NON-LINEAR DYNAMIC ANALYSIS OF MULTISTOREY R.C.C BUILDINGS WITH DIFFERENT PLAN GEOMETRY

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ABSTRACT: The important objective of earthquake engineers is to design and build a structure in such a way that damage to the structure and its structural component during the earthquake is minimized. This report aims towards the non-linear dynamic analysis of a multi-storey RCC building with Varying Plan Geometry. For the analysis purpose model of G+15 RCC with Varying Geometry plan is considered. The analysis is carried by using finite element based software ETABS. Various response parameters such as lateral force, base shear, story drift, Displacement can be determined. For dynamic analysis time history method or response spectra method can be used .Time-history analysis is a step-by-step analysis of the dynamical response of a structure to a specified loading that may vary with time. The analysis may be linear or non-linear. Dynamic analysis can be performed for unsymmetrical building. Dynamic analysis can be in the form of nonlinear dynamic time history analysis. In this paper, a nonlinear time history analysis is performed on a G+15 RCC building frame considering time history of El Centro earthquake 1940 using ETABS. The various response parameters like base shear, storey drift, storey displacements etc are calculated. The maximum stress and moment to find out and compared within the considered configuration as per IS 1893:2002.

Keywords – *Non-linear Dynamic analysis, ETABS, Varing Geometry*

I. INTRODUCTION

The Role and Use of Nonlinear Analysis in Seismic Design while buildings are usually designed for seismic resistance using elastic analysis, most will experience significant inelastic deformations under large earthquakes. Modern performance- based design methods require ways to determine the realistic behavior of structures under such conditions. Enabled by advancements in computing technologies and available test data, nonlinear analyses provide the means for calculating structural response beyond the elastic range, including strength and stiffness deterioration associated with inelastic material behavior and large displacements. As such, nonlinear analysis can play an important role in the design of new and existing buildings. Nonlinear analyses involve significantly more effort to perform and should be approached with specific objectives in mind.

A. Objectives: Labour Productivity And Uses

- To analyse seismic response of the multi-storey buildings (G+15) by Non-linear dynamic analysis method.
- Study of Linear and Non-linear Dynamic Analysis of structure having using Etabs computer programming according to IS 1893 (part-1):2016.
- To study the seismic response of buildings in terms of maximum stress and moment to find out and compared within the considered configuration.

B. Limitations of the Study

1. The only RC framed buildings are considered for the analysis.
2. The buildings considered (G+15 storey buildings) without basement, shear wall.
3. The contribution of infill walls is considered as non-integral with RC frames.
4. The out of plane action of masonry walls is neglected in the analysis.

5. The effect of the supporting foundation medium on the motion of structure gives soil structure interaction but this effect may not consider in the seismic analysis for structures supported on rock or rock like materials.
6. The Flexibility of floor diaphragms are neglected and considered as rigid diaphragm.
7. The base of the column is assumed to be fixed in the analysis.

II. LITERATURE SURVEY

As the height of the building increases the effect of lateral loads (seismic and wind loads) become very predominant. This chapter will discuss the previous work done on this subject. Many of the scholars have studies on performance of RC frame with different geometry of building, shear walls etc. Some of the papers are discussed below.

Deekshithay L[1] the storey shear decreases with the increase in height of storey. It is observed that storey shear increases, so the maximum storey shear is in C and H shape model which is vulnerable. It is observed that the storey displacement increases with the increase in height of storey. Displacement for L shape model is more compare to other shape of models.

Ali Kadhim[2] the effective design and construction of an earthquake resistant structures have great importance all over the world. This project presents multi-storeyed residential building analysed and designed with lateral loading effect of earthquake There is a gradual increase in the value of lateral forces from bottom floor to top floor in software analysis.

Amir Salihovic[3] Analyses were performed by SAP2000 and compared to experimental and VecTor2 results. Models made in SAP2000 differ in the simulation of the plasticity and the type of the frame elements used to discretize the frame structure. The results obtained allow a better understanding of the characteristics of all numerical models, helping the users to choose the best approach to perform nonlinear analysis.

Gauri G[4] this paper presents a review of the comparison of static and dynamic analysis multistoried building. Design parameters such as Displacement, bending moment, Base shear, Storey drift, Torsion, Axial Force were the focus of the study. The irregular shape building undergoes more deformation and hence regular shape building must be preferred.

Abhay Guleria[5] the case study mainly emphasizes on structural behavior of multi- story building for different plan configurations like rectangular, C, L and I-shape. Modeling of 15- story R.C.C. framed building is done on the ETABS software for analysis. Post analysis of the structure, maximum shear forces, bending moments and maximum story displacement are computed and then compared for all the analyzed cases.

Balaji.U. A[6] In this work a residential of G+13 multi-story building is studied for earthquake loads using ETABS software. Assuming that material property is linear static and dynamic analysis are performed. This non-linear analysis are carried out by considering severe seismic zones and the behavior is assessed by taking types II soil condition. Different response like, displacements, base shear are plotted.

III. METHODOLOGY WORK STUDY

- The study is carried out for the behavior of G+15 storied R.C frame buildings with a regular plan having rectangular, square and circular plan varying geometry.
- Floor height provided as 3.2 m. And also, properties are defined for the frame structure. Models are created in ETABS software.
- Various types of load are considered. For static behavior dead load of the building is considered as per IS 875 Part 1 and live load is considered as per IS 875 Part III, lateral load confirming IS 1893 (part 1) 2016.
- The three-dimensional reinforced concrete structures with G+15 storey were analyzed by Response spectrum analysis using ETABS software.
- The analysis results will show the seismic response of buildings in terms of storey shear, storey drift, storey displacement, time period, base shear, base moments, storey displacement, etc.

IV. PROBLEM STATEMENT

Following varying geometry models are used for the analysis by using given property Data

- Rectangular Geometry (18m x 24m)
- Square Geometry (18m x18m)
- Circular Geometry (Dia. – 24m)

Table 1. Parameters to be considered

Sr. No.	Parameter	Values
1.	Number of storey	G+15
2.	Base to plinth	1.5m
3.	Floor height	3.2m
4.	Infill wall	150 mm thick
5.	Materials	Concrete M40 and Reinforcement Fe 500
6.	Frame size	18m X 24m building size
7.	Grid spacing	4.5m grids in X-direction and 6m grids in Y-direction.
8.	Size of column	600 mm x 600 mm
9.	Size of beam	300mm x 600 mm
10.	Depth of slab	150 mm
11.	Total height	49.5m
12.	Plan area	432 m^2

For high rise buildings static analysis is not enough it's necessary to provide dynamic analysis. In proportional static examination, the outcomes are roughly uneconomical on the grounds that the estimations of removals are higher than, dynamic investigation.

V. ANALYSIS OF MODEL

A. Rectangular Geometry

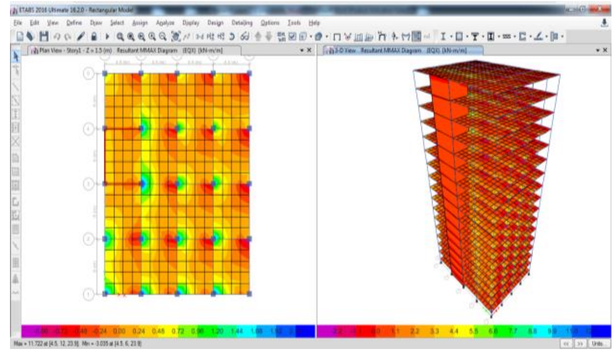

Fig 1. Stresses on building due to dynamic analysis

Above fig shows that the max stress on the rectangular building is around 7-8 Kn-m

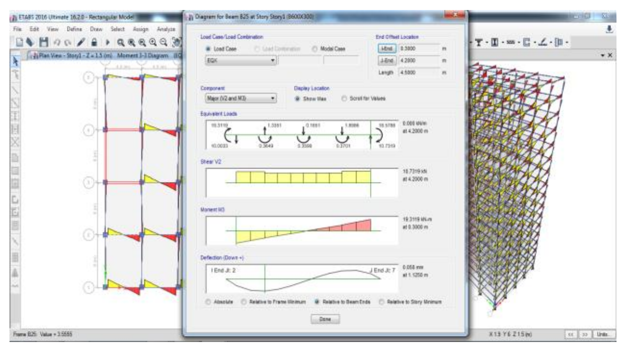

Fig 2. Moment on beams

Above fig shows that the Maximum Moment on the rectangular building is around 19.31 Kn-m

B. Square Geometry

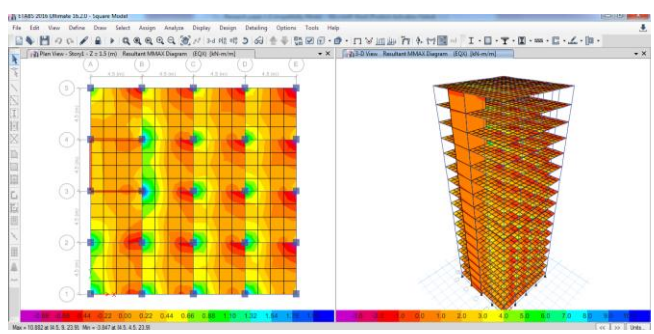

Fig 3. Stresses on building due to dynamic analysis

Above fig shows that the max stress on the square building is around 5-6 Kn-m.

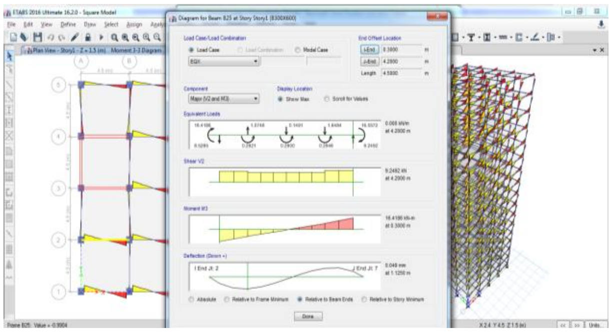

Fig 4. Moment on beams

Above fig shows that the Maximum Moment on the square building is around 16.41 Kn-m

C. Circular Geometry

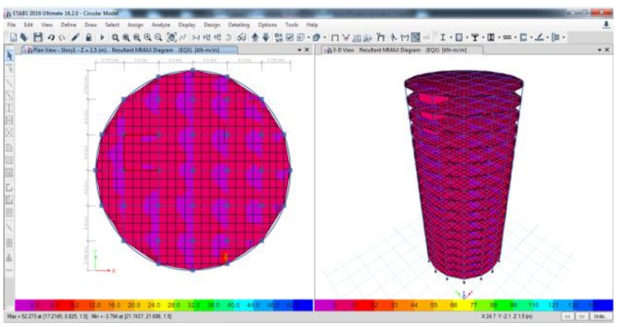

Fig 5. Stresses on building due to dynamic analysis

Above fig shows that the max stress on the circular building is around 11 Kn-m

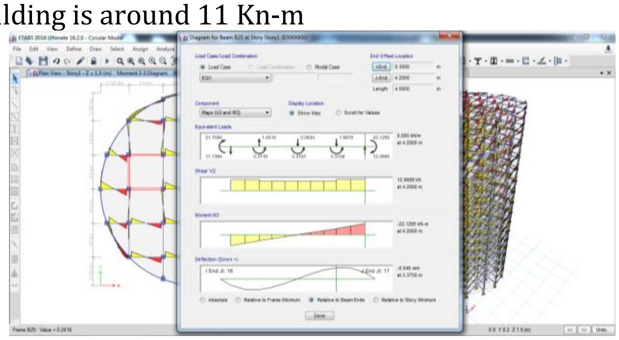

Fig 6. Moment on beams

Above fig shows that the Maximum Moment on the circular building is around 22.12 Kn-m

VI. RESULTS AND DISCUSSIONS

A. Maximum Stress

- Max stress on the rectangular building is around 7-8 kn-m
- Max stress on the rectangular building is around 5-6 kn-m
- Max stress on the rectangular building is around 11 kn-m

B. Maximum Moment

- Maximum Moment on the rectangular building is around 19.31 Kn-m
- Maximum Moment on the rectangular building is around 16.41 Kn-m
- Maximum Moment on the rectangular building is around 22.12 Kn-m

VII. CONCLUSION

The maximum moment and maximum stress for square building is less than rectangular and circular building. From the study it conclude that square RCC geometry is preferable for the dynamic analysis than rectangular and circular geometry.

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Etabs software

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