : 230 mm
Thickness of Shear wall : 150 mm
Live Load on Roof : 3 KN/m$^2$
Floor Finish Load : 1 KN/m$^2$
Design Spectrum :
Type of Soil :Medium
Earth quake Zone : V
Zone Factor, Z : 0.36
Importance Factor : 1
Response Reduction Factor : 5

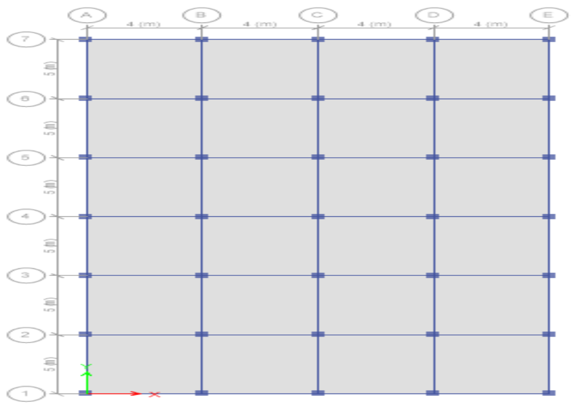
Load Combinations considered for the building analysis are

| Sl.No | Load Combination | Load Patters |
|---|---|---|
| 1. | Gravity analysis | 1.5(DL+LL) |
| 2. | Equivalent static method | 1.2(DL+LL+EQX) |
| | | 1.2(DL+LL+EQY) |
| | | 1.2(DL+LL- EQX) |
| | | 1.2(DL+LL- EQY) |

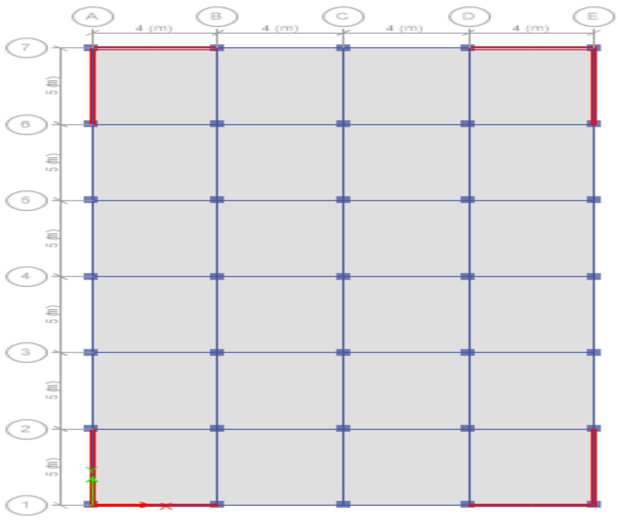
Where,
DL = Dead Load.
LL = Live Load.
EQX,EQY = Earthquake load in X & Y direction.

### 3.2 BUILDING MODELING IN E-TABS 15.0.0

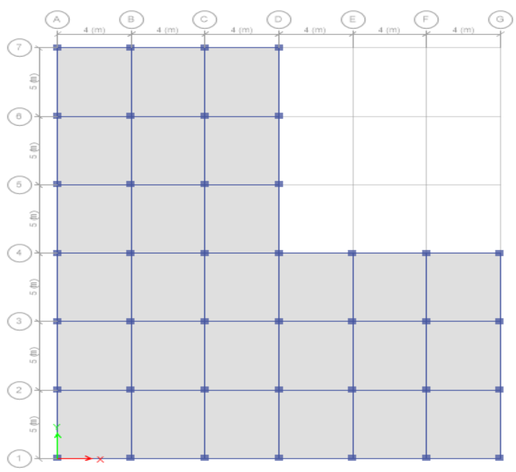
**I-shape Bare framed Building**



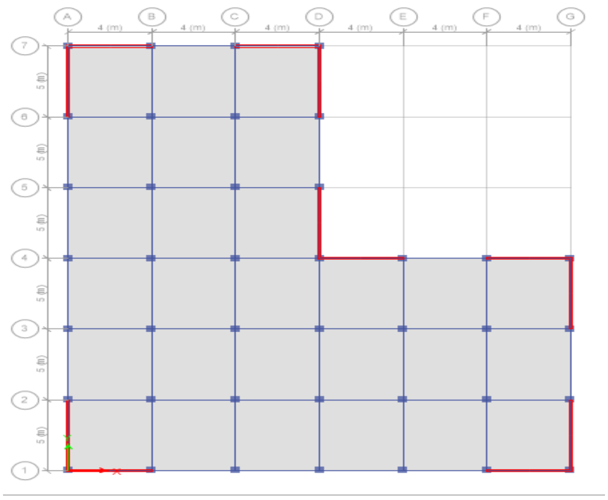
**I-shape Building with Shear wall**



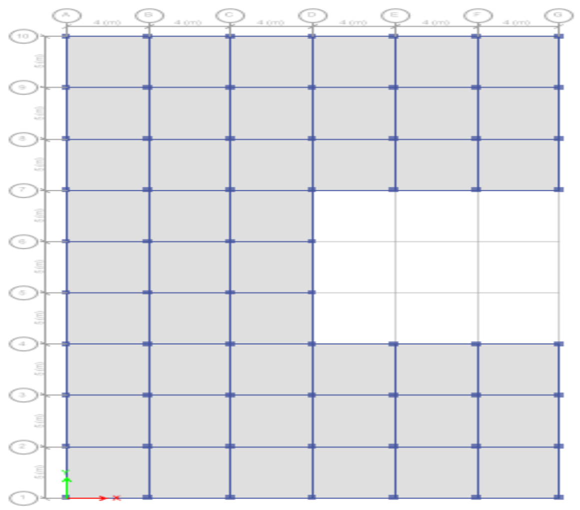
**L-shape Bare frame Building**



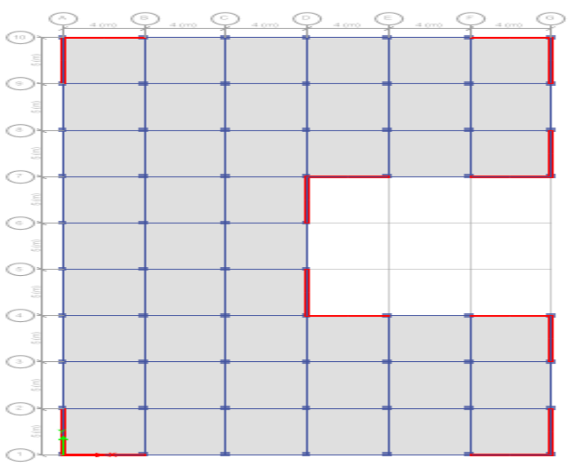
**L-shape Building with Shear Wall**



**C-shape Bare Frame Building**



**C-shape Building with Shear Wall**



## 4.RESULTS AND DISCUSSION

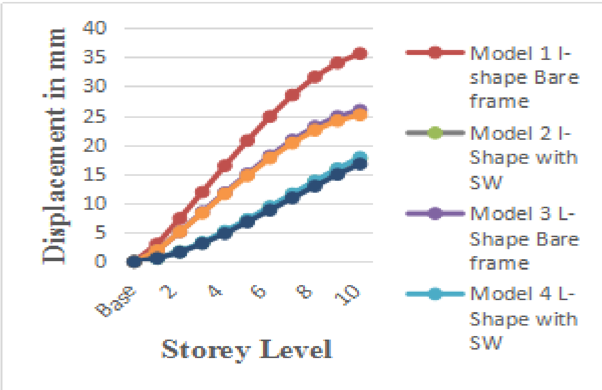
Here the Story Displacement, Story Drift and Base Shear esteems are gotten from Equivalent static method and compared with and without Shear walls structures.

### 4.1 STORY DISPLACEMENT OF ALL MODELS

Story displacement is of all models , along X and Y direction are listed below and compared.

| Story | Model 1 I-shape Bare frame | Model 2 I-Shape with SW | Model 3 L-Shape Bare frame | Model 4 L-Shape with SW | Model 5 C-Shape Bare frame | Model 6 C- Shape with SW |
|---|---|---|---|---|---|---|
| Base | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 3 | 0.6 | 1.9 | 0.6 | 1.9 | 0.6 |
| 2 | 7.4 | 1.7 | 5.1 | 1.7 | 5.1 | 1.6 |
| 3 | 11.9 | 3.2 | 8.5 | 3.3 | 8.3 | 3.1 |
| 4 | 16.4 | 5.1 | 11.8 | 5.2 | 11.6 | 4.8 |
| 5 | 20.7 | 7.1 | 15 | 7.2 | 14.7 | 6.8 |
| 6 | 24.8 | 9.3 | 18.1 | 9.4 | 17.7 | 8.8 |
| 7 | 28.5 | 11.5 | 20.8 | 11.6 | 20.3 | 10.9 |
| 8 | 31.6 | 13.7 | 23.1 | 13.8 | 22.5 | 12.9 |
| 9 | 34 | 15.8 | 24.8 | 15.9 | 24.1 | 14.9 |
| 10 | 35.6 | 17.6 | 25.9 | 17.8 | 25.1 | 16.7 |

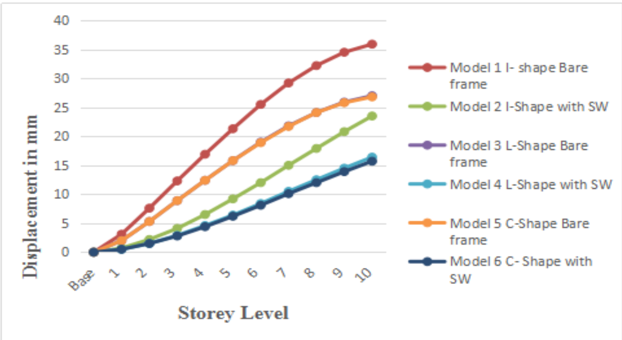
Table No.1 Story Displacement of all models in X-Direction in mm.




Graph No.1 Story Displacement of all models in X-Direction in mm.

| Story | Model 1 I-shape Bare frame | Model 2 I-Shape with SW | Model 3 L-Shape Bare frame | Model 4 L-Shape with SW | Model 5 C-Shape Bare frame | Model 6 C- Shape with SW |
|---|---|---|---|---|---|---|
| Base | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 3.1 | 0.7 | 2 | 0.5 | 2 | 0.5 |
| 2 | 7.6 | 2.2 | 5.3 | 1.5 | 5.3 | 1.5 |
| 3 | 12.3 | 4.1 | 8.9 | 2.9 | 8.9 | 2.8 |
| 4 | 16.9 | 6.5 | 12.4 | 4.6 | 12.4 | 4.4 |
| 5 | 21.3 | 9.2 | 15.8 | 6.4 | 15.8 | 6.2 |
| 6 | 25.5 | 12 | 19 | 8.4 | 18.9 | 8.1 |
| 7 | 29.2 | 15 | 21.8 | 10.5 | 21.7 | 10.1 |
| 8 | 32.2 | 17.9 | 24.1 | 12.5 | 24.1 | 12 |
| 9 | 34.5 | 20.8 | 25.9 | 14.5 | 25.8 | 13.9 |
| 10 | 35.9 | 23.5 | 27 | 16.4 | 26.8 | 15.7 |

Table No.2 Story Displacement of all models in Y-Direction in mm.



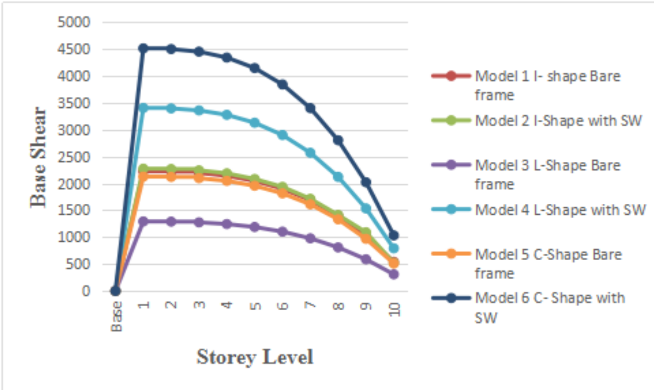

Graph No.2 Story Displacement of all models in Y-Direction in mm.

## 4.2 BASE SHEAR OF ALL MODELS

Base Shear of all models , along X and Y direction are listed below and compared.

| Story | Model 1 I- shape Bare frame | Model 2 I-Shape with SW | Model 3 L-Shape Bare frame | Model 4 L-Shape with SW | Model 5 C-Shape Bare frame | Model 6 C- Shape with SW |
|---|---|---|---|---|---|---|
| Base | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 2224.17 | 2273.06 | 1292.50 | 3401.85 | 2125.53 | 4509.11 |
| 2 | 2218.26 | 2266.92 | 1289.05 | 3392.70 | 2119.87 | 4496.11 |
| 3 | 2194.65 | 2242.34 | 1275.26 | 3356.09 | 2097.20 | 4448.13 |
| 4 | 2141.52 | 2187.03 | 1244.22 | 3273.70 | 2046.20 | 4338.37 |
| 5 | 2047.06 | 2081.75 | 1189.05 | 3127.25 | 1955.54 | 4143.23 |
| 6 | 1899.48 | 1935.08 | 1102.85 | 2898.40 | 1813.88 | 3838.33 |
| 7 | 1686.96 | 1713.85 | 978.71 | 2568.87 | 1609.89 | 3399.28 |
| 8 | 1397.69 | 1412.74 | 809.75 | 2120.35 | 1332.24 | 2801.67 |
| 9 | 1019.87 | 1091.45 | 589.06 | 1534.52 | 969.59 | 2021.13 |
| 10 | 541.70 | 521.70 | 309.75 | 793.07 | 510.62 | 1033.25 |

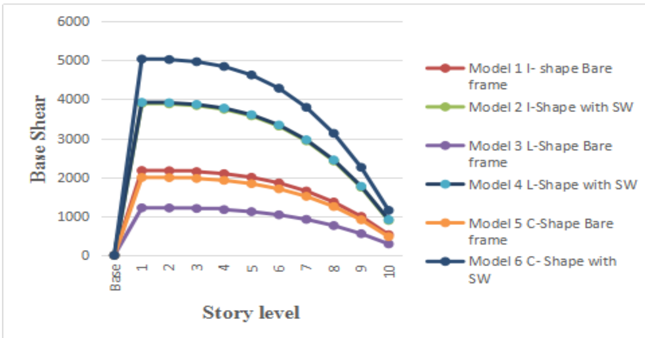
Table No.3 Base Shear of all models in X-Direction in KN.




Graph No.3 Base Shear of all models in X-Direction in KN.

| Story | Model 1 I-shape Bare frame | Model 2 I-Shape with SW | Model 3 L-Shape Bare frame | Model 4 L-Shape with SW | Model 5 C-Shape Bare frame | Model 6 C- Shape with SW |
|---|---|---|---|---|---|---|
| Base | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 2174.02 | 3892.42 | 1217.11 | 3921.44 | 1996.76 | 5032.3 |
| 2 | 2168.25 | 3881.42 | 1213.86 | 3910.89 | 1991.44 | 5018.74 |
| 3 | 2145.17 | 3839.81 | 1200.87 | 3868.68 | 1970.14 | 4964.30 |
| 4 | 2093.24 | 3745.10 | 1171.65 | 3773.72 | 1922.24 | 4841.8 |
| 5 | 2000.91 | 3576.73 | 1119.69 | 3604.89 | 1837.07 | 4624.02 |
| 6 | 1856.66 | 3313.66 | 1038.52 | 3341.10 | 1703.99 | 4283.73 |
| 7 | 1648.92 | 2934.83 | 921.62 | 2961.24 | 1512.36 | 3793.73 |
| 8 | 1366.18 | 2419.20 | 762.51 | 2444.20 | 1251.33 | 3126.78 |
| 9 | 996.88 | 1745.73 | 554.70 | 1768.89 | 910.85 | 2255.66 |
| 10 | 529.48 | 893.36 | 291.68 | 914.21 | 479.68 | 1153.15 |

Table No.4 Base Shear of all models in Y-Direction in KN.



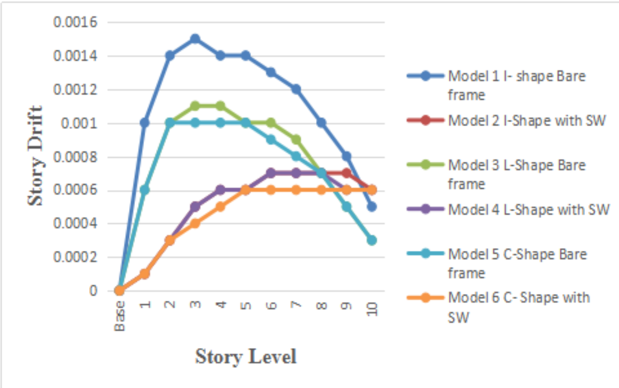

Graph No.4 Base Shear of all models in Y-Direction in KN.

## 4.3 STORY DRIFT OF ALL MODELS

Story Drift of all models , along X and Y direction are listed below and compared.

| Story | Model 1 I- shape Bare frame | Model 2 I-Shape with SW | Model 3 L-Shape Bare frame | Model 4 L-Shape with SW | Model 5 C-Shape Bare frame | Model 6 C- Shape with SW |
|---|---|---|---|---|---|---|
| Base | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0.0010 | 0.0001 | 0.0006 | 0.0001 | 0.0006 | 0.0001 |
| 2 | 0.0014 | 0.0003 | 0.0010 | 0.0003 | 0.0010 | 0.0003 |
| 3 | 0.0015 | 0.0005 | 0.0011 | 0.0005 | 0.0010 | 0.0004 |
| 4 | 0.0014 | 0.0006 | 0.0011 | 0.0006 | 0.0010 | 0.0005 |
| 5 | 0.0014 | 0.0006 | 0.0010 | 0.0006 | 0.0010 | 0.0006 |
| 6 | 0.0013 | 0.0007 | 0.0010 | 0.0007 | 0.0009 | 0.0006 |
| 7 | 0.0012 | 0.0007 | 0.0009 | 0.0007 | 0.0008 | 0.0006 |
| 8 | 0.0010 | 0.0007 | 0.0007 | 0.0007 | 0.0007 | 0.0006 |
| 9 | 0.0008 | 0.0007 | 0.0005 | 0.0006 | 0.0005 | 0.0006 |
| 10 | 0.0005 | 0.0006 | 0.0003 | 0.0006 | 0.0003 | 0.0006 |

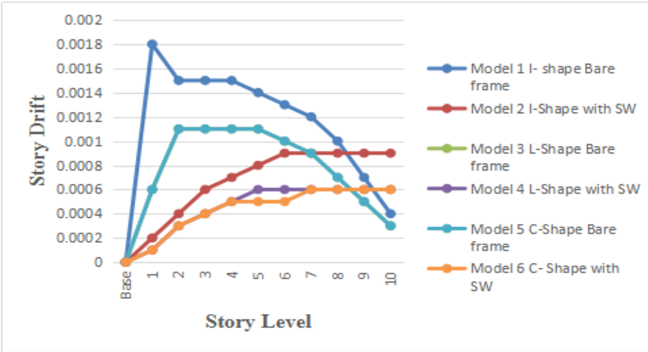
Table No.5 Story Drift of all models in X-Direction.




Graph No.5 Story Drift of all models in X-Direction.

| Story | Model 1 I-shape Bare frame | Model 2 I-Shape with SW | Model 3 L-Shape Bare frame | Model 4 L-Shape with SW | Model 5 C-Shape Bare frame | Model 6 C- Shape with SW |
|---|---|---|---|---|---|---|
| Base | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0.0018 | 0.0002 | 0.0006 | 0.0001 | 0.0006 | 0.0001 |
| 2 | 0.0015 | 0.0004 | 0.0011 | 0.0003 | 0.0011 | 0.0003 |
| 3 | 0.0015 | 0.0006 | 0.0011 | 0.0004 | 0.0011 | 0.0004 |
| 4 | 0.0015 | 0.0007 | 0.0011 | 0.0005 | 0.0011 | 0.0005 |
| 5 | 0.0014 | 0.0008 | 0.0011 | 0.0006 | 0.0011 | 0.0005 |
| 6 | 0.0013 | 0.0009 | 0.0010 | 0.0006 | 0.0010 | 0.0005 |
| 7 | 0.0012 | 0.0009 | 0.0009 | 0.0006 | 0.0009 | 0.0006 |
| 8 | 0.0010 | 0.0009 | 0.0007 | 0.0006 | 0.0007 | 0.0006 |
| 9 | 0.0007 | 0.0009 | 0.0005 | 0.0006 | 0.0005 | 0.0006 |
| 10 | 0.0004 | 0.0009 | 0.0003 | 0.0006 | 0.0003 | 0.0006 |

Table No.6 Story Drift of all models in X-Direction.




Graph No.6 Story Drift of all models in X-Direction.

## 4.4 OBSERVATION

1.The Maximum story displacement in X-Direction of top story for I,L,C shape shear wall structures gets lessened by 49%, 68% and 66% individually when compared with the maximum displacement of I,L,C shape bare frame structures.
2.The Maximum story displacement in Y-Direction of top story for I,L,C shape shear wall structures gets lessened by 65%, 60% and 50% individually when compared with the maximum displacement of I,L,C shape bare frame structures.
3.The Base Shear in X-Direction of top story for I,L,C shape shear walls structures gets increased by 96%, 39% and 49% individually when compared with the base shear of I,L,C shape bare frame structures.
4.The Base Shear in Y-Direction of top story for I,L,C shape shear walls structures gets increased by 59%, 31% and 41% individually when compared with the base shear of I,L,C shape bare frame structures.
5.The Maximum story drift in X-Direction for I,L,C shape shear wall structures upto seventh story it gets progressively decreased when compared with bare frame structures, and from 8th to top story it gets increased in I- shape is 83%, in L-shape it is 50%, in C- shape it is 50% as compared with bare frame buildings.
6.The Maximum story drift in Y-Direction for I, L,C shape shear wall structures upto eighth story it gets step by step lessened when compared with bare frame structures, and from 9th to top story it gets increased in I- shape is 49%, in L-shape it is 50%, in C- shape it is 50% as compared with bare frame buildings.

## 5.CONCLUSION AND FUTURE SCOPE

## 5.1 CONCLUSION

1.The Shear walls building is having high effectiveness of decreasing story uprooting because it diminished 50-70% with contrasting exposed edge structures.
2.L-shape, C-shape structures with Shear walls are having great reaction or great outcomes in base shear, story drift and displacement.

3.It shows that in X-direction in all shape of models the L-shape is having less displacement.
4.In Y-direction in all shape of models the I-shape is having less displacement with shear wall.
5.In all shapes the I-shape building with shear wall is having increased base shear both in X and Y direction and the L-shape is having very less increased base shear.
6.In all shapes from 8th to 10th story the story drift is increased and below 8th story it is lessened.
7.From the review it demonstrates that, the building gives better execution by utilizing the shear wall in it for opposing seismic tremor when contrasted with bare frame building.
8.From the review it demonstrates that the Y-Direction esteems in all parameters of every one of the six sort models are high.
9.By utilizing shear walls the building will oppose seismic tremor proficiently with Our Indian atmosphere.
10.By including shear walls we can lessen the cross area of section and shaft if any possible.

## 5.2 FUTURE SCOPE

1.This study gives idea about the performance of Plan irregular buildings.
2.This study will helps further referencing for dynamic analysis of plan irregular buildings.
3.We can analyze plan irregular buildings by push over analysis.
4.By providing shear walls with steel bracing systems we can analyze the plan irregular buildings.
5.This will be analyzed for vertical irregular buildings.
We can analyze plan irregular buildings by wind load combinations.

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