International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 09 , September 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

Comparison on dynamic lateral loading seismic (earthquake) analysis using different software

Nitasha Dhiman[1], Ankush Tanta[2]

[1]PG Research Scholar, [2]Assistant Professor, Department of Civil Engineering,
Baddi University of Emerging Sciences and Technology, Solan (India)

ABSTRACT

The seismic upgrading of exterior beam-column joints in existing RC moment resisting frames designed and built prior to the 1970s is imposing a serious challenge in earthquake engineering. Due to the lack of capacity design principles, the construction details used in these structural elements are now recognized to likely lead to nonductile structural failure modes under seismic actions. Based on our research we proposed to compare dynamic lateral loading seismic (earthquake) analysis using different software's (i.e. Staad.Pro, ETABS, and SAP). We designed G+16 storey building using Staad.Pro and analysed the structure for seismic analysis by applying various kind of loads like dead load, live load, combinational load etc. The seismic considerations as per IS 1893:2002. Seismic analysis is done by linear static method and response spectrum method as per IS recommendations. Our study we come to conclude that staad.pro is having better performance as compared to other software's like ETABS and SAP. The analysis is made taking four categories into consideration.

Keywords: G+16 storey, Seismic Analysis, Dynamic Lateral Loading, Response Spectrum Method (RS), Linear Static Method (LS).

I. INTRODUCTION

Bearing capacity

In geotechnical engineering, bearing capacity is the capability of soil to guide the loads applied to the floor. The bearing capability of soil is the maximum common touch stress among the foundation and the soil which should now not produce shear failure within the soil. Ultimate bearing ability is the theoretical most strain which may be supported without failure; allowable bearing capability is the last bearing potential divided by way of an aspect of safety. Sometimes, on soft soil sites, huge settlements may arise under loaded foundations without real shear failure going on; in such cases, the allowable bearing potential is primarily based on the maximum allowable agreement. There are 3 modes of failure that limit bearing potential: popular shear failure, neighborhood shear failure, and punching shear failure [12].

Dynamic Bearing capacity

The dynamic load capacity of a bearing any bearing can be decided on from the bearing catalogue where all details bearing on the unique bearing are given. The dynamic load potential of the bearing is specific and has been determined primarily based on various empirical formulas which the manufacturer has advanced primarily based at the years of revel in and studies finished. See Selection of Rolling Elements – Part five to discover the dynamic load capacity of a bearing in the bearing catalogue.

International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 09 , September 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

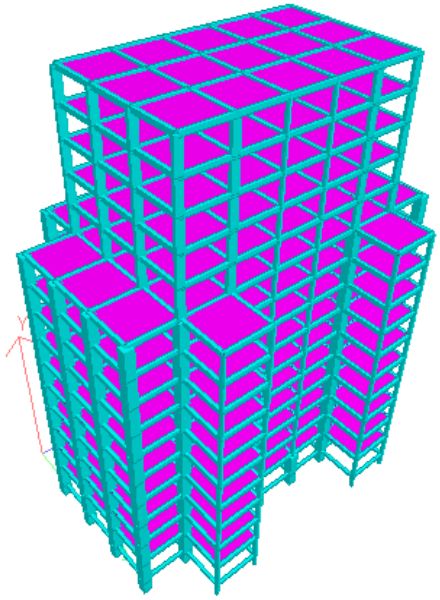

Fig1:3Dview of Structure Designed using Staad.Pro

The dynamic load capacity is a fee which has a unit of 'N' or 'kN' (Newtons or Kilo Newtons). The Dynamic Load potential may be described because the load with a purpose to supply a life of 1,000,000 revolutions of the internal race. The dynamic load rating as a result performs a crucial function for the bearing lifestyles. The relation between the bearing life and the dynamic load ability is expressed as observe.

$$L = (C/P)^{3}$$ - for Ball bearing

$$L = (C/P)^{10/3}$$ – for Roller bearings

Here L = Bearing L Life,

P = Equivalent Radial Load, Newtons

C = Dynamic Load capacity of the bearing, Newtons

Since our generally understand the anticipated life for a bearing and the equal radial load at the bearing, it would be easy for us to decide the fee of C, the dynamic Load capability of the bearing. All that we want to do is to choose a bearing, whose dynamic load ability price, C is extra than the cost calculated.

Static Load Capacity:

The static load potential of the bearing is denoted via Co. The unit is Newton's (N). This price is given to make certain that the equal radial load does now not exceed the static load capacity of the bearing. This denotes the amount of load the bearing can be capable of face up to in standstill condition without developing any deformation within the bearing i.e. to the inner race, outer race or the rolling elements. By experiments it has been concluded that when a bearing is subjected to this load i.e. The most of the Static Load capability, it has a tendency to supply a deformation of zero.0001 instances the diameter d of the rolling detail [2].

Shallow Foundations

A shallow basis is a sort of basis which transfers constructing hundreds to the earth very near the floor, in preference to a subsurface layer or number depths as does a deep foundation. Shallow foundations consist of unfold footing foundations, mat-slab foundations, slab-on-grade foundations, pad foundations, rubble trench foundations and earth bag foundations [13].

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

Shallow foundations are built where soil layer at shallow intensity (upto 1.5m) is capable of support the structural masses. The intensity of shallow foundations is usually less than its width.

The different types of shallow foundation are:

1. Strip footing
2. Spread or isolated footing
3. Combined footing
4. Strap or cantilever footing
5. Mat or raft Foundation

1. Strip Footing:

A strip footing is provided for a load-bearing wall. A strip footing is likewise furnished for a row of columns that are so carefully spaced that their unfold footings overlap or almost contact each different. In this kind of case, it's far greater within your budget to provide a strip footing than to provide some of unfold footings in one line. A strip footing is likewise called non-stop footing.

2. Spread or Isolated Footing:

A spread footing (or remote or pad) footing is furnished to assist a person column. A spread footing is round, rectangular or rectangular slab of uniform thickness. Sometimes, it's far stepped or hunched to spread the load over a huge area [6].

3. Combined Footing:

A blended footing supports two columns. It is used whilst the 2 columns are so near each different that their man or woman footings might overlap. A combined footing is also supplied while the belongings line is so near one column that a selection footing would be eccentrically loaded when stored absolutely in the belongings line. By combining it with that of an indoors column, the burden is frivolously dispensed. A mixed footing can be square or trapezoidal in plan.

4. Strap or Cantilever footing:

A strap (or cantilever) footing consists of isolated footings linked with a structural strap or a lever. The strap connects the 2 footings such that they behave as one unit. The strap is designed as an inflexible beam. The individual footings are so designed that their combined line of movement passes through the ensuing of the full load. A strap footing is more good value than a mixed footing while the allowable soil pressure is notably high and the space between the columns is huge.

5. Mat or Raft Foundations:

A mat or raft basis is a huge slab supporting some of columns and partitions underneath the complete structure or a massive a part of the shape. A mat is needed when the allowable soil pressure is low or wherein the columns and walls are so close that man or woman footings would overlap or nearly contact each different. Mat foundations are useful in lowering the differential settlements on non-homogeneous soils or in which there's a large version in the hundreds on character columns [6].

Construction

Construction is the process of constructing a constructing or infrastructure. Construction differs from manufacturing in that production normally includes mass production of similar objects without a chosen patron, whilst production commonly takes place on region for a regarded consumer. Construction as an enterprise

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

comprises six to 9 percent of the gross domestic fabricated from advanced countries. Construction starts with planning, layout, and financing; and continues till the project is built and equipped for use.

Large-scale creation calls for collaboration across more than one discipline. An architect usually manages the job, and a production supervisor, layout engineer, production engineer or venture manager supervises it. For the hit execution of a project, powerful planning is vital. Those involved with the layout and execution of the infrastructure in question should bear in mind zoning requirements, the environmental impact of the activity, the a hit scheduling, budgeting, production-site safety, availability and transportation of building substances, logistics, inconvenience to the public because of construction delays and bidding, and so forth. The largest construction initiatives are called megaprojects.

Types of construction:

- Building construction
- Residential construction
- New construction techniques and sustainability [5]

II. LITERATURE REVIEW

E. Pavan Kumar et.al in (2014) Look at the seismic analysis of shape for static and dynamic evaluation in ordinary moment resisting frame and unique moment resisting body. Equivalent static evaluation and response spectrum evaluation are the methods utilized in structural seismic analysis. They take into consideration the residential constructing of G+ 15 storied structure for the seismic evaluation and its miles placed in region II. The overall structure was analyzed by pc with the use of STAAD.PRO software. They found the reaction reduction of instances regular moment resisting frame and special moment resisting frame values with deflection diagrams in static and dynamic evaluation. The special moment of resisting body structured is good in resisting the seismic hundreds. [8].

S. Arun kumar et.al in (2016) the growth in urbanization for the beyond few years has made the car parking as a chief problem. Therefore the first storey of the condominium is used for parking. RC framed homes with the ground storey open are recognized to perform poorly at some stage in sturdy earthquake shaking, because of the absence of infill wall, the presence of masonry infill wall influences the general behavior of the shape whilst subjected to lateral forces, while masonry infill are considered to interact with their surrounding frames the lateral stiffness and lateral load sporting potential of shape largely growth. Earthquakes that came about these days have shown that a huge variety of existing strengthened concrete homes specially soft storey constructing are vulnerable to harm or even disintegrate in the course of a sturdy earthquake. The first storey of the constructing behaved as a smooth story wherein the columns have been not able to provide good enough shear resistance in the course of the earthquake. So in this paper the look at is completed with various constructing models which include soft storey shape with shear wall, and soft storey with metal bracings at the first storey. They have a looked at consists of the evaluation of soft storey building with ETABS software through pushover analysis technique and the consequences and end of the evaluation is to be protected. [1].

Arun kumar N pattar et.al in (2015) STAADPro and ETABS are the cutting-edge main layout software's inside the market. Many layout organizations use these software's for their undertaking layout purposes. So, this venture in particular offers with the comparative analysis of the results received from the design of a regular and a plan multi storey building structure whilst designed the usage of STAADPro and ETABS software's one by

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

one. These outcomes may also be as compared with guide calculations of a sample beam and column of the identical shape designed as in keeping with IS 456. In this study they're reading and designing a tall building G+21 storey the use of Staad Pro, E-tabs and with the aid of conventional guide technique, finally comparing analyzed and layout values. [9].

Pardeshi sameer et.al in (2016) 3D analytical version of G+15 storied buildings had been generated for symmetric and asymmetric building models and analyzed using structural evaluation tool ETABS software program. Mass and stiffness are basic parameters to evaluate the dynamic response of a structural device. Multi-storied homes are behaved differently relying upon the numerous parameters like mass-stiffness distribution, foundation kinds and soil situations. 2001 Bhuj earthquake in Gujrat, India verified the damage and disintegrates of the buildings because of the irregularities in structural stiffness and floor mass. This paper is concerned with the consequences of numerous vertical irregularities at the seismic response of a structure. The objective of the project is to perform Response spectrum analysis (RSA) of ordinary and abnormal RC constructing frames and Time history Analysis (THA) of regular RC constructing frames and carry out the ductility primarily based design using IS 13920 corresponding to reaction spectrum evaluation. Comparison of the results of evaluation of irregular structures with everyday shape is performed. [3].

Dr. Saraswati Setia et.al in (2012) investigated the have an effect on of some parameters on behavior of a constructing with soft storey. The modeling of the whole building is performed the usage of the pc program STAAD.Pro 2006. Parametric studies on displacement, inter storey glide and storey shear had been carried out the use of equal static analysis to analyze the effect of these parameter at the behavior of buildings with smooth storey. The decided on building analyzed via five numerical fashions. [10].

Fadi Hage Chehade et.al in (2009) analyzed the slopes stability under seismic loading in Lebanon using a global numerical dynamic approach. This approach allows taking into account important parameters that are generally ignored in simplified engineering methods as the soil deformability and frequency content of seismic input. Such parameters are critical in triggering instability under seismic loading. Analysis is conducted using elastoplastic soil behavior that could monitor the evolution of the slope state after an earthquake and clarify the most probable failure circles. It will focus on the slopes reinforcement in order to give recommendations for the most appropriate reinforcement scheme for vulnerable slopes under seismic loading [4].

Rafael Keller Tesser et.al in (2014) ported a seismic wave simulator to Adaptive MPI to profit from its load balancing framework. By using dynamic load balancers, they improved the performance of the application by 23.85% when compared to the original MPI implementation. They also show that load balancers are able to adapt to the variation of load imbalance during the application's execution [11].

III. PROBLEM FORMULATION

Earthquakes occur when masses of rock in Earth's crust slip and slide against one another. This kind of movement is most common along a fault, a break in a body of rock that can extend for miles or even hundreds of miles. When pieces of crustal rock suddenly slip and move, they release enormous amounts of energy, which then propagates through the crust as seismic waves. At the Earth's surface, these waves cause the ground to shake and vibrate, sometimes violently. The concept of performance-based design is that a designer can be inventive in terms of the combinations of structural framing systems and detailing chosen vs. adhering to

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

prescriptive criteria contained in building code. But this approach presumes that the designer can demonstrate, typically through simulation that the structure is capable of performing acceptably.

IV. PROPOSED RESEARCH METHODOLOGY

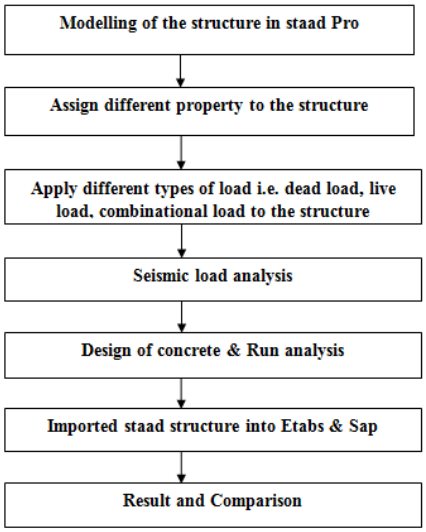

Fig 2: Proposed Research Methodology

V. SIMULATION AND EXPERIMENTAL RESULTS

The population explosion and advent of industrial revolution led to the exodus of people from villages to urban areas i.e. construction of multi-storied buildings has become inevitable both for residential and as well as office purposes. The high raised structures are not properly designed for the resistance of lateral forces. It may cause to the complete failure of the structures. The earthquake resistance structures are designed based on the some factors. The factors are natural frequency of the structure, damping factor, type of foundation, importance of the building and ductility of the structure. The structures designed for ductility need to be designed for less lateral loads as it has better moment distribution qualities. We proposed to compare dynamic lateral loading seismic (earthquake) analysis using different software (i.e. Staad.Pro, ETABS, and SAP). We have designed structure using Staad.Pro and after completion of structure designing the whole structure are imported to structure design and analysis software's, required dead loads, live loads and combinational loads are applied and tested for structure failures.

International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 09 , September 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

Table 4.1 Building Description

Length x Width	35x25 m
No. of storey	16
Storey height	3m
Storey height from base	1.5m
Beam 1st storey	300x300mm
Beam from 2- 16 storey	450x300mm
Circular interior columns	400mm (diameter)
Rectangular column 1-11 storey	900x900mm
Rectangular column 12-16 storey	750x300mm
Slab thickness	150mm
Support condition	Fixed

Table 1.2 Seismic Parameters

City	Chandigarh
Zone factor	0.24
SMRF	5
Soil type	Medium
Damping ratio	0.05
Type of building	RC framed

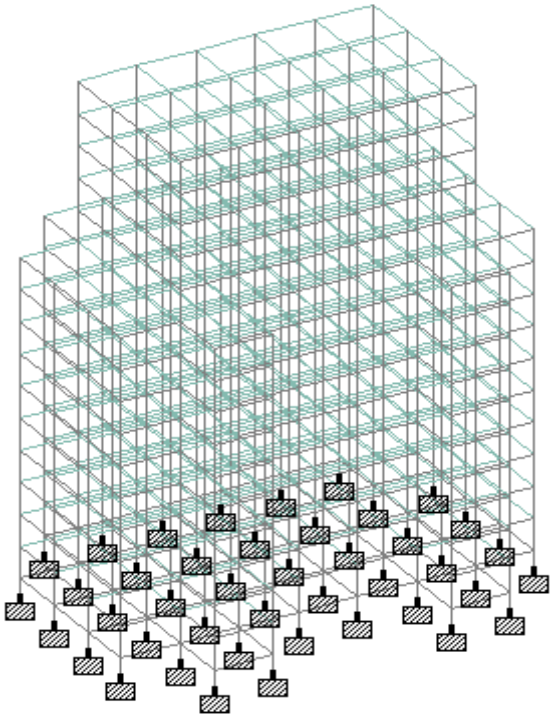

Fig 3: Isometric View of Designed Structure

International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 09 , September 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

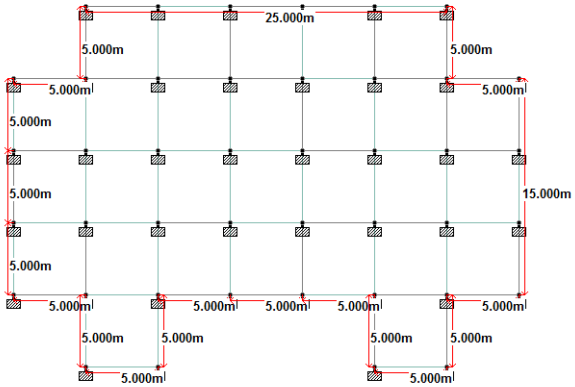

Fig 4: Top View of Designed Structure using Staad.pro

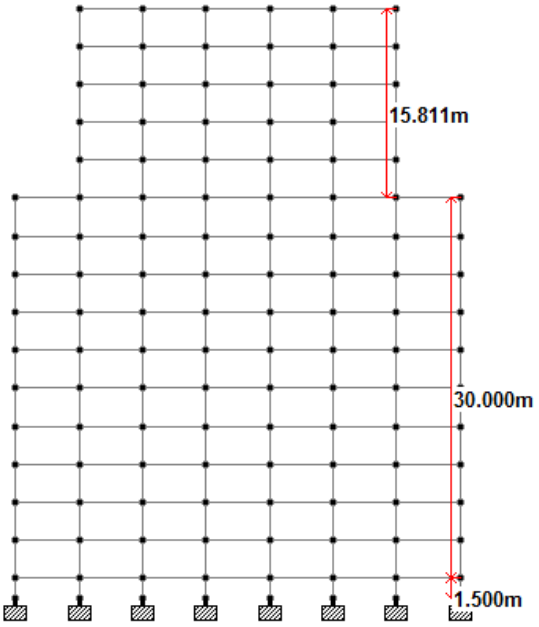

Fig 5: Top View of Designed Structure using Staad.pro

The designed structure is analyzed for dynamic lateral loading seismic (earthquake) analysis by using Linear Static Method (LS) and Response Spectrum Method (RS).

Linear Static Method:

All design against seismic loads must consider the dynamic nature of the load. However, for simple regular structures, analysis by equivalent linear static methods is often sufficient. This is permitted in most codes of practice for regular, low-to medium-rise buildings. It begins with an estimation of base shear load and its distribution on each story calculated by using formulas given in the code. Linear static method can therefore work well for low to medium-rise buildings without significant coupled lateral-torsional effects, are much less suitable for the method, and require more complex methods to be used in these circumstances.

Response Spectrum Method:

The representation of the maximum response of idealized single degree freedom system having certain period and damping, during earthquake ground motions. The maximum response plotted against of un-damped natural period and for various damping values and can be expressed in terms of maximum absolute acceleration,

International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 09 , September 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

maximum relative velocity or maximum relative displacement. For this purpose response spectrum case of analysis have been performed according to IS 1893.

Structure Analysis by using Linear Static Method (LS):

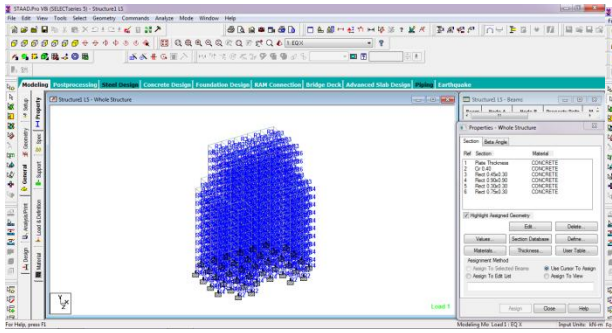

Fig 6: Assigning Properties to Designed Structure

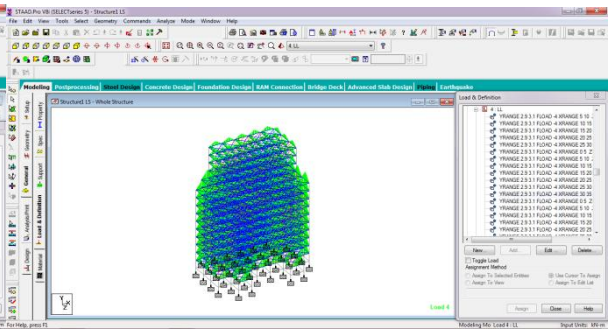

Fig 7: Applying Live Load to Designed Structure

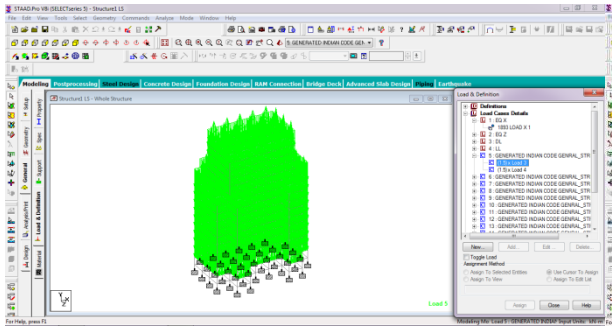

Fig 8: Applying Combinational Load to Designed Structure

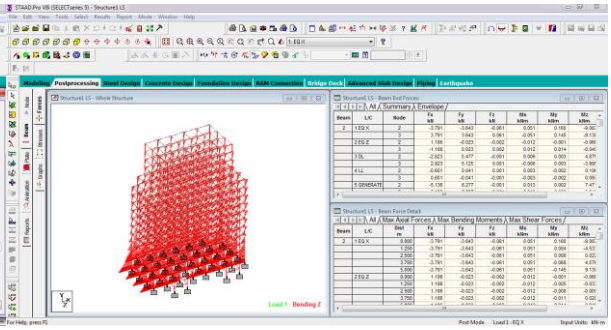

Fig 9: Forces of Designed Structure

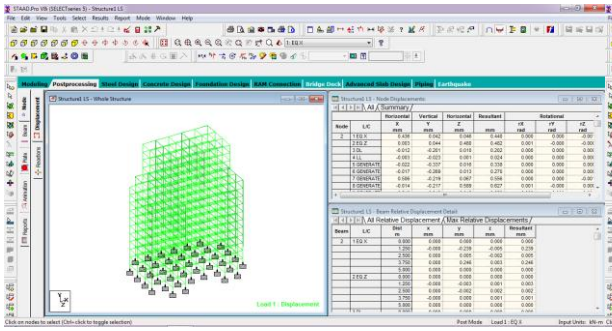

Fig 10: Node Displacement of Designed Structure

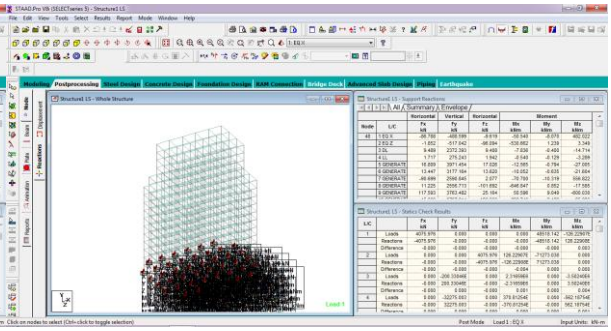

Fig 11: Support Reaction of Designed Structure

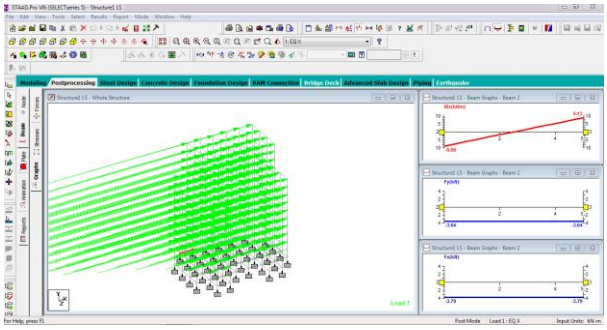

Fig 12: Graphs of Designed Structure

International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 09 , September 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

Structure Analysis by using Response Spectrum Method (RS):

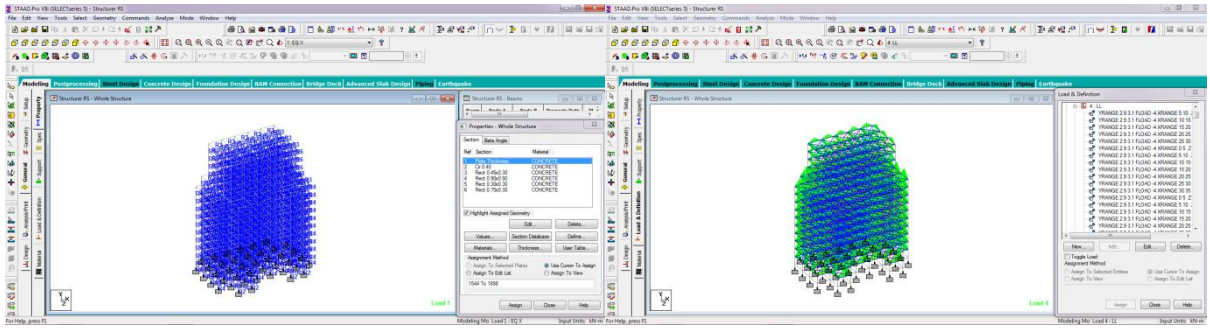

Fig 13: Assigning Properties to Designed Structure Fig 14: Applying Live Load to Designed Structure

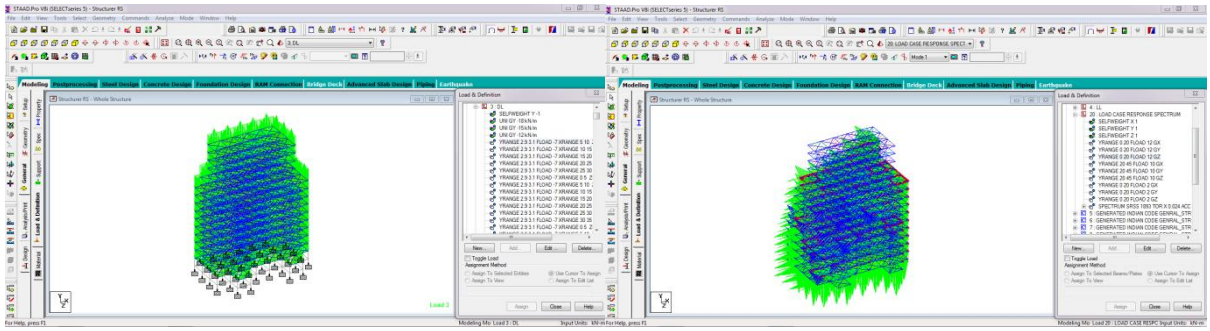

Fig 15: Applying Dead Load to Designed Structure Fig 16: Applying Spectrum Load to Designed Structure

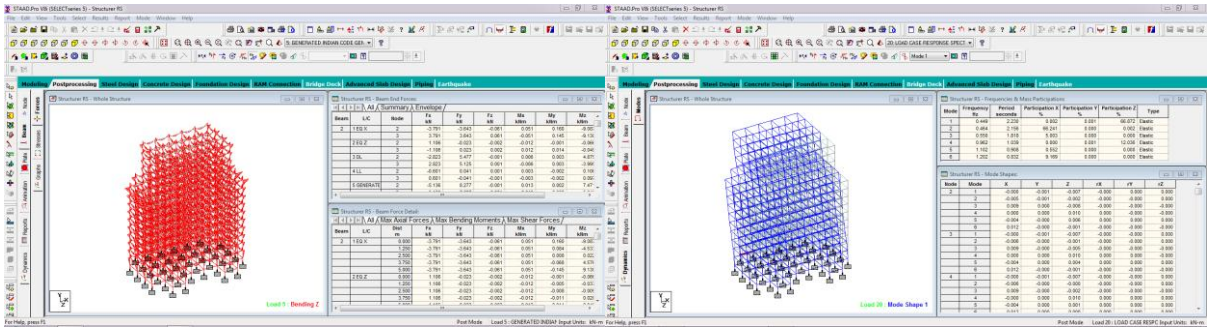

Fig 17: Forces of Designed Structure Fig 18: Mode Shape of Designed Structure

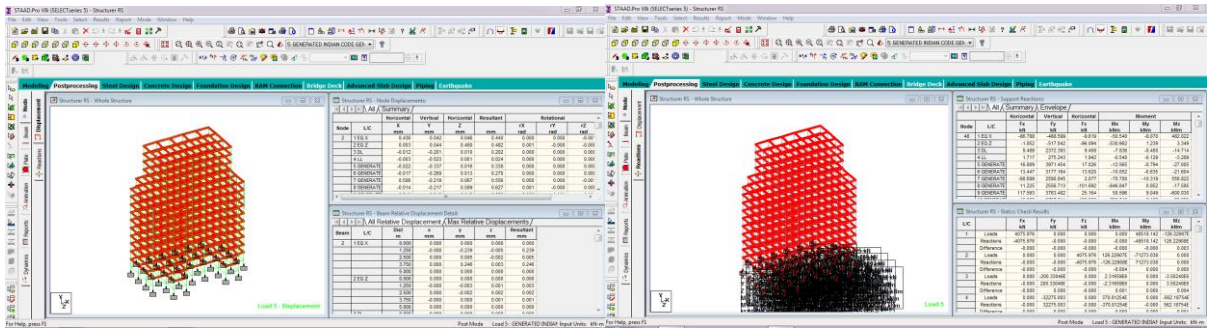

Fig 19: Node Displacement of Designed Structure Fig 20: Reactions of Designed Structure

International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 09 , September 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

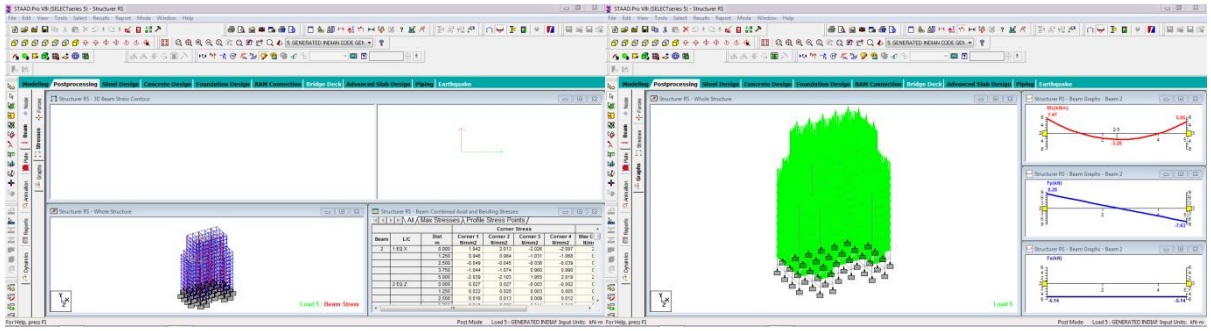

Fig 21: Stresses of Designed Structure **Fig 22: Graphs of Designed Structure**

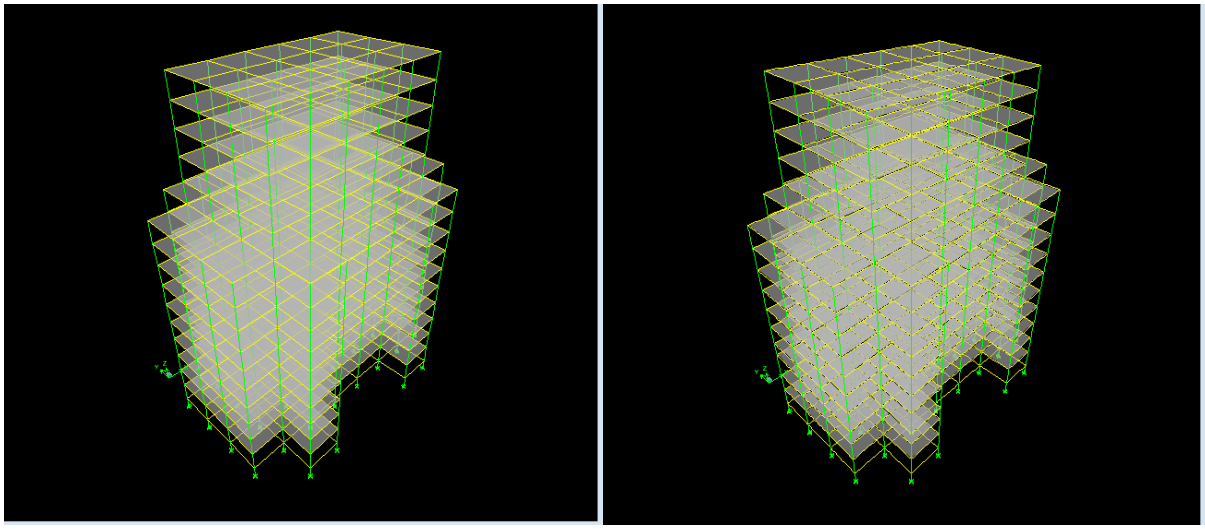

Fig 23: 3D View of Imported Structure using ETABS **Fig 24: Analysis of Imported Structure using ETABS**

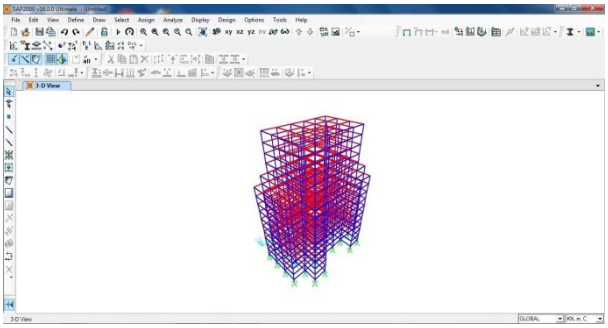

Fig 25: Imported Structure using SAP

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

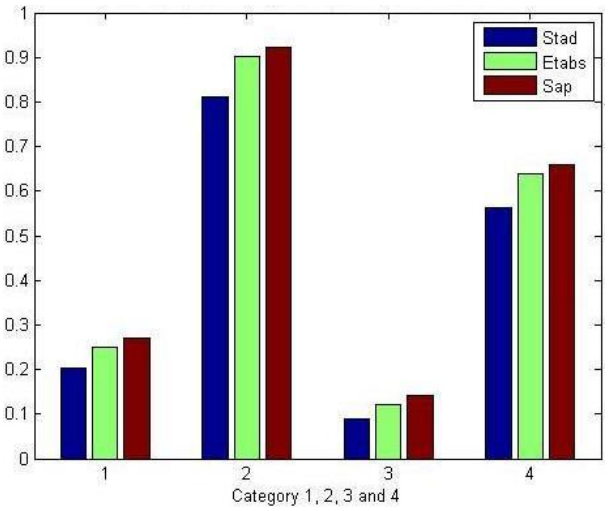

Fig 26: Comparison of Category Wise Structure Strength by using LS method

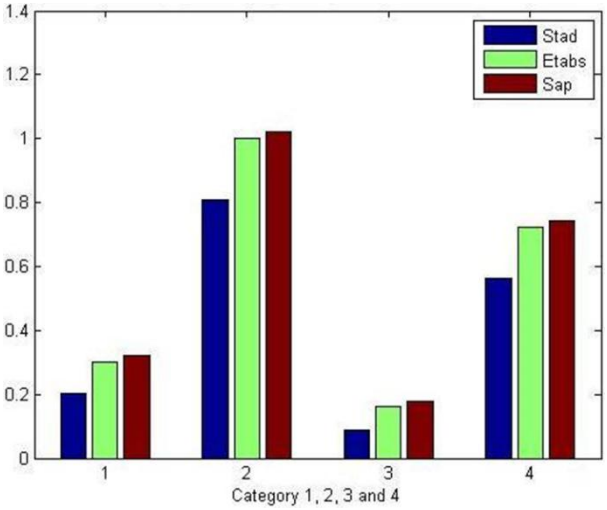

Fig 27: Comparison of Category Wise Structure Strength by using RS method

We have analyzed the designed model for dynamic lateral loading seismic (earthquake) analysis by using Linear Static Method (LS) and Response Spectrum Method (RS). The result of analysis shows that the analysis is formed using four categories. The analysis of model is done using structure analysis software's (i.e. Staad.Pro, ETABS, and SAP). The result shows that Staad.Pro is having better performance in both Linear Static Method (LS) and Response Spectrum Method (RS).

VI. CONCLUSION AND FUTURE SCOPE

The damage caused by recent earthquakes shows that many existing reinforced concrete structures built before the modern design code may be insufficiently constructed to survive a severe earthquake. During severe earthquakes, column hinging cannot be avoided in many structures, particularly for bridge columns. Concrete columns designed and constructed without adequate confinement reinforcement in potential plastic hinge regions are particularly vulnerable. Therefore, retrofitting concrete columns is of paramount importance in the rehabilitation of existing structures. Based on our research we proposed to compare dynamic lateral loading seismic (earthquake) analysis using different software's (i.e. Staad.Pro, ETABS, and SAP). We designed G+16 storey building using Staad.Pro and analyzed the structure for seismic analysis by applying various kind of

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

loads like dead load, live load, combinational load etc. The seismic consideration as per IS 1893:2002.Seimic analysis is done by Linear static method and response spectrum method as per IS recommendations. Our study we come to conclude that staad.pro is having better performance as compared to other software's like ETABS and SAP. The analysis is made taking four categories into consideration.

REFERENCES

[1] Arunkumar, S. and Devi, G.N., 2016. Seismic demand study of soft storey building and its strengthening for seismic resistance. International Journal of Emerging Trends and Technology in Computer Science (IJETTCS), 5(2).

[2] Brighthub Engineering. 2017. Dynamic Load Capacity of Bearing. [ONLINE] Available at: http://www.brighthubengineering.com/machine-design/14856-selection-of-rolling-element-bearings-part-six/.

[3] CHANDLER, A., 1993. Inelastic seismic response of code-designed multistorey frame buildings with regular asymmetry. Earthquake Engineering and Structural Dynamics, 22, p.43lv445.

[4] Chehade, F.H., Sadek, M. and Shahrour, I., 2009, July. Nonlinear global dynamic analysis of reinforced slopes stability under seismic loading. In Advances in Computational Tools for Engineering Applications, 2009. ACTEA'09. International Conference on (pp. 46-51). IEEE.

[5] En.wikipedia.org. (2017). Construction. [online] Available at https://en.wikipedia.org/wiki/Construction.

[6] Gopal Mishra. 2017. TYPES OF SHALLOW FOUNDATIONS IN CONSTRUCITON. [ONLINE] Available at: http://theconstructor.org/geotechnical/types-of-shallow-foundations/5308/.

[7] IS 1893:2002 code of practice "Criteria for earthquake resistant design of structure".

[8] Kumar, E.P., Naresh, A., Nagajyothi, M. and Rajasekhar, M., 2014. Earthquake Analysis of Multi Storied Residential Building-A Case Study. International Journal of Engineering Research and Applications, 4, pp.59-64.

[9] Mehta, G., Sharma, B. and Kumar, A., 2016. Optimization of Member Size and Materials for Multistoried RCC Buildings using ETABS. Indian Journal of Science and Technology, 9(44).

[10] Setia, S. and Sharma, V., 2012. Seismic response of RCC building with soft storey. International Journal of Applied Engineering Research, 7(11), p.2012.

[11] Tesser, R.K., Pilla, L.L., Dupros, F., Navaux, P.O.A., Méhaut, J.F. and Mendes, C., 2014, February. Improving the performance of seismic wave simulations with dynamic load balancing. In Parallel, Distributed and Network-Based Processing (PDP), 2014 22nd Euromicro International Conference on (pp. 196-203). IEEE.

[12] Wikipedia. 2017. Bearing capacity - Wikipedia. [ONLINE] Available at: https://en.wikipedia.org/wiki/Bearing_capacity.

[13] Wikipedia. 2017. Shallow foundation - Wikipedia. [ONLINE] Available at: https://en.wikipedia.org/wiki/Shallow_foundation.