# "Analysis of RC Building Using Base Isolation and Damper System"

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**Abstract:** An earthquake is a sudden violent shaking of earth which results in great destruction. Due to the sudden violent shaking, a large amount of energy will be released and imparted to the structure. Due to this imparted energy, the structures experiences large displacements, drifts which leads to the failure of the structure. Hence for the safety of structure can be made resistant to seismic activity by vibration control systems. The structure can be made earthquake resistant by techniques such as base isolation and provision of dampers in the structures.

Base isolation is a technique of isolating the structure from the ground such that earthquake effects are reduced to a larger extent. Seismic dampers on the other hand absorb the energy provided by earthquake ground motions to the structure. The present study aims in understanding the seismic response of R C structures when subjected to an earthquake ground motion by using base isolation and dampers as vibration control system and a comparative study is made between the two vibration control systems using ETABS software.

Key Words: Base isolation, Dampers, Vibration Control, Seismic response, Displacements, Drifts, ETABS.

## I. Introduction

Earthquakes have the negative impact on society. It causes loss of human life and heavy economic losses due to building damages. Earthquakes cause damage to structural element as well as nonstructural element of building. Earthquake mainly affects structural components of lateral load resisting system. Earthquake produces huge amount of stresses and deformations on structural element of building. From last few decades structural engineers have been doing research on the characterization and evaluation of structural damage. The different approaches to characterize damage such as ductility, drift ratio, maximum deformation, strain softening and energy dissipation characteristics at component, element or structural level. The number of tall buildings being built is increasing day by day. Today large number of low rise or medium rise and high rise buildings existing in the world. Mostly these structures are having low natural damping So increasing damping capacity of a structural system, or considering the need for other mechanical means to increase the damping capacity of a building, has become increasingly common in the new generation of tall and super tall buildings. But, it should be made a routine design practice to design the damping capacity into a structural system while designing the structural system.

### A. Base Isolation System

Seismic isolation is being used worldwide to protect the structures like buildings, bridges etc., from the destructive effects of earthquakes. In base isolation the base becomes horizontally flexible, which strengthen the structure against earthquakes. There are so many factors and suitability explained for application of base isolation techniques. In seismic isolation, the fundamental aim is to reduce substantially the transmission of the earthquake forces and energy into the structure. This is achieved by mounting the structure on an isolation system with considerable horizontal flexibility so that during an earthquake, when the ground vibrates strongly under the structure, only moderate motions are induced within the structure itself.

### **B.** Dampers

The control of structural vibrations produced by earthquake or wind can be done by various means such as modifying rigidities, masses, damping, or shape, and by providing passive or active counter forces. To date, some methods of structural control have been used successfully and newly proposed methods offer the possibility of extending applications and improving efficiency. The concept of vibration control, using a mass damper, dates back to the year 1909, when Frahm invented a vibration control device called a dynamic vibration absorber. Since 1971, many TMDs have been successfully installed in high-rise buildings and towers all over the world for example, the Citicorp Centre in New York City, the John Hancock Building in Boston, and many observatory towers in Japan and have been reported as being able to reduce wind-induced vibrations. Through intensive research and development in recent years, the dampers has been accepted as an effective vibration control device for both new and existing structures, to enhance their reliability against wind, earthquake and human activity.

## **II.** Methodology

- □ Literature Survey
- □ Study guidelines for base isolation and dampers
- □ Critical study the various provisions of Indian Standard Codes.
- $\hfill\square$  Modeling of structure in Commercial Software
- □ Analysis of structure by using Software
- $\Box$  Comparison of Result

### **III. Research Work**

A detailed literature review of semi-active control systems **Michael D. Symans et. al (1999)** provides references to both theoretical and experimental research but concentrates on describing the results of experimental work. Specifically, the review focuses on descriptions of the dynamic behavior and distinguishing features of various systems which have been experimentally tested both at the component level and within small scale structural models. The semi-active systems which are reviewed include stiffness control devices, electro rheological dampers, magnet orheological dampers, friction control devices, fluid viscous dampers, tuned mass dampers and tuned liquid dampers. The review clearly demonstrates that semi-active control devices have the potential for improving the seismic behavior of full scale civil structures.

T.T. Soonga et. al (2002) studied about passive systems encompass a range of materials and devices for enhancing structural damping, stiffness and strength Also for a specific level of seismic intensity, a designated performance level of the structure is proposed by Fabio Mazza, Alfonso Vulcano (2008) which assumes the elastic lateral storey-stiffness due to the braces proportional to that of the unbraced frame, is combined with the Direct Displacement-Based Design. Fabio Mazza and Alfonso Vulcano (2011) analyzed that the insertion of steel braces equipped with viscoelastic dampers (VEDs) is a very effective technique to improve the seismic or wind behaviour of framed buildings. C C Patel, R S Jangid (2012) examined the dynamic response of two adjacent single-degree-of-freedom (SDOF) structures connected by viscous damper under base acceleration. The base acceleration is modeled as harmonic excitation as well as stationary white noise random process. The governing equations of motion of the coupled structure are derived and solved for relative displacement and absolute acceleration responses. The viscous damper is found to be effective for response control of adjacent structures by connecting with appropriate damping coefficient of damper.

**Faramarz Khoshnudian et. al. (2013)** studied a four-story building with different eccentricities supported on elastomeric isolators with different vibration periods and damping ratios as well as three different records is used to study the effects of vertical component of earthquakes on the seismic behavior of asymmetric steel isolated structures. **Fabio Mazza, Alfonso Vulcano (2014)** also analyzed expressions of the equivalent damping which obtained considering the energy dissipated by the HYDBs and the framed structure. Also they studied a displacement-based design procedure for proportioning hysteretic damped braces (HYDBs) in order to attain, for a specific level of seismic intensity, a design at the performance level of a reinforced concrete (r.c.) in-elevation irregular framed building which has to be retrofitted. **George D., Hatzigeorgiou et.al. (2014)** examines the inelastic response behaviour of structures with supplemental viscous dampers under near-source pulse-like ground motions. **Amir Soltani et. al. (2014)** introduces a simple approach to determine optimum parameters of a nonlinear viscous damper for vibration control of structures. A MATLAB code is developed to produce the dynamic motion of the structure considering the stiffness matrix of an SDOF frame and the non-linear damping effect.

Mehdi Ezati Kooshki et.al. (2015) studied an effective way to protecting of structures against grand motions by new method (semi base isolation system). In the new way structures isn't completely decouple of bases and it changed natural frequency of structures due earthquake by changing horizontal stiffness. The proposed semi base isolation (SBI) system were applied to a one story frame and compared with end fixed frame and the time history analysis was conducted on record of Kobe earthquake (1995), San Fernando (1971) and Santa Barbara (1978), by used finite element software (ABAQUS 6-10-1). The analysis results can shows that the efficiency reduced the floor acceleration and displacement and velocity. This study shows that (SBI) system has great potential in future application of seismic isolation technology. Alaa Barmo et. al. (2015) examined the response of buildings isolated using isolation system hybrid consisting of Lead-Rubber Bearings (LRB), Flat Sliding Bearings (FSB), with the addition of Rotation Fiction Damper (FD) at the base, then compare the results with buildings that have traditional foundation, in terms of the (period, displacement and distribution shear force and height of the of the building).

Pratik M. Vaja, Dr. Vinubhai et.al. (2016), it is observed that viscous damper technique is very significant in order to reduce the seismic response of RC Structure as compared to fixed base building and control the damages in structure during strong ground shaking. R. Patel et.al. (2018) studied viscous damper is used to reduce the seismic response of the structure which is subjected to earthquake load. Non-linear time history analysis is used for dynamic analysis. After the analysis of the structure the results obtained are

compared and iterated to obtain the final values of the damper properties. H. A. Admane et.al. (2017) has been found that the TMD can be successfully used to control vibration of the structure.Simple TMD with optimum frequency ratio, provided in the form of soft story at building top is found to be effective in Reducing seismic response of building. Applying the three earthquake loadings first is the corresponding to compatible time history in the EL-Centro earthquake. A Soft story at the top of building reduces top building deflection about 20%-61.Second is the corresponding to compatible time history in the Northridge earthquake a soft story at the top of building Reduces top building deflection about 6%-15%. Third is the corresponding to compatible time history in the Taft earthquake a soft story at the top of building reduces top. Building deflection about 38%-67% Among 2% to 5% tmds 5% TMD is found better than 2%, 3%, 4% tads in reducing displacement.

#### **IV. Future Scope**

In recent years, considerable attention has been paid for the development of structural control and become an important part of designing new structures to resists the hazardous forces. There have been significant efforts by researchers to investigate the possibilities of using various control methods to mitigate earthquake hazards. Controlling seismic behaviour is possible only through faithful design that ensures all behavioural actions considered in buildings during analysis. Also, there is a need to work on the following areas to overcome the gap areas.

1.National level guidelines and codes are not available presently for the reference of engineers and builders.

2. Engineers and scientists have to accelerate the pace of their research work in the direction of developing and constructing base isolated structures with tunned mass dampers and come out with solutions which are simple in design, easy to construct and cost effective as well.

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