ISSN : 2455-9679
Impact Factor : 4.256

IJRTSM

INTERNATIONAL JOURNAL OF RECENT TECHNOLOGY SCIENCE & MANAGEMENT

"ANALYSIS OF THE SEISMIC RESPONSE OF A STEEL REINFORCED CONCRETE BUILDING USING THE BASE ISOLATION TECHNIQUE - A REVIEW"

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ABSTRACT

Since there are more earthquake-prone regions in the world, structural engineers are expected to design our buildings to withstand the effects of earthquakes. We strive to satisfy a single fundamental equation, which states that capacity is larger than demand, for all possible load scenarios we may encounter during the design process, such as gravity and wind.

The widespread loss of lives and property as a result of severe earthquakes justifies the adoption of strategies to reduce the amount of ground motion that occurs during an earthquake in order to save lives and property in the aftermath. The main use of the foundation isolation technique is to shield any concrete building from the destructive effects of seismic attacks. It is one of the most successful strategies and has grown in popularity over the past three decades. This occurs as a result of the base isolation technique, a flexible base that largely decouples the structure from ground motion, and the fact that structure reaction accelerations are typically lower than ground acceleration. This project uses the Response Spectrum approach for dynamic analysis, adopting base isolation techniques and supplying base isolators like laminated neoprene pads with various diameters and a thickness of 160 mm.

Keyword: *Earthquake; base isolation; concrete structure; response spectrum method; foundation; laminated neoprene pads.*

I. INTRODUCTION

Earthquake is the sudden release of accumulated energy in the tectonic plates of the earth crust and resulting in propagation of seismic waves called P waves, S waves and surface waves. Earthquake occurs at the faults at boundaries the tectonic plates, causing colliding, separation, sliding, or sub ducting between the adjacent plates. A large proportion of world's population lives in regions of seismic hazards at risk from earthquakes of varying severity and frequency of occurrence earthquake causes significant loss of life and damage of property every year.

The modern seismic design primarily works upon the inelastic response of the structural members and systems to dissipate the energy imparted to a structure by an earthquake. In recent years, base isolation technique has been applied for structural design technique for buildings in highly seismic areas. The objective of seismic isolation system is to decouple the building structure from the damaging components of the earthquake input motion. The decoupling prevents the superstructure of the building from taking down the earthquake energy.

The basic concept of base isolation is to uncouple a structure from the ground by interposing a flexible element/bearing between structure and foundation. Seismic base isolation is a new technique that diminishes the effects of an

ISSN : 2455-9679
Impact Factor : 4.256

earthquake by essentially isolating the structure and its contents from potentially dangerous ground motion especially in the high frequency range where the building is most affected.

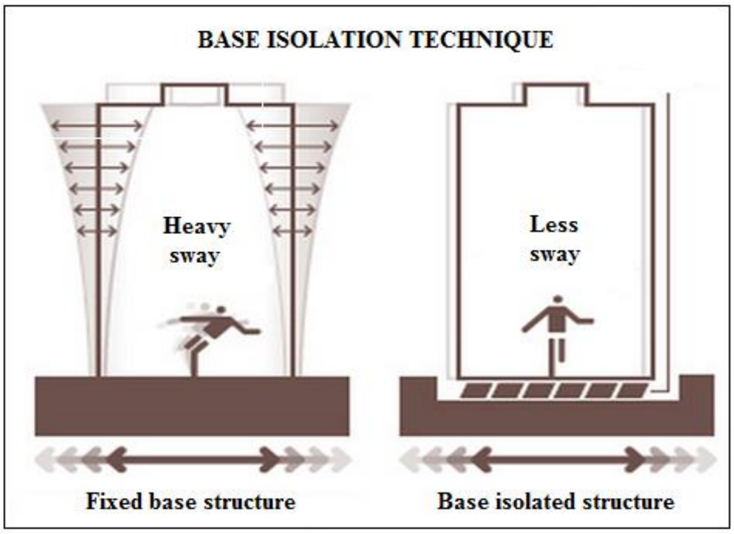

Figure 1: Base isolation in buildings

Base isolation consists of energy dissipation core (lead plug), vulcanized rubber layers, steel reinforcing plats, bottom mounting plate and over rubber. Energy dissipation core reduces earthquake forces and displacements by energy displacements by energy dissipation and also it provides wind resistance. Rubber layers provide lateral flexibility to the systems. Steel reinforcing provides vertical load capacity and also it confines lead core. A bottom mounting plate is incorporated with the isolator to be connected with the structure below and above isolator. Rubber is used to protect the steel plate.

In seismic isolation, the elementary aim is to reduce substantially the transmission of the earthquake forces and energy into the structure. This reduction in transmission 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.

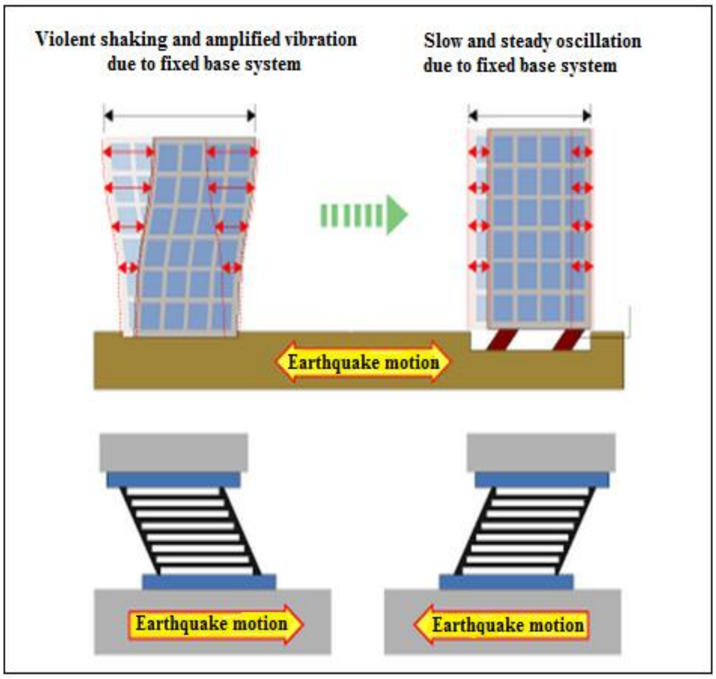

Figure 2: Response of buildings

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II. LITERATURE REVIEW

Davis and Menon (2004) concluded that the presence of masonry infill panels modifies the structural force distribution significantly in an OGS building. The total storey shear force increases as the stiffness of the building increases in the presence of masonry infill at the upper floor of the building. Also, the bending moments in the ground floor columns increase (more than two fold), and the mode of failure is by soft storey mechanism (formation of hinges in ground floor columns).

Fumiaki Arima1 et al., (2000) they invented the new base-isolated system called Crossed Linear Bearings (CLB) which enables isolation application to lightweight houses or high-rise buildings or cylindrical structures. This system was developed to overcome the "restriction on application" which is caused by engineering problems such as buckling, or tensile failure when using conventional multi-rubber- bearing systems. Many experimental data or earthquake records have been examined in comparison with theory and analysis. The system demonstrated effective performance on response control, and it was verified that CLB has sufficient ground to be put into application. Based on this recognition, several buildings have already been constructed utilizing CLB systems.

Peng-Hsiang and Charng (1998) the benefits of implementing a seismic isolation system were investigated by comparing the performance of base isolated, segmental and fixed base multi-storey buildings. With the inclusion of seismic isolation devices, the base isolated and segmental buildings with elasto-plastic and bilinear isolation devices have; significantly reduced top floor deflections, accelerations, inter storey drifts and base shears when compared with the fixed base building.

Soong and Dargus et al., (1997) Using seismic isolation devices/systems to control earthquake induced vibration of bridges and buildings is considered to be a relatively matured technology and such devices have been installed in many structures world-wide in recent decades. Design guidelines have been established and they are periodically improved as new information based on research and or field observations become available during the past 20-30 years.

III. EXPERIMENTAL STUDY

3.1. Plan Dimension of the Structure

The structural plan of the multi-storey building taken for the purpose of this research will be of 15.25 m x 30.50 m. The different span of 4.9 m, 3.6m and 4.9 m has been taken for the analysis. The building will have 7bays in the longitudinal direction and 3 bays in the short direction. The height of the building has been taken a 28.0m and each storey of height 4.0m.

3.2. Objectives

- To study the behaviour of structural elements of a structure.
- To study response of the whole structure during earthquake combined with various loads such as gravity loads, live loads, wind loads, earthquake loads.
- To evaluate and compare the parameters like time period, base shear and displacement of the structure under various configuration of base isolation.

IV. RESEARCH METHODOLOGY

The methodology adopted for the study is to create four structural models varying the base configurations with typical structural members using standard structural analysis software STAAD. Pro to compute parameters like time period, displacement and base shear of the structure.

The base configuration of the structure is varying from fixed support condition to fully base isolated. For structural analysis gravity loads, live loads, wind loads and earthquake loads are considered. After carrying out analysis of these models, the time period, base shear, displacement, design of beam, column and foundation for various models are computed.

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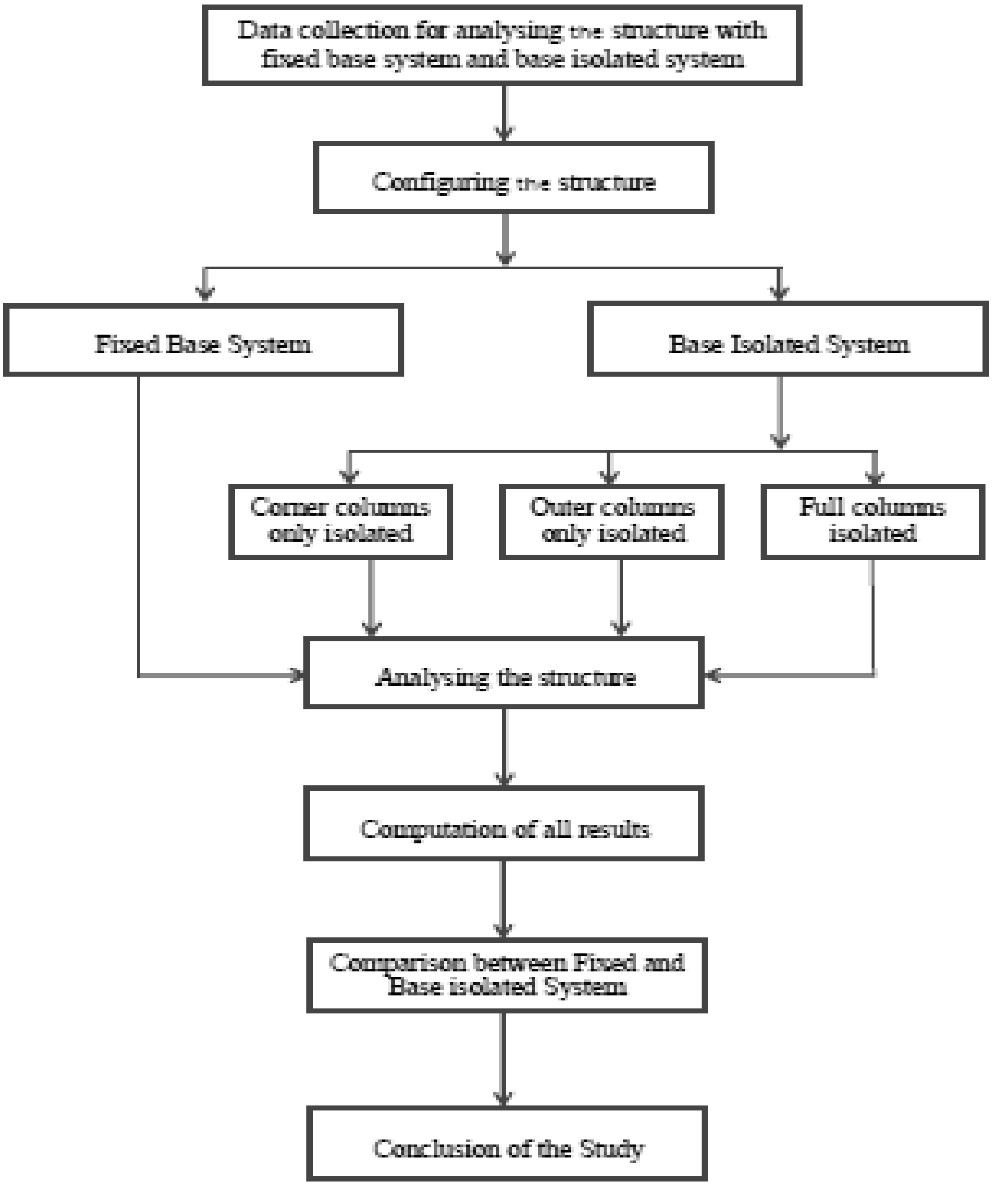

Figure 3: Flow chart of the methodology adopted

V. Result

In fixed base building time period increases when the storey height increases this implies that increased dead load and live load of multi storey building absorbs the considerable ground motion for the fixed base building. The base shear decreases non-linearly when the height of building increases. The displacement increases proportionately when the height of building increases. It is suggested that building which has more importance are recommended to design structure with base isolation to reduce the effect of earth quake in the structure. Further research is required for preparation of draft code or design aid in the near future is indispensible, as there is neither design aid nor standard code for a seismic design of multi storey building using base isolators in India.

VI. Scope of the work

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