IJMTARC – VOLUME – V – ISSUE – 23, JULY-SEP, 2018

ISSN: 2320-1363

DESIGN OF SHEAR WALLS IN RESPONSE SPECTRUM METHOD USING ETABS

VENKATA SAI DINESH BONGARALA [(1)], **V. Bhargavi** [(2)]

1 Dept., of Civil Engg., M-Tech Student (Structural Engineering), Visaka technical campus

2 Dept., of Civil Engg., Assistant Professor **M.E (ph.d)**, Visaka technical campus

ABSTRACT: Shear wall is a basic important structural component. These walls can be utilized for giving more strength & safety to the structure, when the structures are subjected to external loads, such as earthquake loads, wind loads etc. These types of walls are used basically for the loads due to earthquake are a matter of concern. These lateral forces can play a main role for the construction of tall structure. In tall building the later stresses in the structure, induce undesirable stresses in the structure, induce undesirable vibrations or cause excessive lateral sway of the structure. Reinforced concrete building soften have vertical plate-like RC wall scaled Shear Walls in addition to slabs beam sand columns. Shear walls are efficient both in terms of construction cost and in minimizing earthquake damage in structural and non-structural element Structural design of buildings for seismic loading is primarily concerned with structural safety during major Earthquakes, in tall buildings, it is very important to ensure adequate lateral stiffness to resist lateral load. The provision of shear wall in building to achieve rigidity effectively and economical.

In this project, a 10-storey building in Zone IV is presented to reduce the effect of earthquake using reinforced concrete shear wall-framed structures in the building. The results were tabulated by performing Response spectrum analysis using ETABS version 9.7.4 in the form of maximum storey displacements, base shear reactions, mode shapes and storey drifts. Effect of Irregularity was studied by creating openings in shear wall and by varying the thickness of Shear wall, along the storey's.

INTRODUCTION

A big part of India is susceptible to negative ranges of seismic dangers. Hence, it is essential to absorb to account the seismic load for the layout of systems. In buildings the lateral loads due to earthquake are a count of difficulty. These lateral forces can produce important stresses within the structure, result in undesirable stresses in the shape, set off unwanted vibrations or cause immoderate Lateral sway of the shape.

1.2 EARTHQUAKE:

Rocks are manufactured from elastic cloth, and so elastic pressure Thus, whilst the rocks along a susceptible vicinity inside the Earth's Crust attain their energy, a sudden motion takes there location to opposite aspects of the fault (a crack within the rocks in which motion has taken vicinity) unexpectedly slip and release the big elastic pressure strength stored within the interface rocks. And, after the earthquake is over, the process of stress build-up at this changed interface between the rocks begins all over again. Earth scientists recognize this as the Elastic Rebound Theory. The material points at the fault over which slip happens typically constitute a rectangular three-dimensional volume, with its lengthy size frequently running into tens of kilometers.

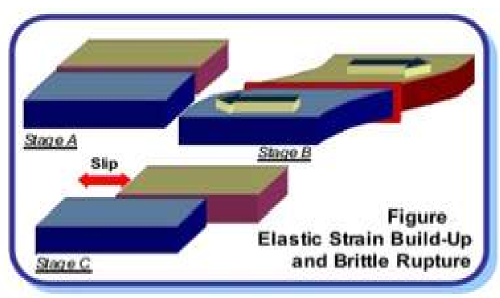


Figure
Elastic Strain Build-Up and Brittle Rupture

SEISMIC ZONES OF INDIA

IJMTARC – VOLUME – V – ISSUE – 23, JULY-SEP, 2018

ISSN: 2320-1363

The varying geology at distinctive places within the region means that the chance of adverse earthquakes taking place at different places is exclusive. Thus, a seismic sector map is needed to pick out those regions. The seismic region maps are revised now and again as extra knowledge is won on the geology, The Indian Standards furnished the Primary seismic quarter map in 1962, which have become later revised in 1967 and once more in 1970..

RC SHEAR WALL

Shear partitions are vertical factors of the horizontal force resisting machine. Shear partitions are constructed to counter the results of lateral load acting on a shape. In residential construction, when shear partitions are designed and built well, and they'll have the power and stiffness to resist the horizontal forces. Their thickness may be as little as 150mm, or as high as 400mm in excessive upward push homes. Shear walls are commonly provided along both length and width of homes Fig 1.2 shows the shear wall beginning from base to pinnacle of the building.

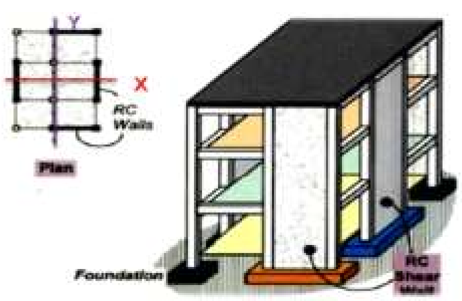


Figure 1.2: Reinforced Concrete Shear Wall

Advantages of Shear Wall

Properly designed and particular buildings with shear partitions have proven excellent performance in beyond earthquakes. The overwhelming success of homes with shear partitions in resisting strong earthquakes is summarized inside the quote:

We cannot afford to build concrete homes meant to face up for severe earthquakes without shear walls. Shear partitions in excessive seismic regions require special detailing. However, in past earthquakes, even homes with enough quantity of partitions that had been not mainly special for seismic performance (however had sufficient properly- Allocated reinforcement) had been saved from crumble. Shear wall buildings are a famous desire in many earthquake prone countries, like Chile, New Zealand and USA.

Architectural Aspects of Shear Wall

Most RC homes with shear walls also have columns; those columns normally deliver gravity hundreds (i.e., those due to self-weight and contents of building). Shear walls provide massive power and stiffness to homes within the route in their orientation, which extensively reduces lateral sway of the building and thereby reduces damage to shape and its contents. Since shear walls deliver huge horizontal earthquake forces, the overturning outcomes on them are big. Thus, design in their foundations calls for special attention.

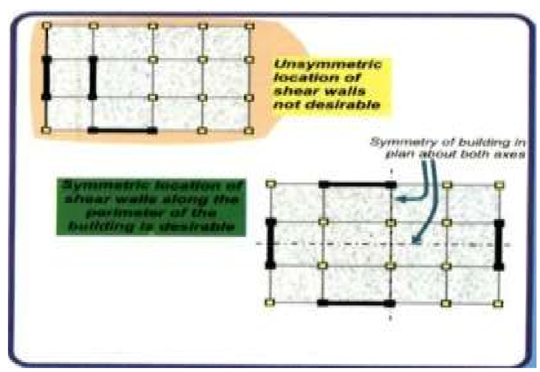


Figure 1.3: Shear walls must be symmetric in plan

Ductile Design of Shear Wall.

Just like reinforced concrete (RC) beams and columns, RC shear walls additionally perform tons higher if designed to be ductile. Overall geometric proportions of the wall, kinds and quantity of reinforcement, and reference to closing factors in the building assist in improving the ductility of partitions. The Indian Standard Ductile Detailing Code for RC individuals (IS:13920-1993) offers unique format tips for ductile detailing of shear walls.

IJMTARC – VOLUME – V – ISSUE – 23, JULY-SEP, 2018

ISSN: 2320-1363

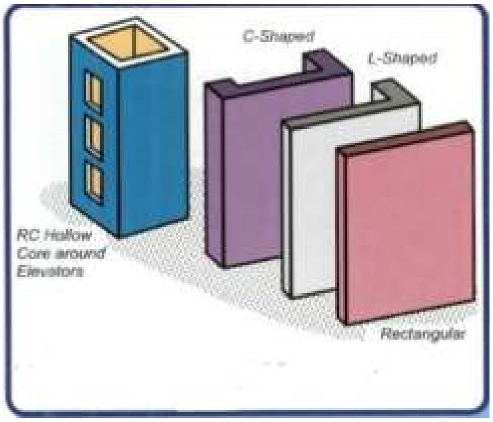


Figure 1.4: Shear walls in RC buildings (All geometries are possible)

LITERATURE REVIEW

2.1. GENERAL

The literature survey is being performed to become aware of the paintings associated with the prevailing examine. Considerable quantity of research has been achieved on the layout of shear wall, placement of shear wall and so forth. This section highlights various experimental and theoretical research conducted within the field of designing of systems.

2.2. LITERATURE REVIEW ON SHEAR-WALLS

Placement of Shear walls:

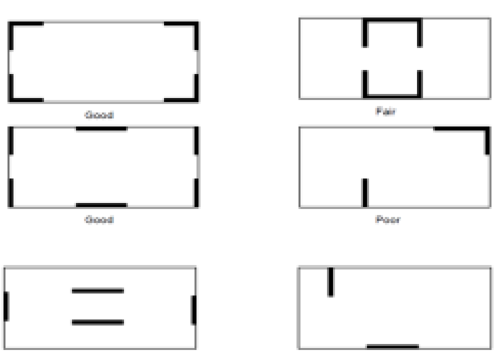


Figure 2.1: Placement of Shear walls

SUMMARY

It has been nicely mounted by way of many researchers that the thinking about shear partitions are very powerful for strengthened concrete structures to withstand lateral masses. From the literature research, the following statement have been made,

- Most of the look at is concentrated on impact of shear wall (with/ without openings) at numerous places of the shape
- Most of the buildings are modeled the use of ETABS software
- Placing Shear wall away from center of gravity resulted in increase in maximum of the individuals forces. Therefore, they're located symmetrically to reduce the outcomes.

SEISMIC ANALYSIS OF RC FRAMED STRUCTURES

There are one-of-a-kind strategies available for the analysis of framed systems subjected to earthquake loads. The strategies of analysis may be broadly categorized into the subsequent types.

- Linear Static Method (Equivalent Static Method)
- Modal Analysis
- Linear Dynamic approach (Response Spectrum and Linear Time History Method)
- Non-Linear Static Method (Pushover Analysis)
- Non-Linear Dynamic Method (Non-linear Time History Analysis)

Out of these four strategies, in Linear static approach, Equivalent Static, Modal Analysis and Response Spectrum technique is considered for analyzing the overall performance of Shear wall.

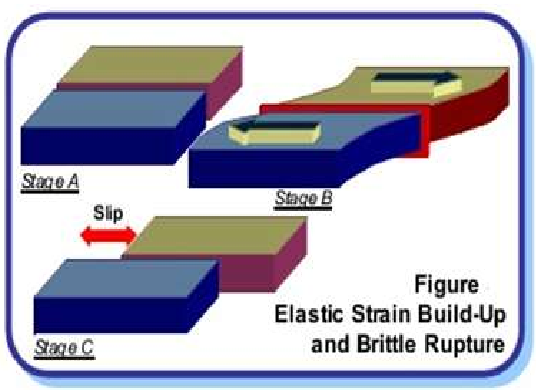
RESPONSE SPECTRUM ANALYSIS

IJMTARC – VOLUME – V – ISSUE – 23, JULY-SEP, 2018 ISSN: 2320-1363

In order to perform the seismic analysis and layout of a shape to be constructed at a particular region, the real time records record is wanted. However, it isn't possible to have such records at each and each place. Further, the seismic assessment of structures cannot be accomplished definitely based mostly on the height charge of the ground acceleration as the response of the form depend upon the frequency content cloth of floor motion and its very own dynamic residences.

MODAL ANALYSIS

A modal evaluation calculates the frequency modes or herbal frequencies of a given machine, but now not usually its complete time information reaction to a given enter. The herbal frequency of a machine relies upon simplest at the stiffness of the shape and the mass which participates with the shape (which include self-weight). It isn't relying at the weight function.



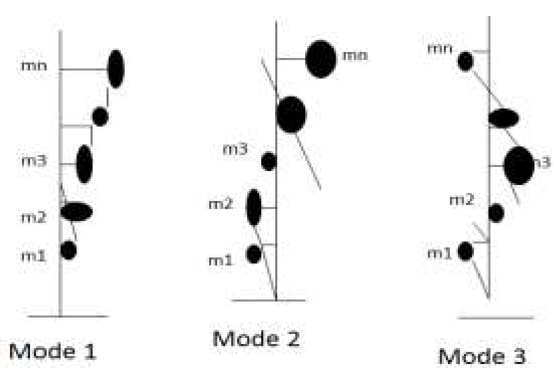


Figure 3.1: Mode Shapes

FACTORS AFFECTING RESPONSE OF STRUCTURE

3.5.1 Importance Factor (I):

Ensures higher design seismic force for more important structures.

Table 3.1 Importance Factor

Sl No	Structure	Importance Factor
1	Important service and community buildings, such as hospitals; schools; monumental structures; emergency buildings like telephone exchange, television stations, radio stations, railway stations, fire station buildings– large community halls like cinemas, assembly halls and subway stations, power stations	1.5
2	All other buildings	1.0

A static nonlinear push-over evaluation is used wherein the gravity masses are held constant even as the earthquake forces are regularly accelerated until a mechanism forms or the desired restrict on inter storey glide is passed. It is referred to that during second-resisting frames the reserve strength reduces with an increase inside the quantity of storeys as well as in the level of layout earthquake forces.

.

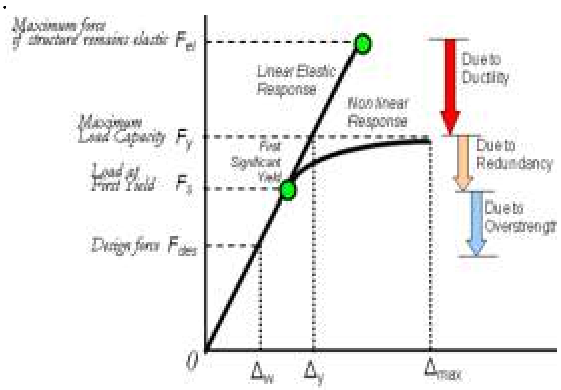


Figure 3.2: Graphs between Total Horizontal Load and Roof Displacement (Δ)

Structural Response Factors (S_a /g):

It is an element denoting the acceleration reaction spectrum of the shape subjected to earthquake ground vibrations and depends on herbal duration of vibration and damping of the structure. Depends on structural traits and soil condition. Structural traits include time period and damping.

IJMTARC – VOLUME – V – ISSUE – 23, JULY-SEP, 2018

ISSN: 2320-1363

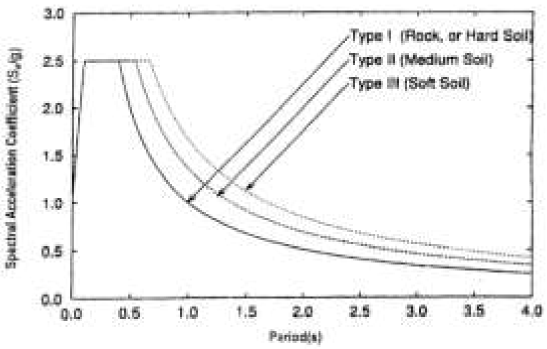
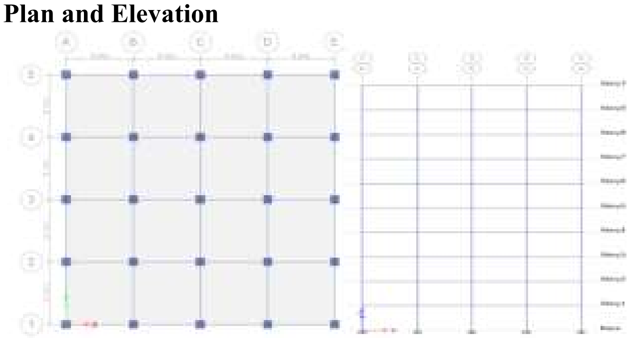


Figure 3.3: Response Spectra

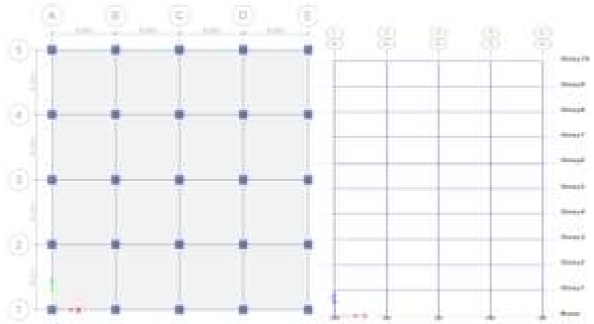
MODELLING OF 10 STOREY STRUCTURE USING ETABS

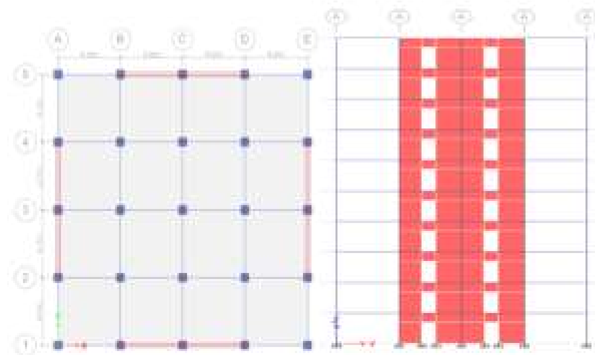
The evaluation of 10 storey building with symmetric configuration is finished through using the software ETABS 2013. Analysis is accomplished for different forms of homes in the thesis like 10 storey homes without shear walls, shear wall with openings & with varying thickness alongside the storeys. The analysis done in step with the IS codes.

Plan and Elevation

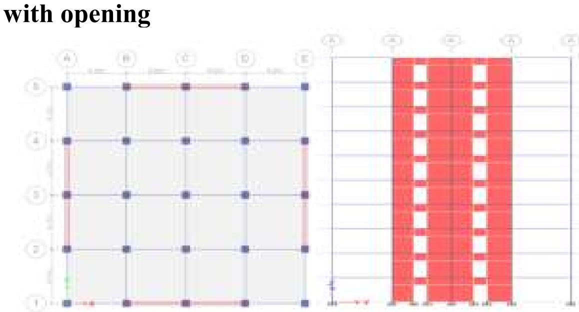


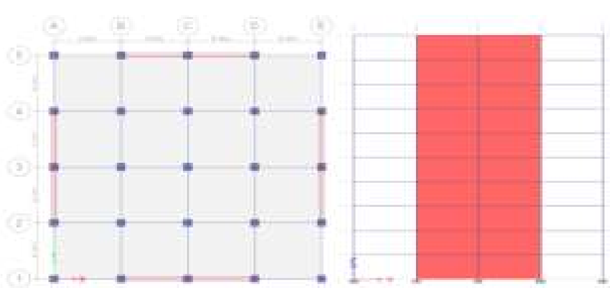
Plan and elevation view of building without shear wall





Plan and elevation view of Shear wall building with opening





Plan and elevation view of Shear wall building with varying thickness

IJMTARC – VOLUME – V – ISSUE – 23, JULY-SEP, 2018

ISSN: 2320-1363

Preliminary Data:

- Type of frame :Ordinary RC moment resisting frame fixed at the base
- Seismic zone :IV
- Number of storeys :9
- Floor height :3 m
- Plinth height :1.5 m
- Depth of Slab :125 mm
- Spacing between frames :4m along both directions
- Live load on floor level :3 kN/m^2
- Live load on roof level :1.5 kN/m^2
- Floor finish :1.0 kN/m^2
- Terrace water proofing :1.5 kN/m^2
- Materials :M 20 concrete, Fe 415 steel and Brick infill
- Thickness of infill wall :230mm (Exterior walls) :150 mm (Interior walls)
- Density of concrete :25 kN/m^3
- Density of infill :20 kN/m^3
- Type of soil :Rocky
- Response spectra :As per IS 1893(Part1):2002
- Damping of structure :5 %

  **Live load on floor level and roof level are taken from IS-875 (Part-) considered RC framed buildings as residential usage
- Shear wall with varying thickness:

Storey	Thickness
Base	350
First	350
Second	350
Third	300
Fourth	300
Fifth	300
Sixth	250
Seventh	250
Eight	250
Ninth	230
Tenth	230

Member and Material Properties

Dimensions of the beams and columns are decided on the basis of trial and blunders process in evaluation of Staad pro and Etabs software's via thinking about nominal sizes for beams and columns and secure sizes are as show inside the desk beneath.

Beams: 230mmx500mm

Columns: 500mmx500mm

Material properties of the building are like M20 grade of concrete, FE415 steel and 13800 N/mm2 of modulus of elasticity of brick masonry in the buildings.

Load calculations

In Etabs we want now not calculate the self weight of frame contributors. This will mechanically consist of the self-weight of structural members inside the evaluation based on gift particular weights given in function of the fabric kind.

Dead Load:

Floor finish : 1.5kN/m^2

Internal wall load : 2.7x0.15x20 = 8.1KN/m

External wall load : 2.7x0.23x20 =12.42KN/m

IJMTARC – VOLUME – V – ISSUE – 23, JULY-SEP, 2018
ISSN: 2320-1363

Parapet Wall : 1x0.15x20= 3KN/m

Live load:

For typical floors : 3kN/m^2

For top floor : 1.5kN/m^2

Load Combination:

In this Project 13 Load Combinations are considered.

In the limit state design of reinforced and prestressed concrete structures, the following load combinations shall be accounted for:

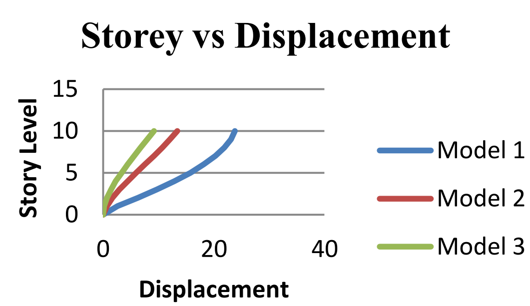
1) $1.5\,(DL + IL)$
2) $1.2\,(DL + IL \pm EL)$
3) $1.5\,(DL \pm EL)$
4) $0.9\,DL \pm 1.5\,EL$

Figure.4.4: Load combinations

RESULTS AND DISCUSSIONS:

Comparison of Displacement

Storey	Model 1	Model 2	Model 3
	Displacements	Displacements	Displacements
10	23.8	13.4	9.2
9	23.1	12.1	8
8	21.9	10.7	6.8
7	20.3	9.2	5.6
6	18.2	7.6	4.5
5	15.8	6	3.4
4	12.9	4.5	2.3
3	9.7	3	1.5
2	6.3	1.7	0.7
1	2.6	0.7	0.2
Base	0	0	0

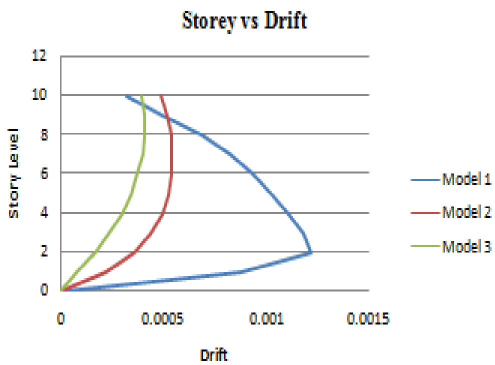


Comparison Of Drift

Storey	Model 1	Model 2	Model 3
	Drifts	Drifts	Drifts
10	0.000318	0.00048	0.000394
9	0.000497	0.000519	0.000405
8	0.000685	0.000538	0.000404
7	0.000822	0.00054	0.000396
6	0.000933	0.00054	0.000371
5	0.001027	0.000526	0.000341
4	0.001109	0.000494	0.000296
3	0.00118	0.000441	0.000234
2	0.001218	0.000359	0.000167
1	0.000875	0.000218	0.00082
Base	0	0	0

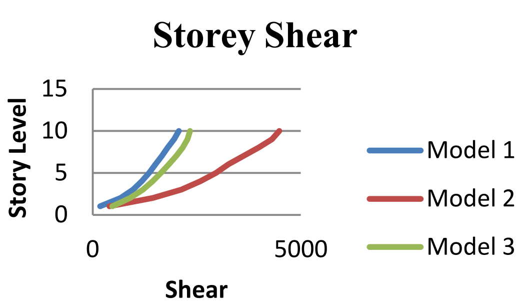
IJMTARC – VOLUME – V – ISSUE – 23, JULY-SEP, 2018

ISSN: 2320-1363



Comparison of Storey Shear

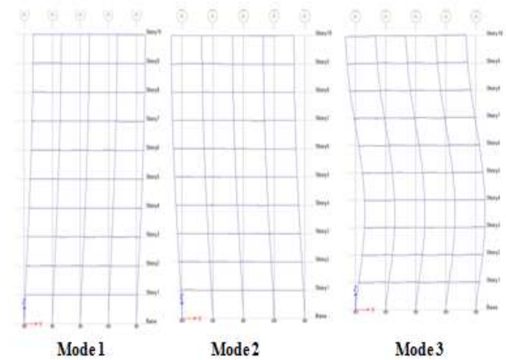
Storey	Model 1	Model 2	Model 3
	Shear	Shear	Shear
10	184	402	472
9	672	1451	905
8	971	2133	1211
7	1179	2583	1443
6	1355	2959	1642
5	1512	3262	1832
4	1661	3620	2010
3	1799	3986	2166
2	1956	4304	2282
1	2072	4484	2338



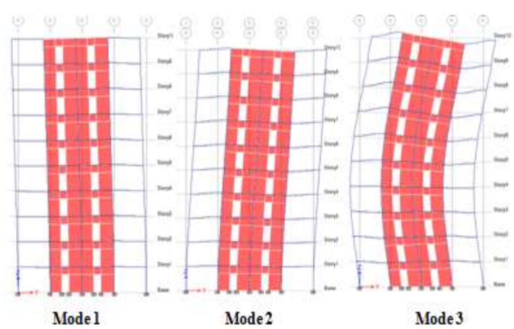
Comparison of Time Period and Mode Shapes

Table 5.4 Time period for three modes

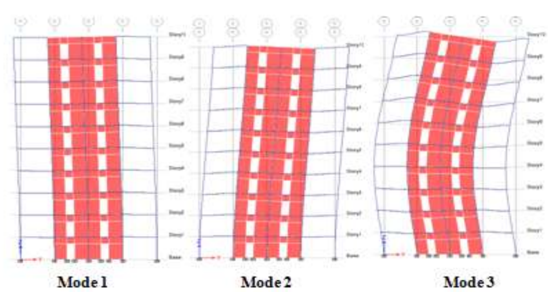
	Model1	Model2	Model3
Mode1	1.985	0.915	0.631
Mode2	1.955	0.903	0.471
Mode3	1.719	0.596	0.138



Mode shapes of model 1

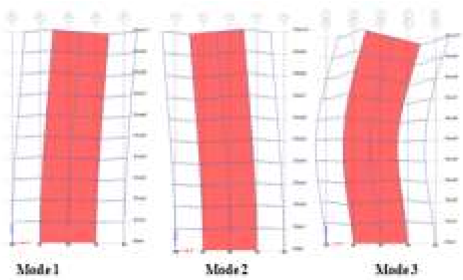


Mode shapes of model 2



IJMTARC – VOLUME – V – ISSUE – 23, JULY-SEP, 2018

ISSN: 2320-1363



Mode shapes of model 3

From the observation of the results it states that Model 3 (Shear wall with Varying thickness) display the less time period and Model 1(with Shear wall) indicates better time period. As we realize time period is inversely proportional to stiffness, , from which we are able to say that Model three sort of buildings might be extra stiffer and more secure during the earthquakes than other 2 form of models

CONCLUSION

The present observe is focused at the seismic universal performance of form without Shear wall, Shear wall with openings and Shear wall with numerous thickness. Both Gravity assessment and Response Spectrum analysis had been achieved to apprehend the behavior of 3 models.

•Comparative studies at the Response Spectrum Analysis of three kinds of Structures were effectively finished.

•Providing shear walls at good enough places notably reduces the displacements and Drift Ratios.

•As the thickness of shear wall will increase, lateral displacements of the form decrease

•From the comparison of Time Period we can say that Structure with shear wall with diverse thickness is stiffer than the opposite systems

•Thesis proved that Performance of shear wall in version 3 (Shear wall with Varying thickness) is more effective than the model 2(presence of openings in shear wall)

REFERENCES

VENKATA SAI DINESH BONGARALA (1),

V. BHARGAVI (2)

(1) Dept., of Civil Engg., M-Tech Student (Structural Engineering), Visaka technical campus

(2) Dept., of Civil Engg., Assistant Professor **M.E (ph.d)**, Visaka technical campus

1 .**AnujChandiwala,(2012)—**Earthquake Analysis of Building Configuration with Different Position of Shear Wall‖, International Journal of Emerging Technology and Advanced Engineering ISSN 22502459, ISO 9001:2008 Certified Journal, Volume 2, Issue 12, December 2012.

2. Dr. S. B. Shinde and N.B. Raut, Effect of Change in Thicknesses and Height in Shear Wall on Deflection of Multistore Buildings. International Journal of Civil Engineering and Technology, 7(6), 2016, pp.587–591.

3. **G.S Hiremath and Saddam Husain(2012)-** Effect of Change in Shear Wall Location with Uniform and Varying Thickness in High Rise Building.

IJMTARC – VOLUME – V – ISSUE – 23, JULY-SEP, 2018

ISSN: 2320-1363

4. **Kumbhare P.S. and A.C.Saoji. (2012), "**Effectiveness of Changing Shear Wall Location on Multi-Storeyed Building", International Journal of Engineering Research and Applications (IJERA), Vol. 2, Pp. 1072-1076.

5. **K Venkatesh,** Study On Seismic Eff Building Shear Wall/ Wall Without Shear Wall, (IJCIET) Volume 8, Issue 1, January 2017, pp.852-862

6. **Meena Shrestha. (2008), "**Effects of Openings in Shear Wall on Seismic Response of Frame Shear Wall Structures", *PhD thesis from Graduate School,* Kasetsart University.

7.**M.Pavani, G.Nagesh Kumar, Dr. Sandeep Pingale,** Shear Wall Analysis and Design Optimization In Case of High Rise Buildings Using Etabs (software), (IJSER) Jan-2015

8. **N. Janardhana Reddy, D. GosePeera, T. Anil Kumar Reddy,** Seismic Analysis of Multi-Storied Building with Shear Walls Using ETABS-2013, (IJSR) ISSN (Online): 2319-7064 , November-2014