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PARAMETRIC ANALYSIS OF MULTISTORY RC BUILDINGS WITH COLUMNS REPLACED BY SHEAR WALLS USING ETABS

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Abstract - *The present investigative effort seeks to explore, study and report the structural/seismic behavior of high rise building (G+20) with columns replaced by shear walls, adopting equivalent static method. Shear walls constitute the most appropriate and important structural components resisting the lateral loads in high rise buildings. Shear walls may also be called upon to resist gravity loads, which may further improve the effectiveness of shear walls as lateral load resisting system in the structures.*

In the present investigation, a high rise reinforced concrete building frame with G+20 stories and regular plan layout measuring 28m in both the orthogonal directions and supported on conventional RC columns is analyzed for gravity and lateral (seismic) loads using ETABS. The same building frame is analyzed with all the columns replaced by four different practically feasible schemes/layouts of shear walls in different orientations and positions. Different structural parameters such as base shear, diaphragm drift, displacements, story forces and maximum drift have been considered in the study. Analyses were carried out considering soil type II and earth quake zone IV. The structural responses of the building frames with columns and those with columns replaced by different shear wall layouts have been critically discussed. It is established that shear walls can advantageously replace columns in building frames. Based on the discussions of comparative study, detailed conclusions have been drawn. It is established that Equivalent static method can be effectively used for modelling the frame with shear walls and with no columns; shear wall scheme 2 (model 2) results in reduced displacements compared to other shear wall layouts and also frame with columns. Shear wall layout 2 was found to be safe and effective.

Key Words: **Shear wall, drift, displacement, base shear, layouts.**

1. INTRODUCTION

Shear wall is a structural member in a reinforced concrete framed structure to resist lateral forces such as wind forces. Shear wall are generally used in high-rise building subject to lateral wind and seismic forces. Adequate stiffness is to be ensured in high rise buildings for resistance to lateral loads induced by wind or seismic events. Reinforced concrete shear walls are designed for buildings located in seismic areas, because of their high bearing capacity, high ductility and rigidity. In high rise buildings, beam and column sizes work out large and reinforcement at the beam-column junctions are quite heavy, so that, there is a lot of clogging at these joints and it is difficult to place and vibrate concrete at these places which does not contribute to the safety of buildings. These practical difficulties call for introduction of shear walls in High rise buildings.

2. LITERATURE REVIEW

Reviewing a literature lets us to see what came before and what did and didn't work for other researchers and to demonstrate my understanding and my ability to evaluate research. Literature review is done to take some references and support. Conducting literature review involves collecting, evaluating and analyzing publications that relate my research.

1. **Jaimin Dodiya** et. al. in their paper titled "ANALYSIS OF MULTISTORY BUILDING WITH SHEAR WALL USING ETABS SOFTWARE" carried out their analysis on G+20 building using equivalent static force method in ETABS. Different orientations of shear walls were used such as Shear wall at corner, opposite direction and I shaped shear wall. Maximum displacements were studied. Form the study it is clear that gives less displacement value in opposite direction in shear wall building for moderate seismic zone. Providing shear wall at opposite direction performing better and more efficient than all other cases. The provision of shear wall position in an appropriate location is advantageous and the structure performs better for an existing or a new structure.

2. **Mahdi Hosseini** et. al. in their paper titled "DYNAMIC ANALYSIS OF HIGH RISE STRUCTURES UNDER DIFFERENT TYPE OF REINFORCED CONCRETE SHEAR WALLS FOR EARTHQUAKE RESISTNCE BUILDING" studied that behavior of high rise structure i.e. G+30 with Different Type of RC Shear Walls i.e. C, Box, E, I and Plus shapes under different type of soil condition with seismic loading. Estimation of structural response such as; story displacements, story stiffness, Lateral loads, Mode shape of shear wall, Time period and frequency was carried out. In dynamic analysis; Response Spectrum method was used. Story displacement, lateral loads, Stiffness in X-direction and Y-direction for soft and medium soil and hard soil were observed. Mode shapes for different shear walls were observed. Modal Load Participation Ratios, Modal Periods and Frequencies were calculated. Building with box shape Shear Walls provided at

the center core showed better performance in term of maximum story displacement.

3. **Anil B** et. al. in their journal titled "Seismic analysis of RC framed building for different position of shear wall" studied the effective and efficient ideal position of shear wall for the building of G+9 (17x17m). The study is carried out through static and response spectrum method for zone V. Five models were analyzed i.e. Building without shear wall, shear wall on each side of middle, at corner extending 3m, at Centre, corner extending 1.5m. Time period, mass participating ratio, displacement and story drift in x and y direction, bending moment, shear force and axial force were calculated. Among five models, the model having shear walls at all four corners extending 3m displayed better result in terms of all parameters mentioned above.

4. **B. Ajitha** et. al. in their paper titled "The analysis and design of G+40 story regular structure with different shear wall for lose soils" studied optimum location of different shapes of shear walls i.e. Box, U, L shape in G+40 symmetrical high rise building. The structure is analyzed for displacement, torsion, strength and stability for zone 2, 3, 4 and 5. Torsion, displacement are less in U shaped model as compared to other models.

3. OBJECTIVE

- Analysis of building frame with columns replaced by shear walls.
- To determine the effect of different positions/orientations of shear wall for building with regular geometry.
- To carryout parametric study with different positions/orientations of shear walls, with regard to base shear, displacement, story drift, time period.
- To find the optimum position of shear wall for structural response under seismic and wind loading.
- Equivalent static analysis is carried out to determine base shear.
- Comparison of results obtained for frames with columns and frames with columns replaced by shear walls.

4. SCOPE

- The Scope of work is limited to
- To understand the behavior of high-rise structure having shear wall.
- Comparative study of building frames with and without Shear wall.
- Understanding the effect of shear wall of different layouts.
- Linear Static analysis of structure with shear wall will be carried out.
- The study will be limited to building frames with regular geometry and symmetric in nature

CLASSIFICTION OF SHEAR WALL

1. Simple rectangular types and flanged walls
2. Coupled shear walls
3. Rigid frame shear wall
4. Framed wall with in filled frames
5. Column supported shear walls
6. Core type shear wall

ADVANTAGES OF SHEAR WALL

1. It provides adequate strength to resist large lateral loads without excessive additional cost.
2. It provides adequate stiffness to resist lateral displacement within permissible limits, thus reducing risk of non-structural damage.
3. Significantly reduces lateral sway.
4. Easy for construction and implementation.
5. More effective for minimizing earthquake.
6. Thinner walls
7. Fast construction time

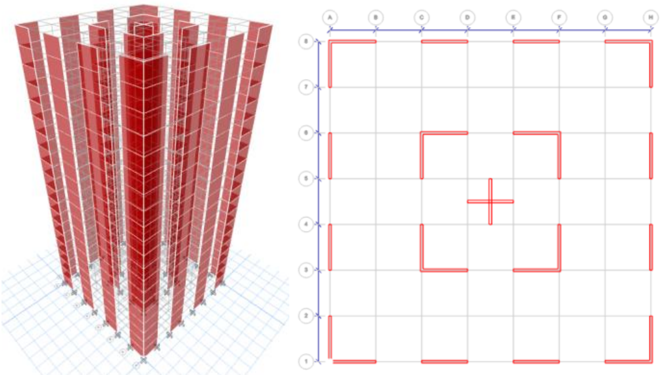
5. METHODOLOGY

To determine the basic components like displacement and base shear this analysis has been carried using the software ETABS for the analysis purpose Equivalent static method, Response spectrum method and time history methods are adopted.

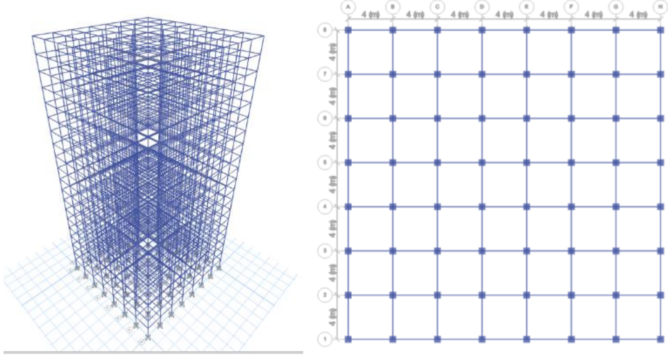
Model Data

No. of stories = G+20
Method = Equivalent static force method
Story height = 3m
Grade of concrete = M40
Grade of steel = Fe500
Thickness of slab = 150mm
Thickness of shear wall = 200mm
Beam size = 300mm*600mm
Column size = 500mm*500mm
Seismic zone = IV
Soil type = II
Importance factor = 1.2
Response reduction factor = 5
DL = 3.5, 4.5, 6.25
LL = 3
FF = 1.25

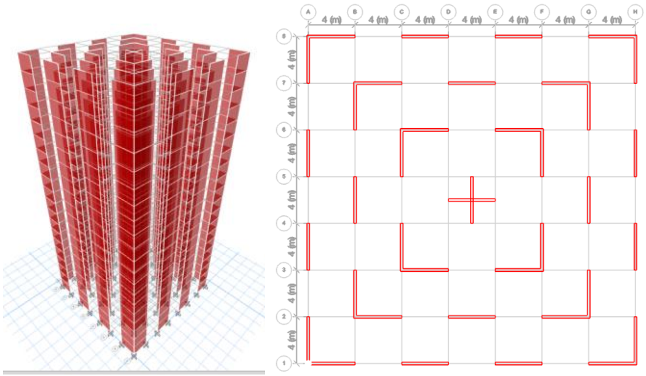
Model 1



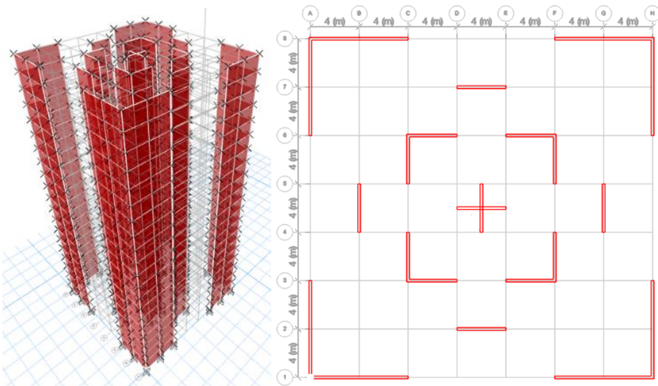
Bare frame



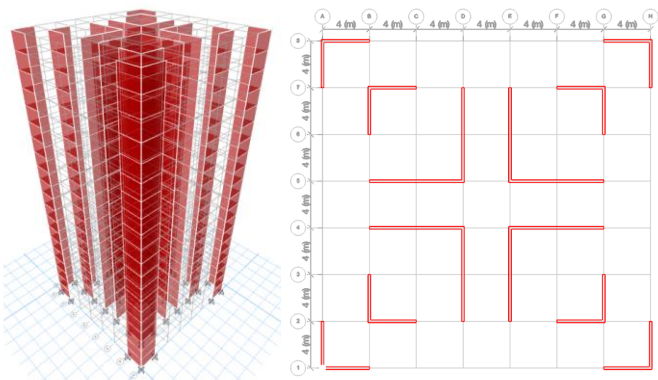
Model 2



Model 3



Model 4



6. RESULTS

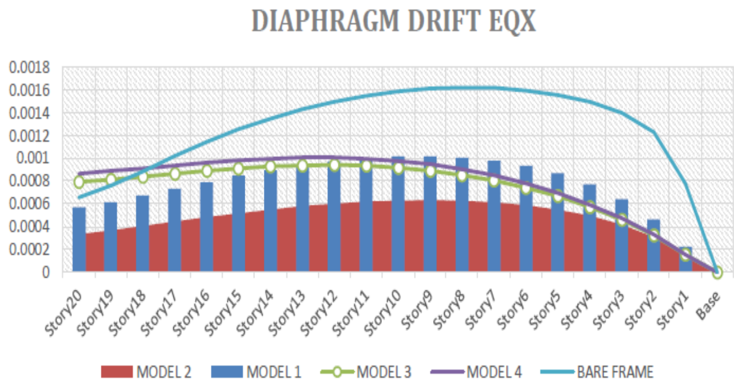


Figure 1 Diaphragm drift of all models for EQX

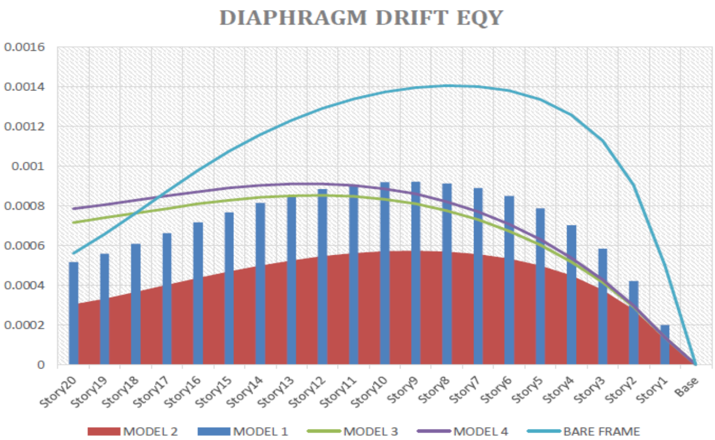


Figure 2 Diaphragm drift of all models for EQY

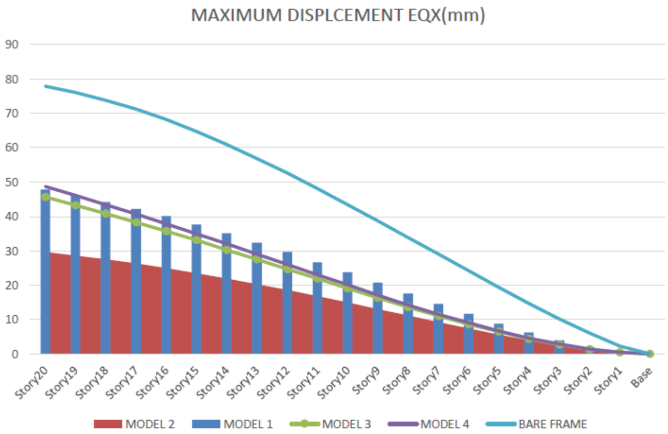


Figure 3 Max displacement of all models for EQX

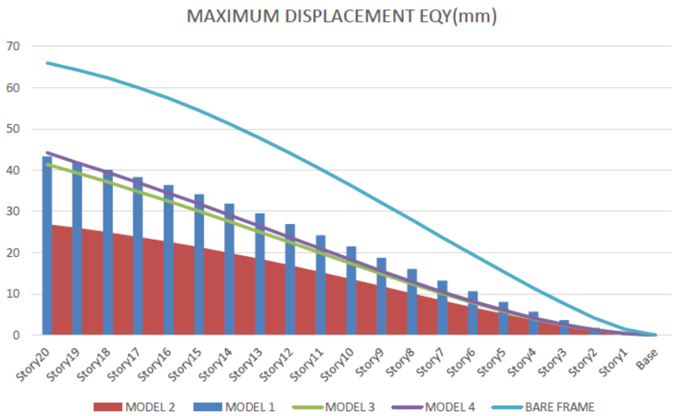


Figure 4 Max displacement of all models for EQY

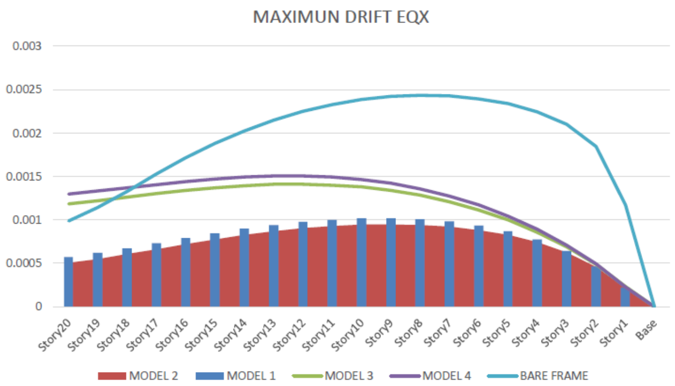


Figure 5 Max drift of all models for EQX

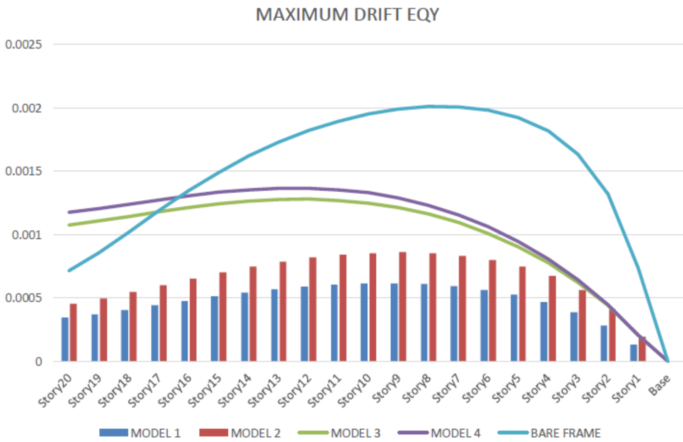


Figure 6 Max drift of all models for EQY

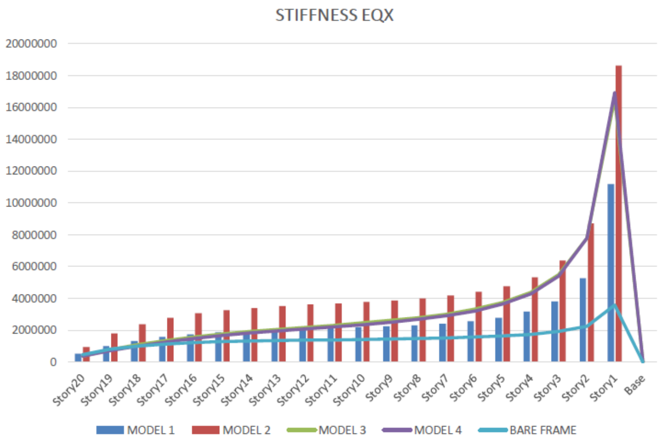


Figure 7 Stiffness of all models for EQX

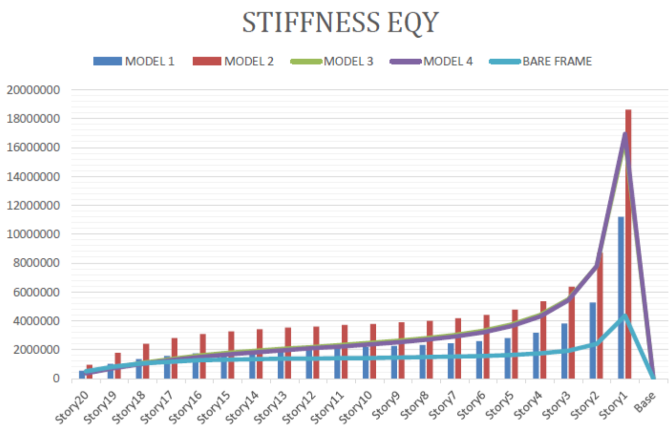


Figure 8 Stiffness of all models for EQY

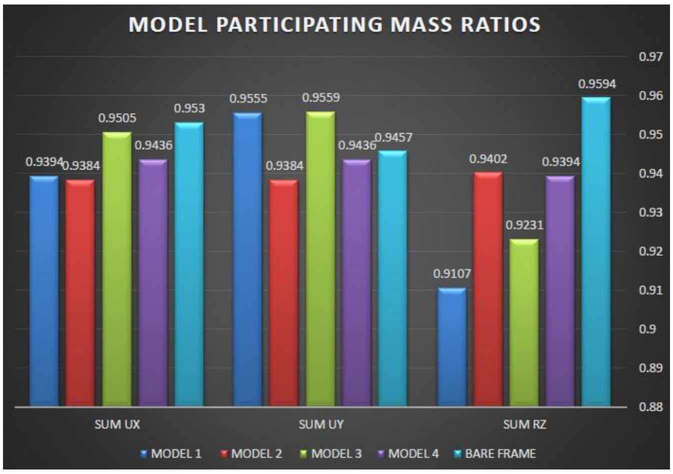


Figure 9 Model participating mass ratios of all models

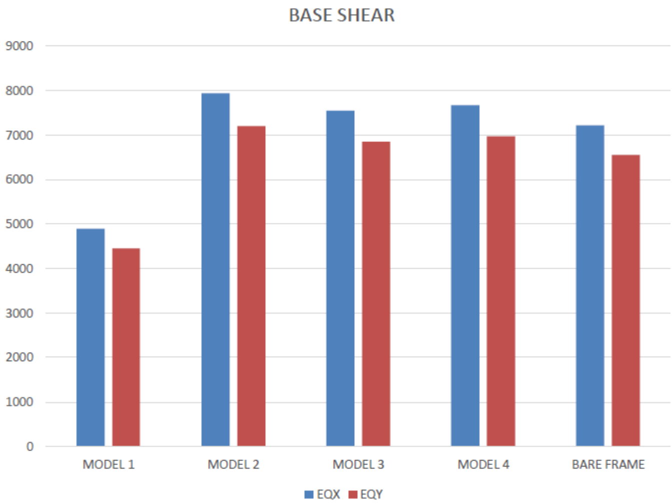


Figure 10 Base Shear of all models

7. CONCLUSION

Provision of shear wall in multi-story building found to be effective in increasing overall seismic response. It is established that shear walls can advantageously replace columns in building frames in terms of displacement, drift, stiffness etc. Equivalent static method can be effectively used for models with no column. It is clear that model 2 gives less displacement compared to all other models. In terms of stiffness model 2 is stiffer. The diaphragm drift and maximum story drift is given by model 2 only. Model 2 gives highest story forces. In terms of base shear model 2 is comparatively shows highest base shear. Overall all parameters were studied and concluded that model 2 is safer and more efficient than all other models.

8. REFERENCES

[1] R.Aparna Shetty - Analysis of Composite Column Building with Lateral Load Resisting Systems using Etabs -Brindavan Institute of Technology & Science, Chinnatekur, Andhra Pradesh, India - July 2018 .

[2] Rinkesh R Bhandarkar - Seismic Analysis & Design of Multistory Building Using Etabs - Faculty of Engineering Technology and Research, Bardoli, Gujarat, India, - 2017.

[3] Rajat Bongilwar - Significance of Shear Wall in Multi-Story Structure With Seismic Analysis Ramdeobaba College of Engineering and Management, Nagpur, India, -2017.

[4] Mayank Devani - ANALYSIS OF MULTISTORY BUILDING WITH SHEAR WALL USING ETABS SOFTWARE - BMCET, Surat - Feb-2018 .

[5] Mahdi Hosseini - DYNAMIC ANALYSIS OF HIGH RISE STRUCTURES UNDER DIFFERENT TYPE SHEAR WALL FOR AN EARTHQUAKE RESISTANT BUILDING DYNAMIC ANALYSIS OF HIGH RISE STRUCTURES OF REINFORCED CONCRETE - JNTUH, Hyderabad, Telangana , India - 2018 .

[6] Anil Baral - Seismic Analysis of RC Framed Building for Different Position of Shear wall - A.U. College of Engineering, Visakhapatnam, Andhra Pradesh,India - may 2015 .

[7] K Crown Mojes - THE ANALYSIS AND DESIGN OF G+40 STOREY REGULAR STRUCTURE WITH DIFFERENT SHEAR WALLS FOR LOOSE SOILS - JNTUCEA, Anantapur ,India - may 2017 .

[8] Mallika.K - Analysis of Shear Wall in High Rise Unsymmetrical Building Using Etabs - G. Pulla Reddy Engineering College, Kurnool (A.P) India - nov 2016 .

[9] Anuja Walvekar - PARAMETRIC STUDY OF FLAT SLAB BUILDING WITH AND WITHOUT SHEAR WALL TO SEISMIC PERFORMANCE - Rajarambapu Institute of Technology, Rajaramnagar - april 2015 .

[10] M R Suresh - THE OPTIMUM LOCATION OF SHEAR WALL IN HIGH RISE R.C BULIDINGS UNDER LATERAL LOADING -Dr Ambedkar Institute of Tecnology Bengaluru, karnataka, India - june 2015 .

[11] SUVASH CHANDRA PAUL - Performance Based Analysis of RC Building Consisting Shear Wall and Varying Infill Percentage - Stellenbosch University South Africa - dec 2013 .

[12] Amitkumar Yadav - Analysis of Tall Structures with and without Openings in Shear Walls - B.R. Harne College of Engineering & Technology, Mumbai, Maharashtra,india - may 2019 .

[13] M.Pavani - Shear Wall Analysis and Design Optimization In Case of High Rise Buildings Using Etabs (software) -JNTU A, Anantapur, India - jan 2015.

[14] Dr. P. D. Hiwase - Comparison between Manual and Software Approach towards Design of Structural Elements - RCOEM Nagpur india - 2018 .

[15] Y. M. FAHJAN - COMPARISON OF PRACTICAL APPROACHES FOR MODELLING SHEARWALLS IN STRUCTURAL ANALYSES OF BUILDINGS - Gebze Institute of Technology Kocaeli, Turkey - 2008 .