Seismic Analysis of Multistorey Building By Linear Time History Method With And Without Shear Walls

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Abstract- *Earthquake is the result of sudden release of energy in the earth's crust that generates seismic waves. Ground shaking and rupture are the major effects generated by earthquakes. It has social as well as economic consequences such as causing death and injury of living things especially human beings and damages the built and natural environment. In order to take precaution for the loss of life and damage of structures due to the ground motion, it is important to understand the characteristics of the ground motion. The most important dynamic characteristics of earthquake are peak ground acceleration (PGA), frequency content, and duration. These characteristics play predominant rule in studying the behavior of structures under seismic loads. The strength of ground motion is measured based on the PGA, frequency content and how long the shaking continues. Ground motion has different frequency contents such as low, intermediate, and high. With the immense loss of life and property witnessed in the last couple of decades alone in India, due to failure of structures caused by earthquakes, attention is now being given to the evaluation of the adequacy of strength in framed RC structures to resist strong ground motions. A ten story reinforced concrete structure has been considered in this study, which lies in Zone V, according to IS 1893:2000 classifications of seismic zones in India. The reinforced concrete shear wall is one of the most commonly used lateral load resisting in high rise building. The reinforced concrete shear wall building is high in plane stiffness and strength which can be used to simultaneously resist large horizontal load and support gravity load. The scope of the present work was to study seismic responses of the ten storey RC shear wall building. Developed mathematical modeling and analyzed the reinforced concrete shear wall building by using different nonlinear methods (time history and pushover method). In this project i am considering linear time history analysis for shear wall. The earthquake analysis of multistorey structure is done by linear and nonlinear methods. Response spectrum method of analysis is linear dynamic analysis. For nonlinear dynamic analysis time history method is used. In this Project, response spectrum method is used for linear analysis. For time history method, time history function of Bhuj earthquake ground motions is used. Both the analyses are done using ETABS software. To study seismic behavior, base shear, time period, storey displacement parameters are studied.*

Keywords- linear analysis, Response Spectrum method, Time History Method, R C Shear wall Building using by E-TABs.

I. INTRODUCTION

The word earthquake is used to describe any seismic event whether natural or caused by a human that generates seismic waves. Earthquakes are caused mostly by rupture of geological faults, but also by other events such as volcanic activity, landslides, mine blasts, and nuclear tests. An earthquake (also known as a quake, tremor or temblor) is the result of a sudden release of energy in the Earth's crust that creates seismic waves. The seismicity or seismic activity of an area refers to the frequency, type and size of earthquakes experienced over a period of time. Earthquakes are measured using observations from seismometers. The seismic evaluation reflects the seismic capacity of earthquake vulnerable buildings for the future use. According to the Seismic Zoning Map of IS: 1893- 2002, India is divided into four zones on the basis of seismic activities. They are Zone II, Zone III, Zone IV and Zone V. The main objective is to create awareness regarding dynamic effect on the building in simple manner with the help of E-TABS. It also shows better response of building under dynamic loading and Minimize the hazard to life for all structures.

II. OBJECTIVE OF THE PROJECT

The objectives of present work are as follows:

a. My research project aims at doing seismic evaluation for the ten storey building using linear dynamic and nonlinear dynamic analysis method with and without shear wall.
b. To analyze the building i had considered Bhuj ground motions.
c. To perform dynamic analysis of the building using time history & response spectrum method.
d. To study the effect of providing shear walls in seismic performance RC frame buildings in dynamic analysis both in linear and nonlinear analysis.
e. To make a study about the guidelines for the earthquake resistant buildings according to IS code.

f. To know about the earthquake design philosophy for an economical and safe design of a building.
g. It is an analysis of the dynamic response of the structures at each increment of time, when its base is subjected to a specific ground motion time history.
h. In this thesis, the structure is subjected to real Bhuj ground motion records. This makes this analysis method quite different from all of the other approximate analysis methods as the inertial forces are directly determined from these ground motions or in forces are calculated as function of time, considering dynamic properties of building structure.

III. METHODOLOGY

a. The methodology adopted to perform the seismic analysis of multi storey building with and without shear wall by using Time history method procedure.
b. An in depth knowledge of E-TABS software is required as the building was modeled in E-TABS and post analysis data obtained from it was used in the analysis of the structure.
c. The demand to capacity ratio of members was calculated to analyze the seismic stability of the structure under the various load combinations in accordance with IS 1893-2002 (part 1).
d. The Seismic analysis is classified into linear analysis and nonlinear analysis.
e. The linear analysis is the behaviour of member up to the elastic limit and the nonlinear analysis is the behaviour of the member beyond the elastic limit.
f. The linear analysis is a designed based and its classifies into two types they are Static and Dynamic
g. Equivalent static method is a linear static analysis
h. Response spectrum method and time history is a linear dynamic analysis
i. The nonlinear analysis is a performance based and its classifies into two types they are Static and Dynamic
j. Pushover analysis is a nonlinear static analysis
k. Time history analysis is a nonlinear dynamic analysis
l. In this thesis analysis of with and without shear walls have been performed with linear and nonlinear Time history analysis by using E-TABS.

IV. LITERATURE REVIEW

4.1 A. S. Patiland P. D.Kumbhar In the present paper study of nonlinear dynamic analysis of ten storied RCC building considering different seismic intensities is carried out and seismic responses of such building are studied. The building under consideration is modelled with the help of SAP2000-15 software. Five different time histories have been used considering seismic intensities V, VI, VII, VIII, IX and X on Modified Mercalli's Intensity scale (MMI) for establishment of relationship between seismic intensities and seismic responses. The results of the study shows similar variations pattern in Seismic responses such as base shear and storey displacements with intensities V to X. From the study it is recommended that analysis of multi-storeyed RCC building using Time History method becomes necessary to ensure safety against earthquake force.

4.2 Arvindreddy, R,J.Fernandes In this paper an analytical study is made to find response of different regular and irregular structures located in severe zone V. Analysis has been made by taking 15 storey building by static and dynamic methods using ETABS 2013 and IS code 1893-2002 (part1). Dynamic Analysis can take the form of a dynamic Time History Analysis or a linear Response Spectrum Analysis. Behaviour of structures is found by comparing responses in the form of storey displacement for regular and irregular structures. Time history analysis is carried out taking BHUJ earthquake. In this present work two types of structures considered are reinforced concrete regular and irregular 15 storey buildings and are analyzed by static and dynamic methods. For time history analysis past earthquake ground motion record is taken to study response of all the structures. Presently there are six models. One is of regular structure and remaining are irregular structural models. This paper show that behaviour irregular structures as compared to regular structure

4.3 Ashwini Bidariet.al has done the analysis and design of high-rise steel building frame with braced and without braced under effect of earthquake and wind .And the soft ware used for all analysis s Sap2000. Dynamic analysis is carried out by using Equivalent Static method and Response spectrum method for earthquake zone V as per Indian code. The Natural period, Design Base shear, lateral Displacements are compared for the different silo supporting models .The braced system gives the economical results as compared to un braced system in terms of frequency and displacement.

4.4 Baldev D. Prajapati has study that the analysis & design procedure adopted for the calculation of symmetric high rise multi-storey building (G+30) under effect of EQ and Wind forces. The R.C.C., Steel, & Composite building with shear wall is considered to resist lateral forces resisting system.

4.5 Prof. R.S. Rajguru, Mr.Ravindra N. Shelke This paper is concerned with the effects of various vertical irregularities on the seismic response of a structure. The objective of the project is to carry out Time history Analysis (THA) of vertically irregular RC building frames and to carry out the ductility based design using IS 13920 corresponding to Equivalent static analysis and Time history analysis. Comparison of the results of analysis and design of irregular structures with regular structure was done. Three types of irregularities namely mass irregularity, stiffness irregularity and vertical geometry irregularity were considered. The absolute displacements obtained from time history analysis of geometry irregular structure at respective nodes were found to be greater than that in case of regular structure for upper stories but gradually as we moved to lower stories displacements in both structures tended to converge.

V. DATA

5.1 Linear Time History Analysis With and Without Shear Wall

A 10 Storey building is taken for analysis. The salient features of the building are:

1. Type of structure	Multi storey rigid joint frame.
2. Seismic zone	V
3. Type of soil	Medium
4. Imposed Load	3 KN/m^2
5.Terrace water proofing	1.5 KN/m^2
6. Floor finishes	1 KN/m^2
7. Depth of slab	125 mm
8. Materials	M20concrete and Fe 415 steel
9. Unit weight of RCC	25 KN/m^2
10. Beams	300 × 450 mm
11. Columns	300 × 500 mm
12. Clear cover of beam	25 mm
13.Clearcover of column	40 mm
14. Wall thickness	200mm.

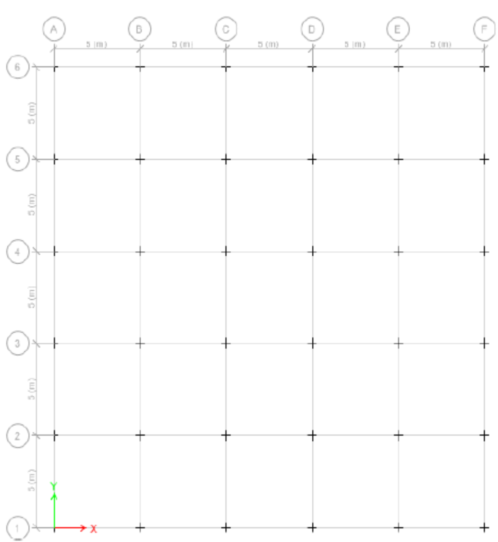

Fig 5.1 Plan of Ten Storey Building

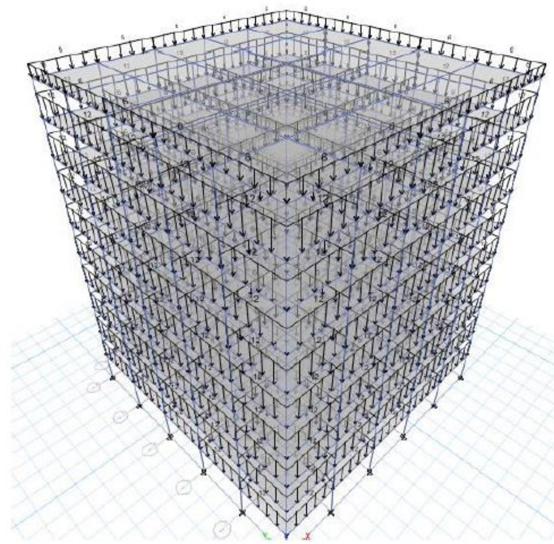
Fig 5.2 Assigning Load Properties

- In this thesis additional element is introduced in ten storey building is the shear wall concept.Then we have defined and assign the shear wall. In this thesis I am considering the core shear wall concept.

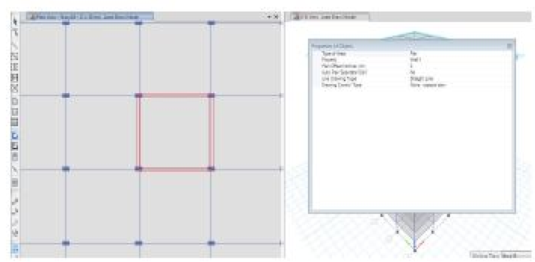
Fig 5.3 Defining Shear Wall

- The model consists of shear wall and openings in shear wall in both elevation and 3D view. They are different types of shear wall we can use in building for example core shear wall and edge shear wall but in this thesis I am considering the core shear wall concept. The design of shear wall is to resist the Lateral loads.

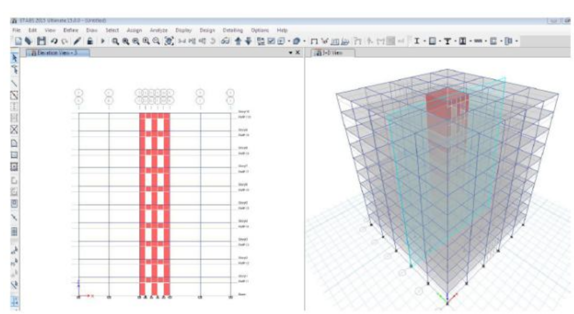
Fig 5.4 Elevation and 3D view of Shear Wall

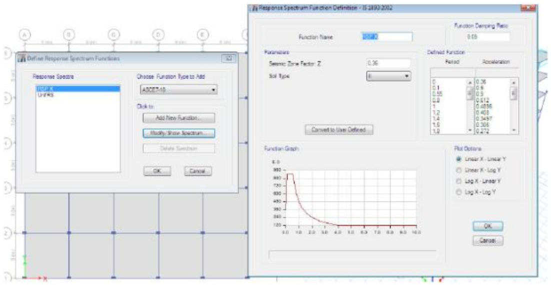

Fig 5.5 Defining Response Spectrum Function

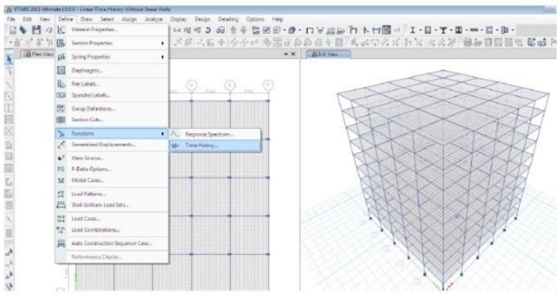

Fig 5.6 Defining Time History Function

VI. RESULTS

6.1 Results of Linear Time History Analysis without Shear Wall

Fig 6.1 Modal Maximum Storey Displacements

Fig 6.2 EQ X Maximum Storey Displacements

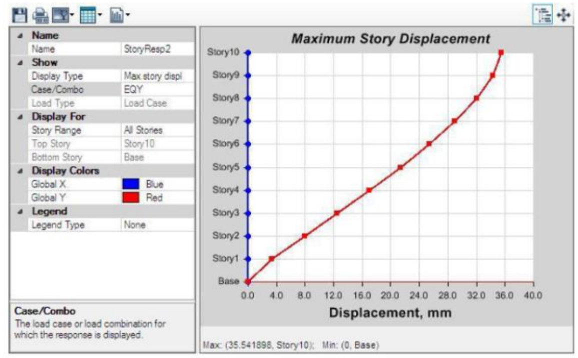

Fig 6.3 EQ Y Maximum Storey Displacements

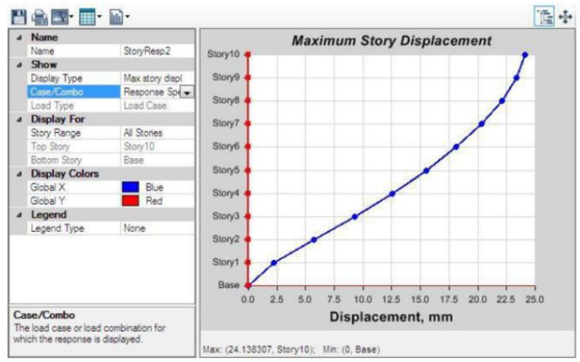

Fig 6.4 RS X Maximum Storey Displacements

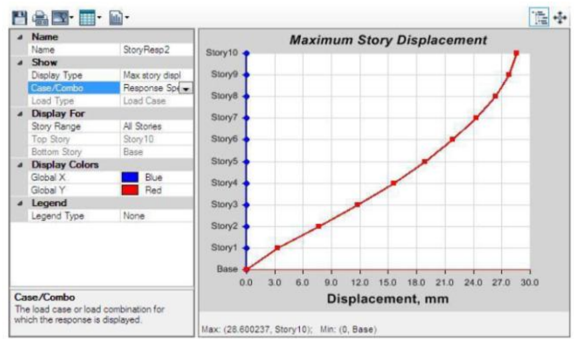

Fig 6.5 RS Y Maximum Storey Displacements

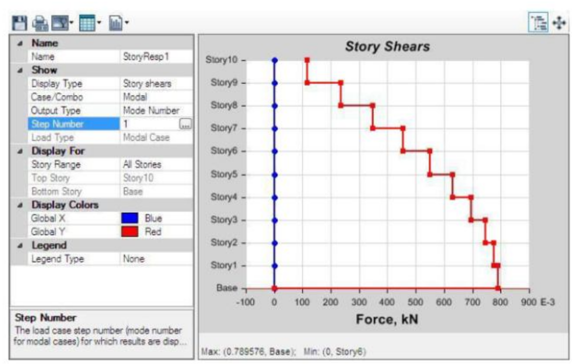

Fig 6.6 Modal Storey Shears

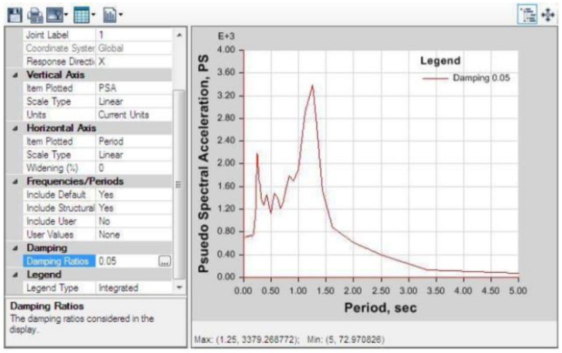

Fig 6.7 TH X (PSA)

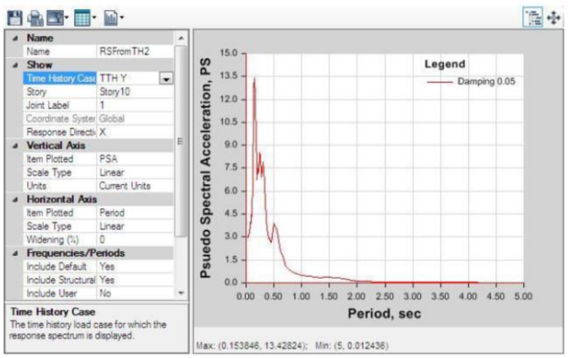

Fig 6.8 TH Y (PSA)

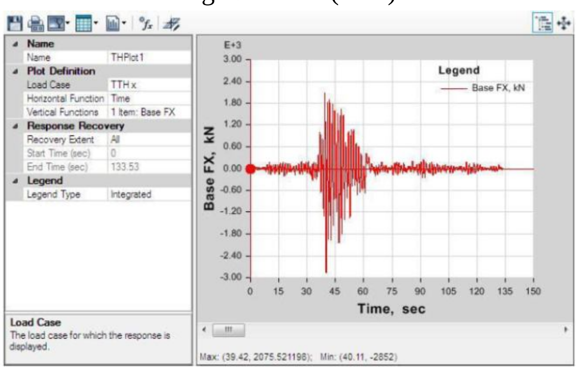

Fig 6.9 Time History Plot (TTH X)

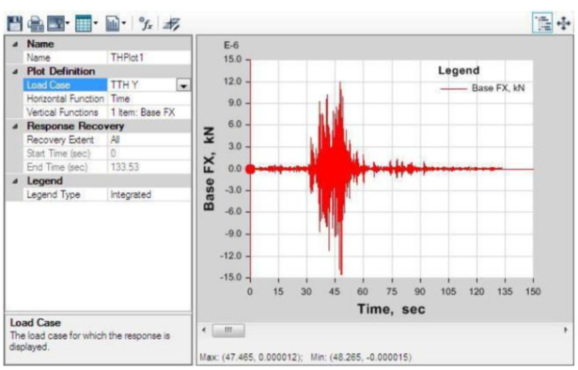

Fig 6.9 Time History Plot (TTH X)

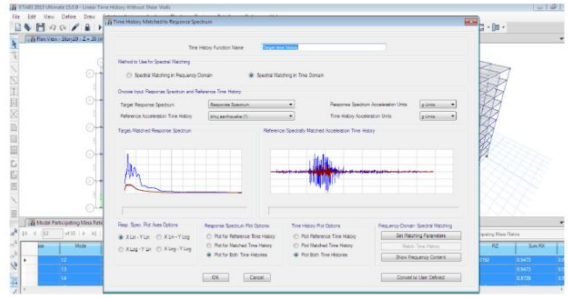

Fig 6.10 Time History Matched to Response Spectrum

6.2 Results of Linear Time History Analysis with Shear Wall

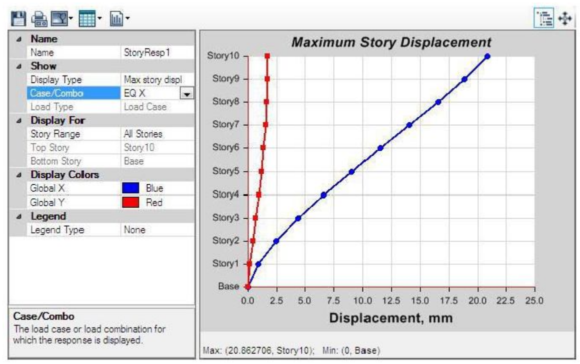

Fig 6.11 EQ X Maximum Storey Displacements

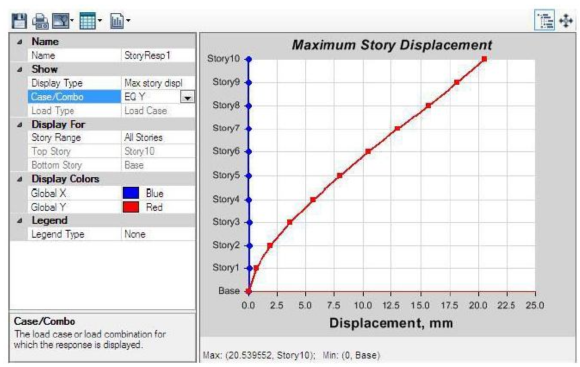

Fig 6.12 EQ Y Maximum Storey Displacements

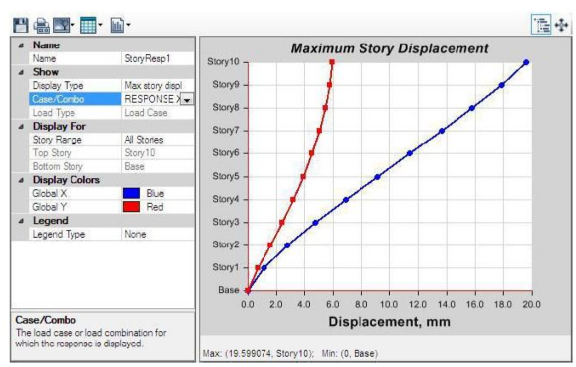

Fig 6.13 RS X Maximum Storey Displacements

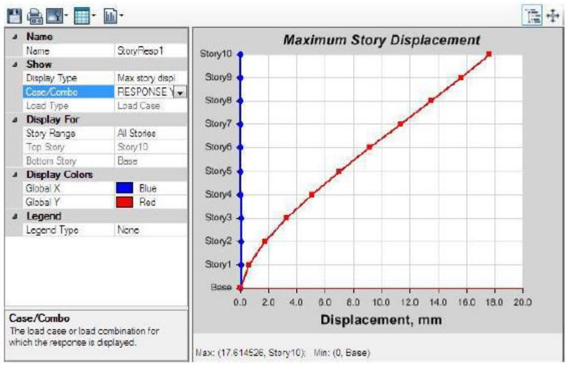

Fig 6.14 RS Y Maximum Storey Displacements

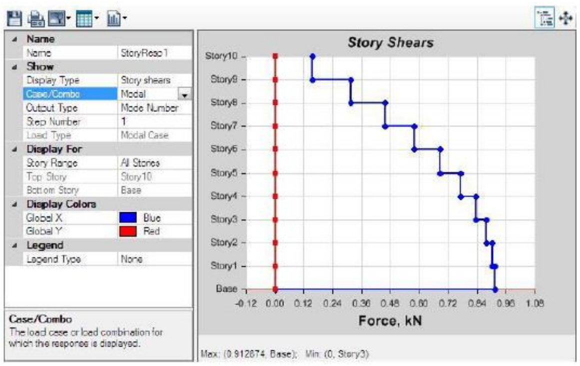

Fig 6.15 Modal Story Shears

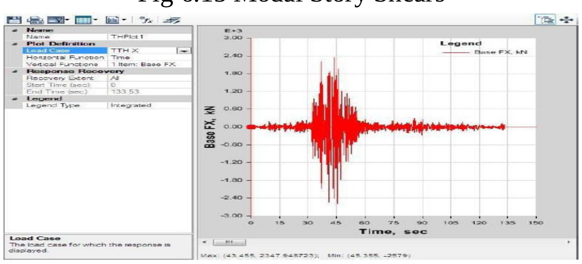

Fig 6.16 Time History Plot (TTH X)

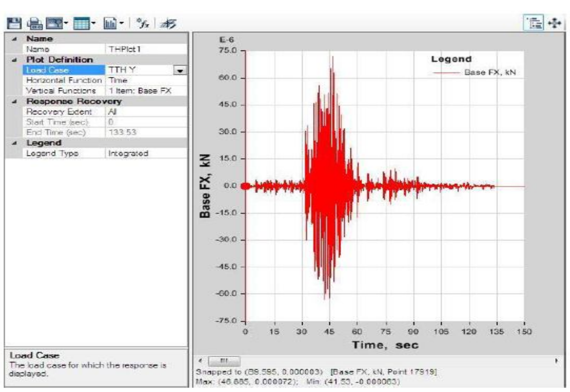

Fig 6.17 Time History Plot (TTH Y)

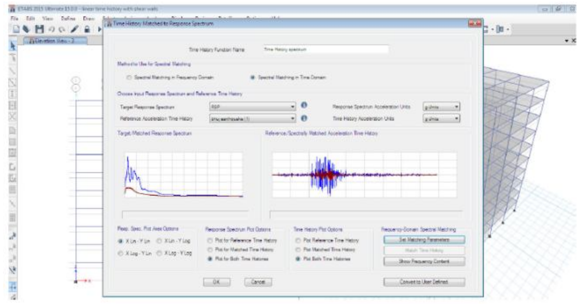

Fig 6.18 Time History Matched to Response Spectrum

Comparisons of Time History Analysis with and without shear wall Maximum Storey Displacements in mm

Without Shear Wall	Storey Displacement	With Shear Wall	Storey Displacement
M.S.D	0.02	M.S.D	0.01
EQ X	29.2	EQ X	20.8
EQ Y	35.5	EQ Y	20.5
RS X	24.1	RS X	19.5
RS Y	28.6	RS Y	17.6

VII. SUMMARY

Ground motion causes earthquake. Structures are vulnerable to ground motion. It damages the structures. In order to take precaution for the damage of structures due to the ground motion, it is important to know the characteristics of the ground motion. The characteristics of ground motion are peak ground acceleration, peak ground velocity, peak ground displacement, period, and frequency content etc.

- The Seismic analysis is classified into linear analysis and nonlinear analysis.
- The linear analysis is the behaviour of member up to the elastic limit and the nonlinear analysis is the behaviour of the member beyond the elastic limit.
- The linear analysis is a designed based and its classifies into two types they are Static and Dynamic.
- Equivalent static method is a linear static analysis
- Response spectrum method and time history is a linear dynamic analysis
- The nonlinear analysis is a performance based and its classifies into two types they are Static and Dynamic
- Pushover analysis is a nonlinear static analysis
- Time history analysis is a nonlinear dynamic analysis
- Time History Analysis and Response Spectrum Method can help demonstrate how progressive failure in buildings really occurs, and identify the mode of

final failure. In this study, results obtained from the response spectrum & time history analysis of ten storey building was in the form of curves and graphs used as the parameter to assess this amount of shear, displacement, response, time of reaction is obtained for with and without shear walls.

In this thesis i had given input as Bhuj earthquake ground motion data in linear and nonlinear time history analysis considered as seismic zone V and it is performed in E-TABS.

The output of the building is given in terms of storey displacement, storey acceleration, and base shear. The responses of Bhuj ground motion for this building are studied.

VIII. CONCLUSIONS

The following are the major conclusions that can be made based on present work carried upon the RC building with and without shear walls analysed for linear Time history method, Earthquake forces, Response spectrum in the seismic zone V using ETABS Software 2015.

In thesis the model is analysed by time history method with and without shear wall the time history method can be applied in linear procedure. Linear Time History analysis is the designed based in this with the help of response spectrum the time history is analysed by inputing the ground motion in the time history and the output is storey displacement, storey shear etc..

In this thesis the Maximum Storey Displacement is less in shear wall compared to without shear wall that is without providing any shear wall in model the displacements are high the after providing shear wall in model the storey displacements are reduced.

- So provide shear wall to reduce displacements in building.
- Shear wall is designed for lateral forces acting on building.

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