NON-LINEAR SESIMIC PERFORMANCE OF A BUILDING USING BASE ISOLATION DEVICE

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ABSTRACT

Researches in past reviewed for base isolation analysis using response spectrum it is found that the design in ancient time are not sure and safe due to lake of technology and lesser software analysis availabilities. Some countries applied base isolation these days and the building response constructed with base isolation performed better at practical ground. The response of base isolated building is lesser in terms of amplitude and the cost of the building can also be optimized. Many researchers studied for this subject and they concluded that base isolation must be applied in critical seismic zones and the isolators must be used to save lives and properties. It is seen that Indian construction practices are lacking to apply use of base isolation in building design. It is suggested in the end that it must be motivated to study and research base isolation in Indian constrains and conditions.

Keyword *Base isolation, LRB, Friction base, fixed base, Drift, Displacement, SAP 2000.*

1. Introduction

Base isolation is a tool in the hands of engineers practicing construction under earthquake boundary conditions. The principle of bake isolation works like, when building is subjected under seismic vibrations and is provided with fixed base the vibration coming from ground are transferred to building and hence building may fails while providing base isolation disconnects the building from ground and reduces earthquake impact and effects.

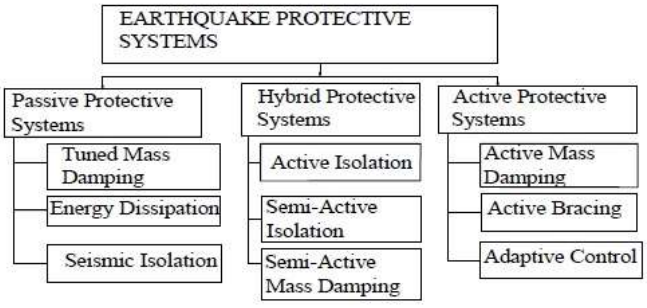

Fig. 1. General diagram of Earthquake protective system

An active control system is one in which an external power source the control actuators are used that apply forces to the structure in a prescribed manner. These forces can be used to both add and dissipate energy from the structure. In an active feedback control system, the signals sent to the control actuators are a function of the response of the system measured with physical sensors (optical, mechanical, electrical, chemical, and so on).

2. BASE ISOLATION

Experiments and observations of base-isolated buildings in earthquakes indicate that building acceleration can be reduced to as little as one-quarter of the ground acceleration.
A. Lead-rubber bearings are frequently used for base isolation. A lead rubber bearing is made from layers of rubber sandwiched together with layers of steel. The bearing is very stiff and strong in the vertical direction, but flexible in the horizontal direction.
B. Friction sliding isolation uses bearing pads that have a curved surface and low-friction materials similar to Teflon. During an earthquake the building is free to slide both horizontally and vertically on the curved surfaces and will return to its original position after the ground shaking stops. The forces needed to move the building upwards limit the horizontal or lateral forces that would otherwise cause building deformations.

3. LITERATURE REVIEW

The researchers are studying and performing research in the field of base isolation to innovate some improved base isolation technique. Both analytical and simulation research is performed to find best type of isolation system on the basis of application and field zone. further expansion and application. The method is advantageous to enhance design quality and reduce design period.

H. Sugihardjo, et al., (2016) A base isolation system is an effective engineering method for reducing seismic impacts by isolating an upper structure from soil vibration due to seismic motion. The primary concept of a base isolation system is the extension of the natural period of a building. However, the production of isolators is very expensive, particularly when an isolator is employed as a residential house's base isolator. To alleviate the issue, a low-cost rubber base isolation system is proposed nonlinear time history analysis (NLTHA) that is based on seven scaled-earthquake records is implemented in one-and two-storey isolated reinforced concrete (RC) residential houses by considering the influence of the isolation ratio. The results indicate that the houses with isolation systems achieved better performance with regard to ductility demand and natural period due to seismic loads. The house with the higher isolation ratio achieved lower ductility demand.

Naveena K and Neeraja Nair (2017) this paper finds that the use of base isolation considerably reduces the response of the structure due to earthquake loading. The significant characteristic of base isolation a system affect the superstructure to have a rigid movement and as a result shows the relative story displacement & story drift of structural element will decrease and consequently the internal forces of beams and columns will be reduced. Due to decrease in lateral loads to stories, the accelerations of the stories are reduced. This results in the reduction of inertia forces. Story overturning moment and story shear are also reduced in base isolated building. From the above points, it is concluded that the performance of isolated structure is efficient in the Earthquake prone areas.

Bhaskar Bhatt, (2017) after much research and development for anti-seismic structures haven't yielded satisfactory results. Studies were being conducted on fixed base structures, but it could be performed on isolated structures. It showed that isolators minimize the lateral load imposed on the structure and reduces size of building components. Base isolation has turned out to be a fruitful design.

Owais Kamran Shaikh and Gitadevi B. Bhaskar, (2018) Modeling and analysis of fixed base and base isolated buildings by using ETABS software and study the effects of earthquake ground motions on these models and study the effectiveness of lead rubber bearing used as base isolation system and carry out comparison between fixed base and base isolated building on the basis of their dynamic properties like maximum shear force, maximum bending moment, base shear, storey drift and storey acceleration. In this manner it could be possible to decide the effectiveness of this base isolation system, giving advices for future possible applications.

4. Methodology

The scope of this project is as follows:
1. In the present study two different structures of each 10 stories (i.e. Rectangular and LShape in plan), of 3mts floor height located in Seismic Zone IV have been considered for this analysis. The plan and the design properties of the structures are shown below.
Self weight of the Structure - 25 KN/ m3
Live load - 3.5 KN/ m3
Thickness of Outer wall - 230mm

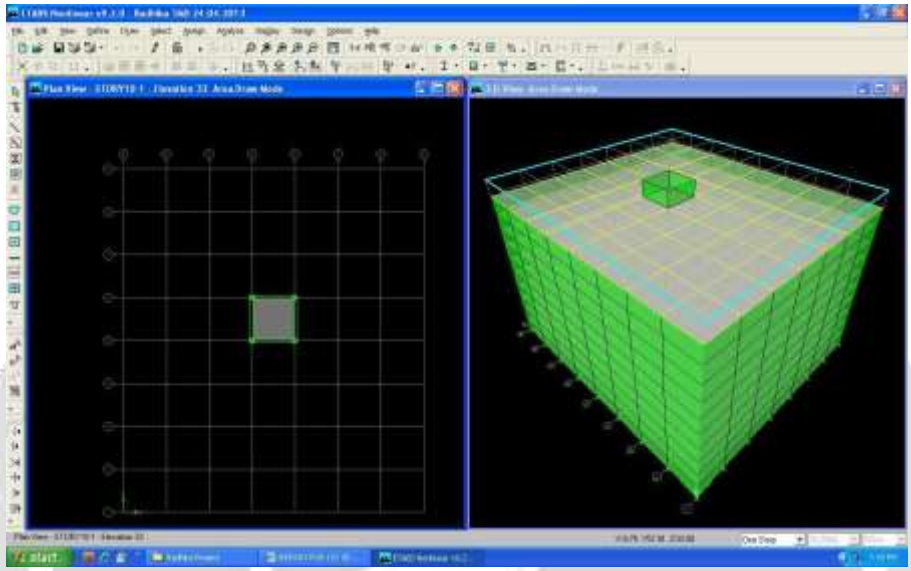

Fig 2 Symmetrical building plan with TMD.

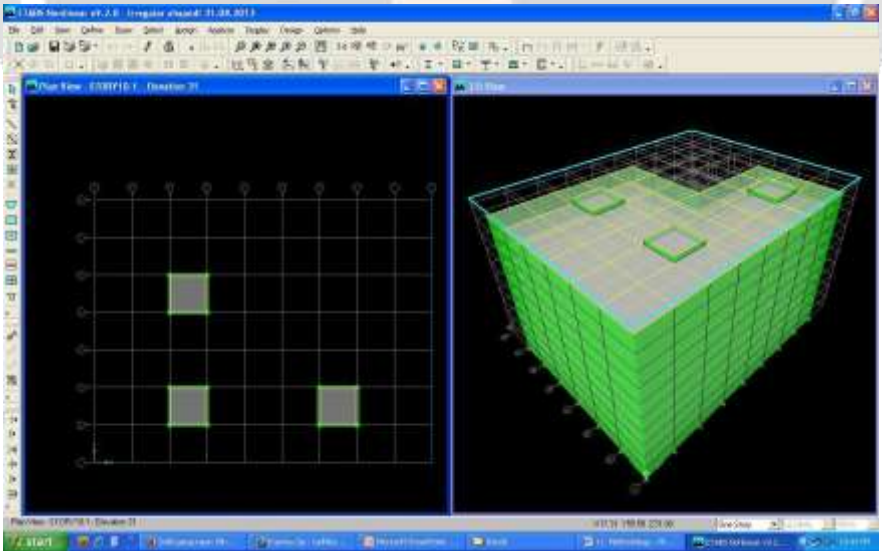

Fig 3 Unsymmetrical Building Plan with TMD.

Non linear Dynamic Time History analysis is done on the above considering R.C.C framed structure by using steel dampers as Tuned Mass Damping Device at top of the building with a damping ratio of 5% using ETABS.

5. Results

In the present study two R.C framed models with ten stories i.e., rectangular in plan and the other is having L-shape in plan. The tuned mass damper was placed at the centre of the grid in plan. Rectangular Plan Building: Placing of Damper in Columns at top of the Building

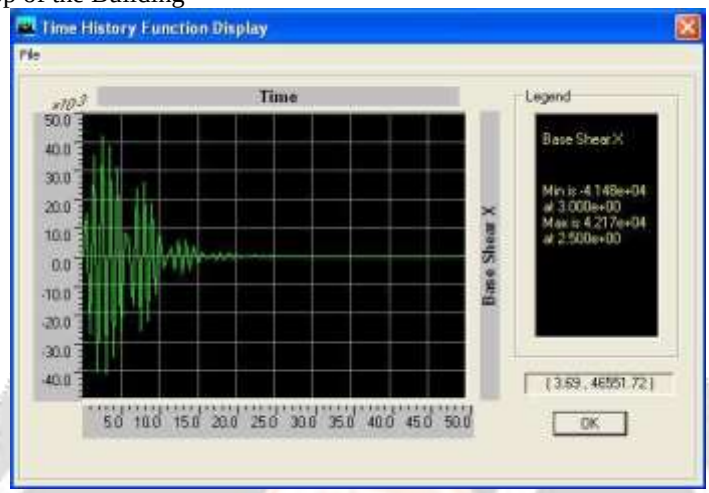

Fig: 4 The Graph Showing between Time Vs Base shear X (Without TMD)

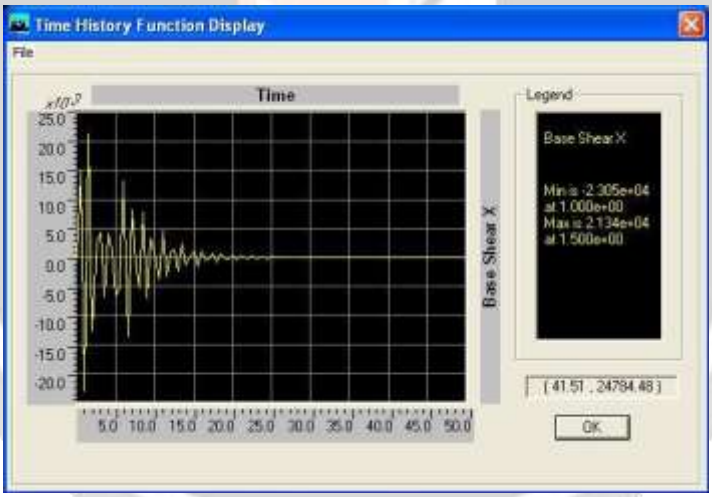

Fig: 5 The Graph Showing between Time Vs Base shear X (With TMD)

Based on the limited studies carried out it is observed that:

- The steel damper provided in columns at top of the building is found to be an effective TMD mechanism.
- Significant contribution from the TMD was noticed when the supports of the columns corresponding to the TMD were hinged.
- The study was carried out approximately keeping the mass of TMD approximately 4% - 5% mass of structure.
- The sizing of the structural elements of the TMD was so made that the frequency of the TMD approximately matches the frequency of the structure.
- From the study it is observed that a suitable TMD can be designed for a particular building using ETABS package.

6. CONCLUSIONS

It is concluded from review that researchers introduces this new technology of base isolation which protects building to damage under seismic action and the results like drift, displacement and base shear are better with building performance in case of base isolation than fixed base. Further some more concluded points are: cost can be optimized using software simulation applications, high rise buildings can be designed for safety using design software's, column beam design can be optimized for size and hence strength, Quality with cost optimization can be designed for future constructions and effective planning and control can be performed for high rise building using simulation and design software's.

7. REFERENCES

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