iJRASET

International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** I **Month of publication:** January 2019

DOI: http://doi.org/10.22214/ijraset.2019.1075

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue I, Jan 2019- Available at www.ijraset.com

Seismic Analysis of Reinforce Concrete Frames Building for Different Position of Shear Walls (Using Etabs Software)

Mood Naresh[1], P Madhuri Swaraj[2], V Sandeep[3], M Vijayakumar[4]
[1, 2, 3, 4]Assistant Professor, Department of civil Engineering, Princeton Institute of Engineering and Technology for Women, Ghatkesar, Hyderabad.Telangana.

Abstract: Shear wall is an 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. the these type of walls , basically play a main role for the construction of tall structure. In the present study, the buildings with different number of stories i.e, 20 stories building is considered for the investigation of structure. These buildings are assumed to be situated in zone IV. These are analyzed by changing the positions of shear walls symmetrically by considering different shape and locations of the shear walls in buildings.The paper aims towards the seismic analysis of multi storey building with symmetrical plan under earthquake zones-III. For the analysis purpose model of G +14 stories of RCC with core and edge shear walls are considered. Various parameters such as lateral force, storey shear, storey displacement, story drift can be determined. ETABS stands for Extended Three dimensional Analysis of Building Systems. ETABS is commonly used to analyze. The case study in this paper mainly prioritizes on structural behavior of G+14 storey building with core and edge shear wall for sloped and plane grounded building. Modeling and analysis of the building is done on the ETABSv9.7.4 software. The seismic analysis of building is carried out for plane grounded and flat grounded building. Estimation of response such as; lateral forces, storey shear and storey displacement and storey drift is carried out. Seismic waves reasons arbitrary ground motions in all possible directions, transmitting from the epicentre. If the structure has not been designed to resist these additional forces it may fail causing loss of life and property. In this way the impacts of sidelong loads like wind loads, quake forces & impact loads, etc. are achieving growing significance and every design engineer will face the issue of giving sufficient strength & stability for the structures against the imposed total lateral loads.

Keywords: Dynamic effect, Finite Element Analysis, storey drift and lateral storey stiffness,Shear wall, ETABS, different shape & locations, Equivalent static method, response spectrum analysis, time history analysis.

I. INTRODUCTION

Various civil structures are primarily based on prescriptive method of building codes and loads which acts on the structure are low and resulting in elastic structural behaviour. A structure can be subjected to the force greater than the elastic limit. The structural safety against major earthquake relate to the structural design of building for seismic loads. The earthquake loading behavior is different from wind loading and gravity loading which requires detail analysis to reach the acceptable elastic range in the structure. In dynamic analysis, the mathematical model of building by determining of strength, mass, stiffness and inelastic member properties are assigned. Dynamic analysis should be performed for symmetrical and unsymmetrical building. The main objective is to create awareness about dynamic effect on the building with the help of ETABSv9.7.4 software; it also Shows better response of building under dynamic loading and minimize the hazard to the life for all structures. mathematical model of building by determining of strength, mass, stiffness and inelastic member properties are assigned. Dynamic analysis should be performed for symmetrical and unsymmetrical building. The main objective is to create awareness about dynamic effect on the building with the help of ETABSv9.7.4 software; it also Shows better response of building under dynamic loading and minimize the hazard to the life for all structures.

ETABSis a FE (finite element) based software and it provides both static and dynamic analysis for wide range of gravity and lateral loads.

This analysis mainly deals with the study of a rectangular plan of G+14 storeys RCC building and is modeled using ETABS. The height of each storey of the building is taken as 3m, making total height of the structure as 45m above plinth level. Loads considered are taken according to the IS-875(Part1, Part2), IS-1893(2002) code and combinations are according to IS-875(Part5).

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue I, Jan 2019- Available at www.ijraset.com

Due to the provision of shear wall at core or at edges in multi-storied building we can resist seismic effect of earthquake. The loads are calculated by ETABS software by providing shear walls at various parts of building.

A. *Shear Wall*

It is a structural system composed of braced panels to counter the effects of lateral loads acting on a structure. Shear wall is called as shear panels. Shear wall are designed to carry wind loads and earthquake loads. Shear walls resist in-plane loads that are applied along its height

Shear wall sections are classified as six sections

1) L-section
2) T-section
3) H-section
4) U-section
5) W-section and
6) Boxsection

In the present dynamic analysis L-type sections and box sections are used. For core shear wall box type section and for edge shear wall L type section shear walls are used

The main two functions of the shear wall are

a) Strength and
b) Stiffness

B. *Objectives*

1) The main objective of this project is to check and compare the dynamic response of G+14 building with core and edge shear walls under different seismic zones, so one can pick the best substitute for construction in all earthquake-prone areas.
2) Core and edge shear wall in R.C. Building will be modeled in ETABSv9.7.4 software and the results in terms of storey displacement, storey drift, and storey shear are compared.
3) To study the comparison between lateral storey displacements and storey shears in building with core shear wall and building with edge shear wall Comparison is to be made between core and edge shear wall building models in all earthquake zones i.e. Zones – III

II. METHODOLOGY

A. *Code-Based Procedure For Seismic Analysis*

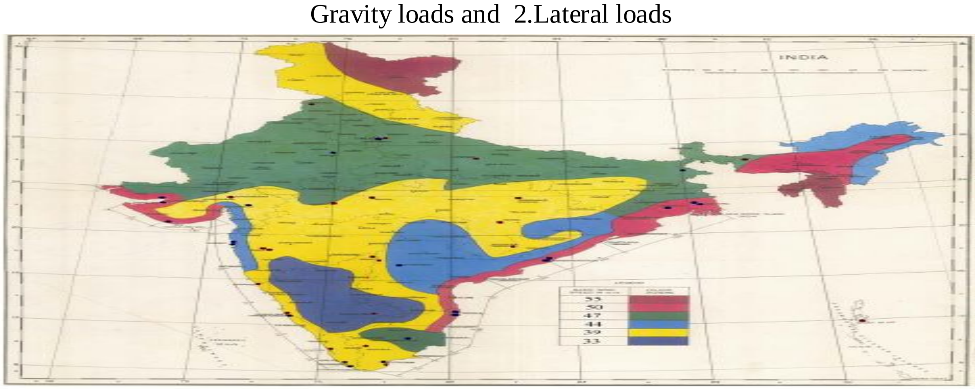
Main features of seismic method of analysis according to IS1893 (Part 1): 2002 are described as follows

1) Equivalent Static Analysis (Linear Static)
2) Response Spectrum Analysis (Linear Dynamic)
3) Time History Analysis (Nonlinear Dynamic)
4) Pushover Analysis (Nonlinear Static)

B. *Loads Considered*

Loads on a structure are generally two types.

Gravity loads and 2.Lateral loads



Basic wind speed zone map in India

Zone wise basic wind speeds in m/s

Zone	Basic wind speed (m/sec)
I	33
II	39
III	44
IV	47
V	50
VI	55

Wind is air in motion relative to the surface of the earth.

The primary cause of wind is traced to earth's rotation and differences in terrestrial radiation.The radiation effects are primarily responsible for convection either upwards or downwards. The wind generally blows horizontal to the ground at high wind speeds. Since vertical components of atmospheric motion are relatively small, the term 'wind' denotes almost exclusively the horizontal wind, vertical winds are always identified as such. The wind speeds are assessed with the aid of anemometers or anemographs which are installed at meteorological observatories at heights generally varying from 10 to 30 meters above ground

C. Design Wind Speed (V,)

The basic wind speed (V,) for any site shall be obtained from and shall be modified to include the following effects to get design wind velocity at any height (V,) for the chosen structure:

1) Risk level;
2) Terrain roughness, height and size of structure; and
3) Local topography.

It can be mathematically expressed as follows: Where

$V = V_b$ X k_l X k_2X k_3

V_b = design wind speed at any height z in m/s;

k_l = probability factor (risk coefficient)

k_2= terrain, height and structure size factor

k_3 = topography factor

III. ETAB

A. Structural Design Software For Structural Analysis Professionals

ETABS is the present day leading design software in the market. Many design company's use this software for their project design purpose. The innovative and revolutionary new ETABS is the ultimate integrated software package for the structural analysis and design of buildings. Incorporating 40 years of continuous research and development, this latest ETABS offers unmatched 3D object based modeling and visualization tools, blazingly fast linear and nonlinear analytical power, sophisticated and comprehensive design capabilities for a wide-range of materials, and insightful graphic displays, reports, and schematic drawings that allow users to quickly and easily decipher and understand analysis and design results.

ETABS is the structural engineer's software choice for steel, concrete, timber, aluminum and cold-formed steel structure design of low and high-rise buildings, culverts, petrochemical plants, tunnels, bridges, piles, aquatic structures and much more.

Structural Software can Offer the following.

1) State-of-the art 2D/3D graphical environment with standard MS Windows functionality.
2) Full range of structural analysis including static, P-delta, pushover, response spectrum, time history, cable (linear and non-linear), buckling and steel, concrete and timber design.
3) Concurrent engineering-based user environment for model development, analysis, design, visualization, and verification.
4) Object-oriented intuitive 2D/3D CAD model generation.
5) Supports truss and beam members, plates, solids, linear and non-linear cables, and curvilinear beams.
6) Advanced automatic load generation facilities for wind, area, floor, and moving loads.
7) Customizable
8) Structural templates for creating a model.

9) Toggle display of loads, supports, properties, joints, members, etc.
10) Isometric and perspective views with 3D shapes.
11) Joint, member/element, mesh generation with flexible user-controlled numbering scheme.
12) Rectangular and cylindrical coordinate systems with mix and match capabilities.

ETABS is a solution for all types of structures and includes tools designed to aid specific structural engineering tasks. For example, for the bridge engineer,

ETABS. incorporates a powerful influence surface generator to assist in locating vehicles for maximum effects.

ETABS software is mainly made for modeling, analysis and design of buildings.

Various advantages in the ETABS are listed below.

a) Fundamental to ETABS modeling is the generalization that multi-story buildings typically consist of identical or similar floor plans that repeat in the vertical direction.
b) ETABS has feature known as similar story. By which similar storey's can be edited and modeled simultaneously. Due to which building is modeled very speedily.
c) Basic or advanced systems under static or dynamic conditions may be evaluated using ETABS
d) ETABS can perform various seismic coefficients, Response Spectrum, Static Non-linear, Time History, Construction sequence and many more analysis with good graphics
e) Once modeling is complete, ETABS automatically generates and assigns code-based loading conditions for gravity, seismic, wind, and thermal forces. Users may specify an unlimited number of load cases and combinations.
f) ETABS can do optimization of steel section.

B. Procedure for Modelling of Building Using ETABS

1) Open ETABSv9.7.4 and select grid only.
2) Define storey data like storey height, storey number and spacing in x and y directions.
3) Define code preference from option menu.
4) Define material properties of concrete and steel from the define menu.
5) Define section properties from frame section in define menu for columns, beams etc.
6) Define slab section from define menu.
7) Give supports conditions
8) Create areas for slabs
9) From define menu, define static load cases like dead load, live load, wind load in x and y direction and earthquake loads in x and y directions according to the IS-Code preferences.
10) Assign loads.
11) Draw shear wall at core/edges.
12) Specify structure auto line constraint
13) Specify response spectrum analysis.
14) Select analysis option and run analysis

C. Models

1.G+14 storey building with edge shear wall
2. G+14 storey building with core shear wall

D. Building Details

1) Geometric Data

Element – G+ 14 storey

Type of frame: OMRF (ordinary moment resisting frame)

Area of building-36mX22.5m

Number of bays

In x-direction – 6

In y-direction – 5

Spacing between frames

In x-direction – 6m
y-direction – 4.5m
Plinth height – 1.5m
Storey height – 3m
Total Height of building-46.5m

2) Material Data

a) Concrete

Grade – M25
Characteristic cube strength of concrete (f_{ck}) – 25 N/mm^2
Density of concrete (γ_{ck}) – 24 kN/m^3
Poisson's ratio – 0.3

b) Steel

Steel – Fe500
Yield strength (f_y) – 500 N/mm^2
Density of steel (γ_{fy}) – 78.5 kN/m^3
Poisson's ratio – 0.2

c) Brick Masonry

Density of brick masonry = 20 kN/m^3

d) Earthquake Data

Frame: Ordinary moment Resisting Frame
Locations: ZONE - III,
Importance Factor (I): 1
Damping: 5 percent
Type of Soil: Medium (Type 2)
Seismic zone factor (z)
ZONE - III– 0.16

e) Loading Data

Wall load : 12kN/m
Live load : 2 kN/m

f) Wind Load

In x-direction (WLx) (according IS: 875-1987)
In y-direction (WLy) (according IS: 875-1987)

g) Earth Quake Loads

In x-direction (EQx) (according IS1893-2002)
In y-direction (EQy) (according IS1893-2002)

h) Load Combinations

i) 1.5 (DL + LL)
ii) 1.2 (DL + LL ± EQ_X)
iii) 1.2 (DL + LL ± EQ_Y)
iv) 1.5 (DL ± EQ_X)
v) 1.5 (DL± EQ_Y)
vi) 0.9 DL ± 1.5 EQ_X
vii) 0.9 DL ± 1.5 EQ

In the present analysis default load combinations are used

i) Member Sizes

Size of Beam –230mmX500mm
Size of Plinth beam-230mmX300mm
Size of Column-300mmX500mm
Depth of Slab-125mm

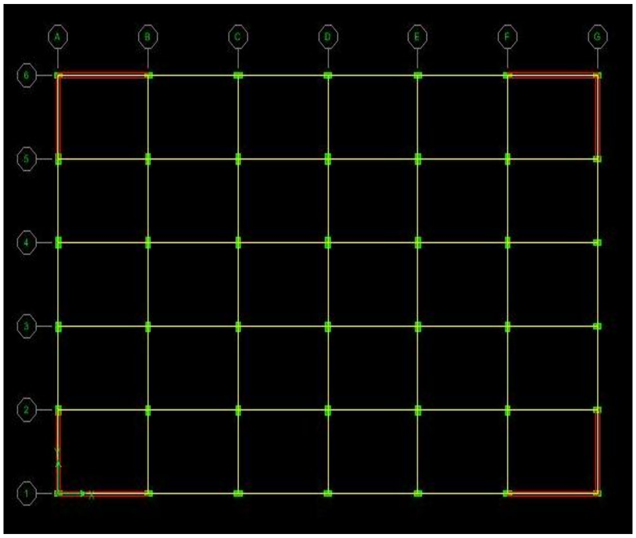
International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue I, Jan 2019- Available at www.ijraset.com

Thickness of Shear wall-230mm
Thickness of wall – 230mm
Clear cover for beams – 25mm
Clear cover for columns – 40mm

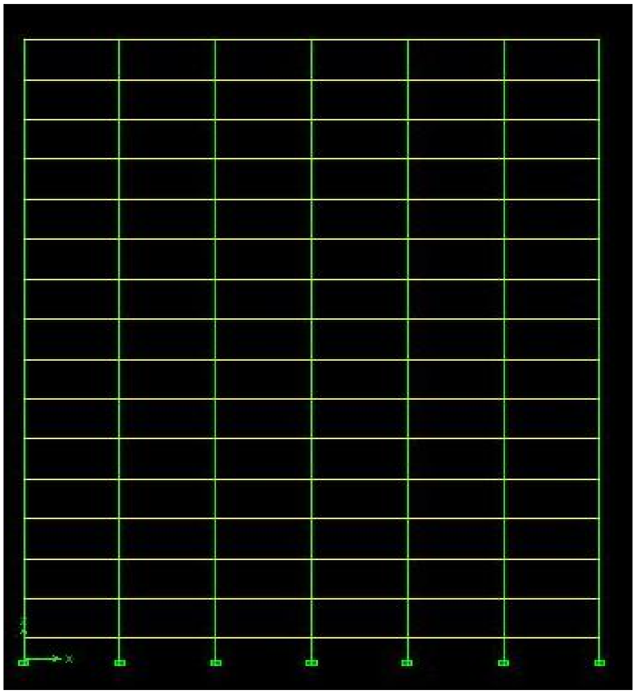
E. Modelling And Bending Moment Diagrams In ETABS

Core shear wall is provided at the central two bays of the building and edge shear wall is provided at the four edges or corners of the building. The prepared models for core shear wall building and edge shear wall buildings were shown below as 2D and 3D plans, undeformed and deformed shapes and bending moments. Deformed shape sown below is under one earthquake zone. The bending moments shown below are also in ZONE - V under worst load combination 1.5(DL+WLx). This combination occurs as DCON27 in ETABS default load combinations

Prepared Models

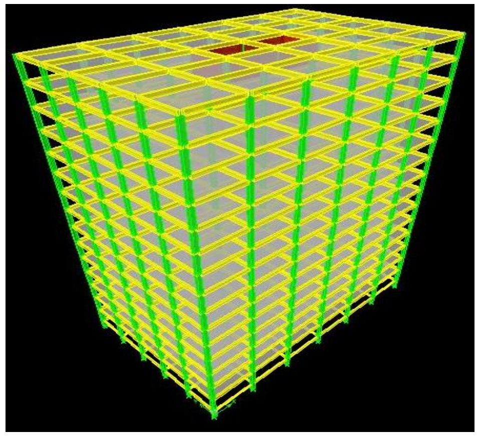


General Plan View of G+14 Storey RCC Building with Edge Shear Wall

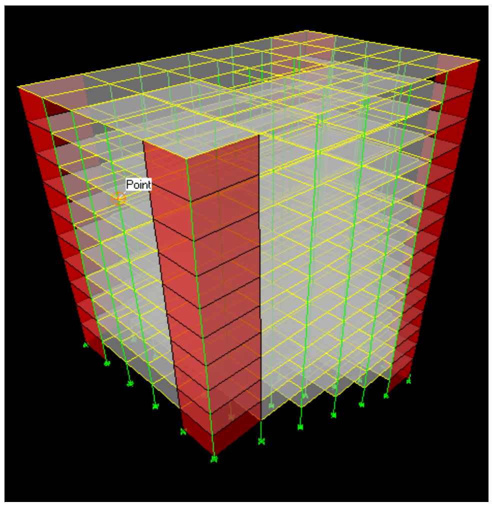


Elevation View of G+14 Storey RCC Building with Core Shear Wall

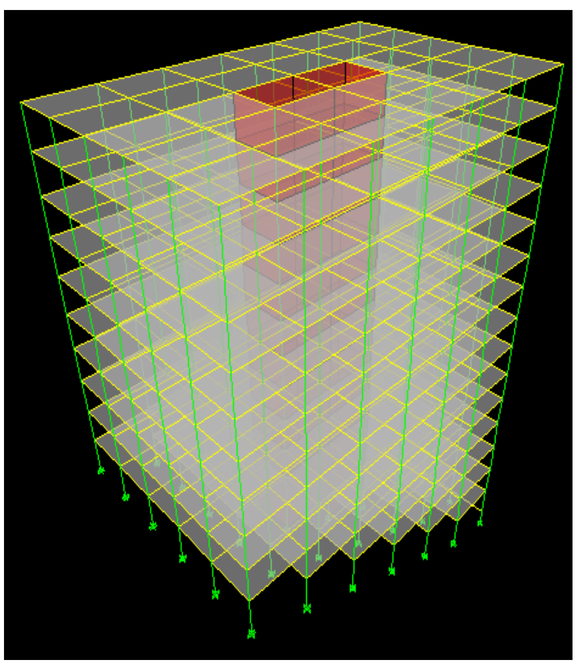
International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue I, Jan 2019- Available at www.ijraset.com



3D View of G+14 Storey RCC Building with Core Shear Wall

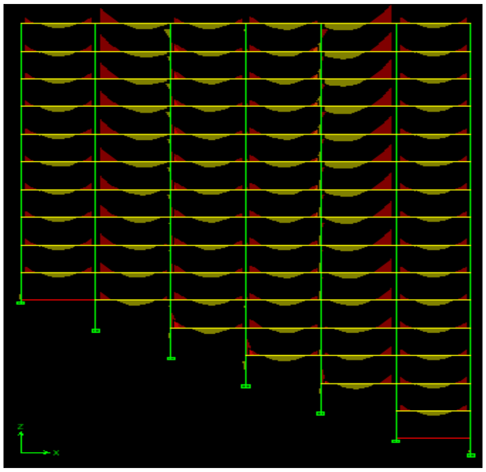


Elevation View of G+14 Storey Slopped RCC Building with Edge Shear Wall

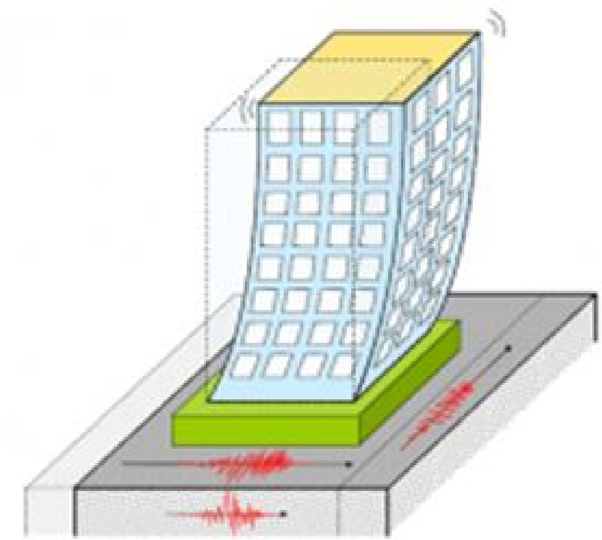


: 3D Elevation View of G+14 Storey Slopped RCC Building with Core Shear Wall

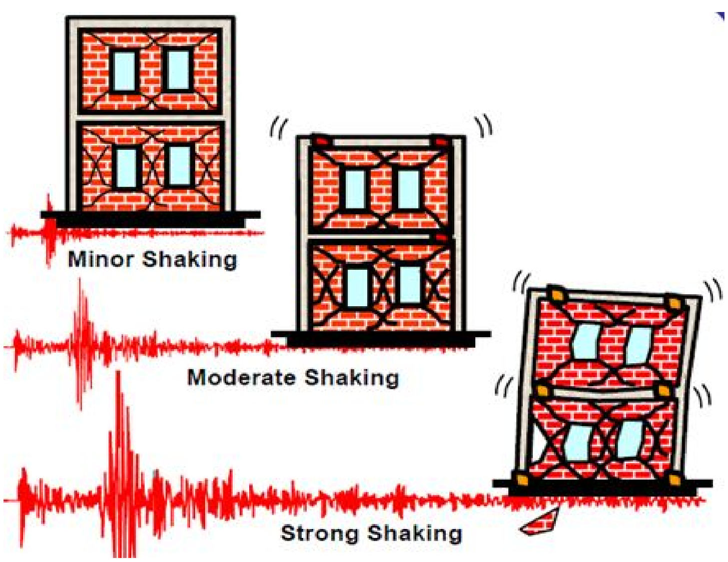
International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue I, Jan 2019- Available at www.ijraset.com



Bending Moment of G+14 Storey Slopped RCC Building with EdgeShear Wall



Behavior of building under earth quake



Performance objectives under different intensities of earthquake

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue I, Jan 2019- Available at www.ijraset.com

IV. ANALYSIS, RESULTS AND DISCUSSION

Seismic analysis is performed on the all models of the building, i.e. building with core shear wall and building with edge shear walls. Response spectrum method is used for the analysis in ETABS. The parameters like storey shear; storey displacement, storey drift and lateral storey stiffness are calculated and compared in Earthquake zones III for edge and core shear walls.

A. *Analysis of Storey Shear*

The maximum storey shear force, displacement and storey drift values are computed from ETABS for all storeys and tabulated. The maximum storey shears in all models are compared and graphs are drawn, storey number to maximum storey shears in different earthquake zones. All maximum storey shears are occurred in X-direction under worst load combination

Maximum Storey Shears (KN) in ESW and CSW for Plane Ground

STOREY	Vx (kN)	
	ESW	CSW
BASE	0	0
STOREY 1	4149.4	4233.63
STOREY 2	4149.4	4233.63
STOREY 3	4146.02	4230.19
STOREY 4	4132.51	4216.42
STOREY 5	4102.11	4185.44
STOREY 6	4048.07	4130.36
STOREY 7	3963.62	4044.30
STOREY 8	3842.03	3920.37
STOREY 9	3676.52	3751.59
STOREY 10	3460.35	3531.37
STOREY 11	3186.75	3252.53
STOREY 12	2848.98	2908.29
STOREY 13	2440.28	2491.75
STOREY 14	1953.89	1996.04
STOREY 15	1383.06	1414.26
STOREY 16	721.03	739.54

B. *Analysis of Storey Drift*

Storey drift is the lateral displacement of the storey. It is the drift of one level of a multistory building relative to the level of below storey. Storey and zone wise drifts are shown below.

Maximum Storey Drifts in ESW and CSW for Plane Ground

STOREY	STOREY DRIFTS (M)	
	ESW	CSW
STOREY 1	0.000211	0.000199
STOREY 2	0.000317	0.000203
STOREY 3	0.000496	0.000242
STOREY 4	0.000664	0.000310
STOREY 5	0.000811	0.000372
STOREY 6	0.000933	0.000425
STOREY 7	0.001034	0.000470
STOREY 8	0.001115	0.000507
STOREY 9	0.001176	0.000536
STOREY 10	0.001219	0.000557
STOREY 11	0.001247	0.000571
STOREY 12	0.001261	0.000579
STOREY 13	0.001264	0.000580
STOREY 14	0.001261	0.000579
STOREY 15	0.001259	0.000577
STOREY 16	0.001276	0.000576

MaximumStorey Shears (KN) in ESW and CSW for Sloped Groun

STOREY	ESW		CSW	
	V_X	V_Y	V_X	V_Y
BASE	0	0	0	0
STOREY 1	26.26	107.18	142.07	35.83
STOREY 2	965.81	158.21	39.90	121.52
STOREY 3	1053.23	253.30	98.51	1822.72
STOREY 4	1124.06	381.68	1402.52	2023.06
STOREY 5	1142.90	516.84	4130.73	4381.30
STOREY 6	1194.95	683.71	4222.39	4417.43
STOREY 7	4739.40	4739.40	4318.66	4414.90
STOREY 8	4594.00	4594.00	4186.33	4255.48
STOREY 9	4396.10	4396.10	4006.20	4037.35
STOREY 10	4137.62	4137.62	3770.94	3770.94
STOREY 11	3810.48	3810.48	3473.18	3473.18
STOREY 12	3406.60	3406.60	3105.59	3105.59
STOREY 13	2917.90	2917.90	2660.79	2660.79
STOREY 14	2336.62	2336.62	2131.45	1996.04
STOREY 15	1653.76	1653.76	1510.20	1510.20
STOREY 16	862.16	862.16	789.71	789.71

C. Analysis Of Storey Displacements

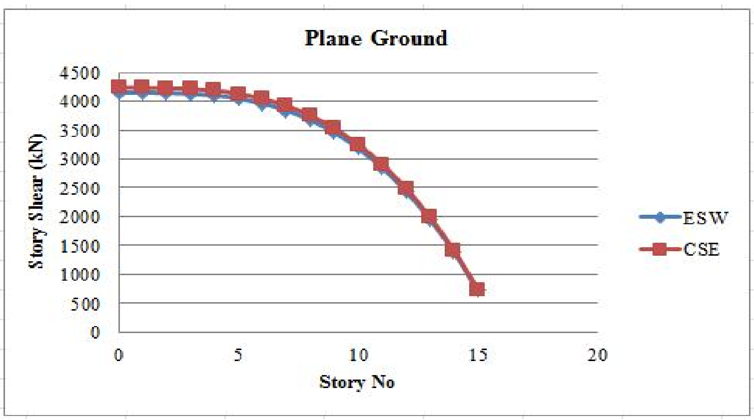
Storey displacements are the vertical displacements of members, occurs due to dead and live loads. These displacement values are same in seismic zone-III. because in this analysis lateral forces are varying due to different earthquake zones and dead loads and live loads are equal in all zones. Storey displacements are compared when edge and core shear walls provided in multistory building

Displacements in Plane Building with ESW and CSW

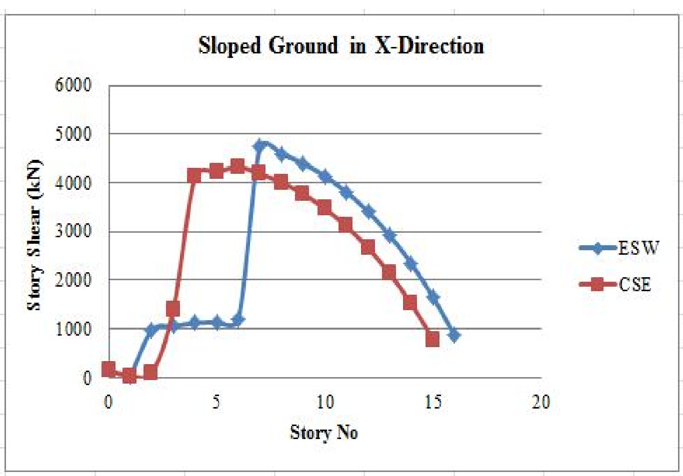
STOREY	STOREY DISPLACEMENTS (M)	
	ESW	CSW
BASE	0	0
STOREY 1	0.0028	0.0027
STOREY 2	0.0082	0.008
STOREY 3	0.0133	0.0128
STOREY 4	0.0179	0.0173
STOREY 5	0.0222	0.0213
STOREY 6	0.0261	0.0251
STOREY 7	0.0296	0.0284
STOREY 8	0.0328	0.0314
STOREY 9	0.0356	0.0341
STOREY 10	0.0380	0.0364
STOREY 11	0.0401	0.0384
STOREY 12	0.0419	0.0400
STOREY 13	0.0433	0.0413
STOREY 14	0.0443	0.0423
STOREY 15	0.0450	0.0430
STOREY 16	0.0454	0.0433

Maximum storey Maximum storey displacements inSloped Building with ESW and CSW

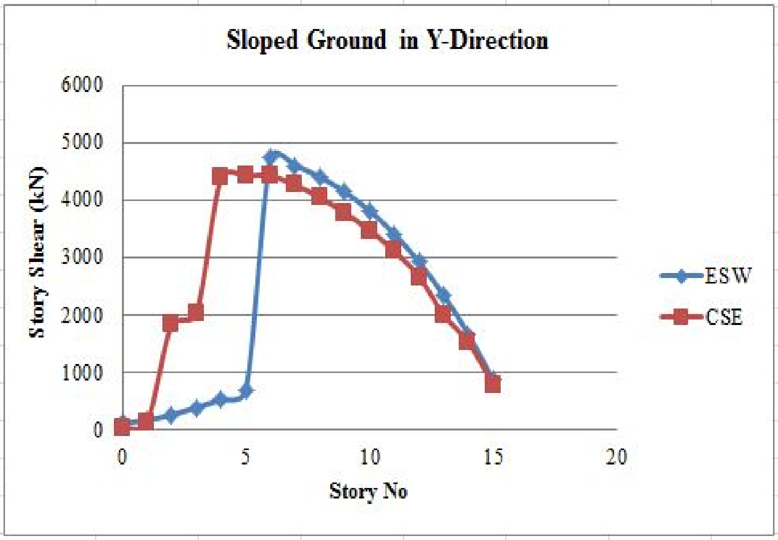
STOREY	STOREY DISPLACEMENTS (M)	
	ESW	CSW
BASE	0	0
STOREY 1	0.0016	0.002
STOREY 2	0.0052	0.0059
STOREY 3	0.0101	0.0099
STOREY 4	0.0147	0.0144
STOREY 5	0.0188	0.0184
STOREY 6	0.0227	0.0221
STOREY 7	0.0261	0.0255
STOREY 8	0.0292	0.0285
STOREY 9	0.0319	0.0311
STOREY 10	0.0343	0.0334
STOREY 11	0.0363	0.0354
STOREY 12	0.0380	0.0370
STOREY 13	0.0394	0.0384
STOREY 14	0.0404	0.0393
STOREY 15	0.0411	0.0400
STOREY 16	0.0414	0.0403



Maximum Storey Shear for Plane Ground Building with ESW & CSW



Maximum Storey Shear for Sloped Ground Building with ESW & CSW in X-Direction



Maximum Storey Shear for Sloped Ground Building with ESW & CSW in Y-Direction

From the above graphs one can conclude that the maximum storey shears are increasing from top storey to bottom storey and storey shears are nearly equal in both the models but more in building with core shear wall when compared to the building with edge shear walls in all earthquake zones. The maximum storey shears are reduced in edge shear wall model as 2.0993 in seismic zones-III respectively compared to core shear wall model. But the reduced percentage from core shear wall to edge shear wall is only about 2%. So the shear wall chosen must be based on storey consideration on the edge shear wall and core shear wall building.

D. Future Scope

In the present work limited analysis i.e., considering only some parameters like storey shear, storey displacement, storey drift and storey stiffness is done by response spectrum method in ETABS software. The study could be extended by including various other parameters such as tensional effects and soft storey effects in a building. Some of the future scopes are listed below.

1) Dynamic nonlinear analysis by time history method.
2) Nonlinear analysis by push over method.
3) Parametric study of models by varying height of building, Number of bays of building etc.
4) Performance-based or capacity based design of structure.
5) Continue to innovate new systems.

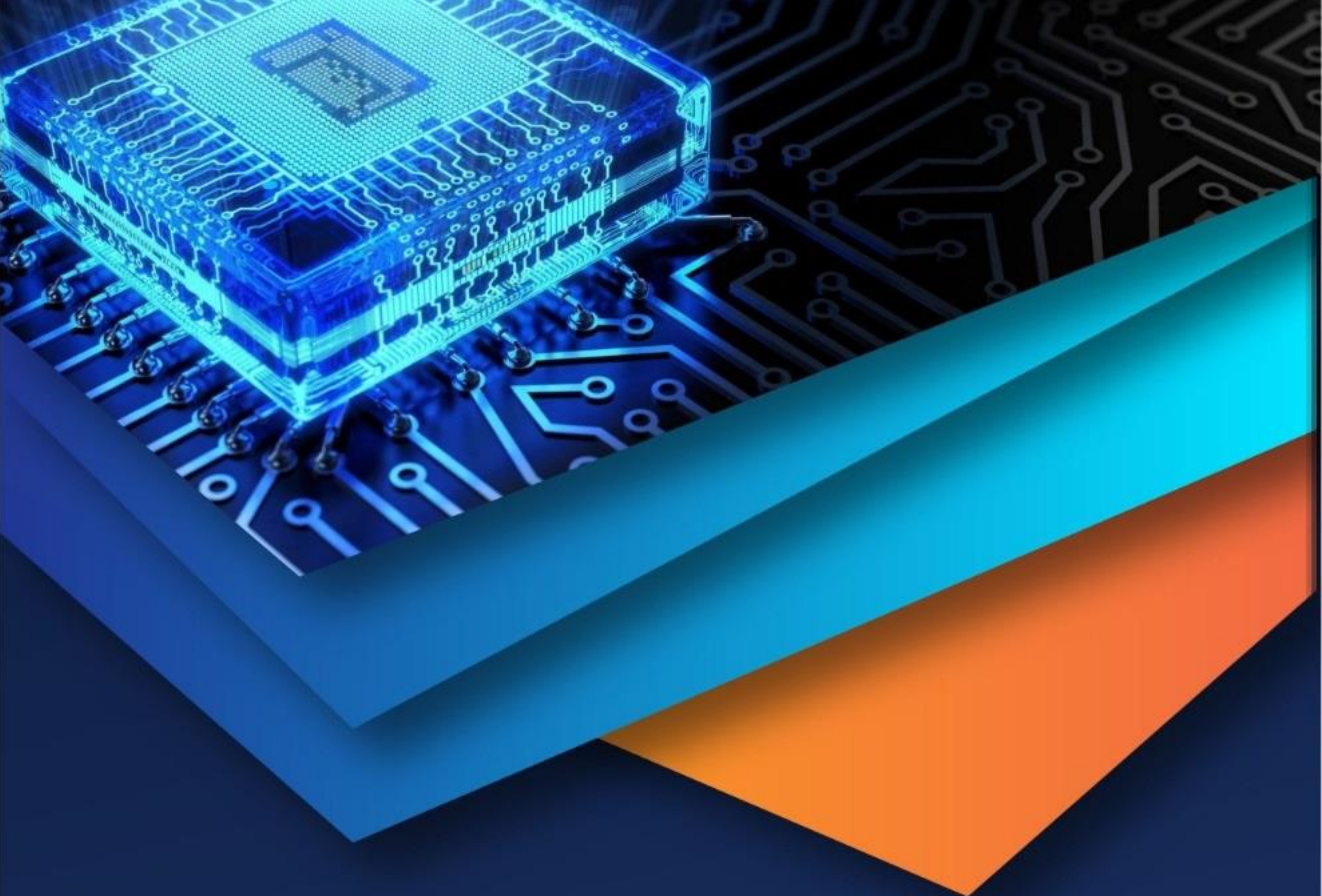
FEM analysis to understand beam-column junction behaviour under earthquake for RCC, Steel and Composite building

V. CONCLUSION

A. The seismic analysis of building with core shear wall and building with edge shear walls are done and compared at earthquake zones – III by using ETABSv9.7.4.
B. Core shear wall building model and Edge shear wall building model gives the nearly equal storey shears in all storeys at all earthquake zones. So selection of shear wall is mainly based on storey drift.
C. When shear walls are provided on the four edges of the building, maximum storey drifts are increased compared to the shear walls provided at centre or core of the building in all zones. So by providing core shear wall, effect of seismic forces can be controlled.
D. Storey displacements are maximum in edge shear wall than core shear wall in the building in all storeys under earthquake zones - III..
E. For better seismic performance of building, it should have adequate lateral storey stiffness. If lateral storey displacements are high, stiffness will be low or vice-versa.
F. So to minimize the earth quake effects core shear wall must be provided because storey drifts are very low compared to edge shear wall in earthquake zones – III

REFERENCES

[1] Pankaj Agarwal and Manish Shrinkhade "Earthquake resistant design of structures", PHI press, New delhi.
[2] S.K Duggal "Earthquake resistant design of structures" Oxford university Press, New Delhi.
[3] Roy R. Craig, Andrew J. Kurdila "Fundamentals of Structural Dynamics", 2nd Edition
[4] Anil K. Chopra "Dynamics of Structures: Theory and Applications to Earthquake Engineering" Prentice Hall, 2012.
[5] Shaik Kamal Mohammed Azam, Vinod Hosur, Seismic performance Evaluation of Multistoried RC framed buildings with Shear wall,International Journal of Scientific & Engineering Research Volume 4, Issue 1, January-2013.
[6] Mayuri D. Bhagwat, Dr.P.S.Patil, "Comparative Study of Performance of Rcc Multistory Building For Koyna and Bhuj Earthquakes",International Journal of Advanced Technology in Engineering and Science www.ijates.com Volume No.02, Issue No. 07, July 2014 ISSN (online): 2348–7550.
[7] Mohit Sharma, Dr. Savita Maru, "Dynamic Analysis of Multistoried Regular Building" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 11,Issue 1 Ver. II (Jan. 2014), PP 37-42, www.iosrjournals.org
[8] A S Patil and P D Kumbhar, "Time History Analysis of Multistoried Rcc Buildings For Different Seismic Intensities" ISSN 2319 –6009, www.ijscer.com, Vol.2, No.3, August 2013 © 2013 IJSCER.
[9] N Janardhan reddy, D Gose peera, "seismic analysis of multistorey building with shear walls using ETABS" volume 4 issue ,November 2015, www.ijsr.net.



10.22214/IJRASET

INDEX COPERNICUS
45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL

IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY