International Journal of Engineering, Science and Mathematics
Vol. 7,Issue6,June 2018,
ISSN: 2320-0294 Impact Factor: 6.765
Journal Homepage: http://www.ijesm.co.in, Email: ijesmj@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gage as well as in Cabell's Directories of Publishing Opportunities, U.S.A

SENSITIVITY ANALYSIS OF LEAD RUBBER BEARING ISOLATOR FOR RC SHEAR FRAME

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ABSTRACT

A primary goal of seismic provisions in building codes is to protect life safety through prevention of structural collapse. To achieve this goal major factors, which results in uncertainties of the structural responses should be recognized. Uncertainty is generally costly in earthquake engineering because of the large amount of the parameters that should be considered for its calculation. Endurance time method is basically a dynamic procedure that tries to predict seismic performance of structures by analyzing their resilience when subjected to predesigned intensifying dynamic excitations.

In most earthquakes, the collapse of structures like houses, schools, hospitals, historic and public buildings results in the widespread loss of lives and damage. Earthquakes also destroy public infrastructure like roads, dams and bridges, as well as public utilities like power and water supply installations. Past earthquakes show that over 95 percent of the lives lost were due to the collapse of buildings that were not earthquake-resistant. Though there are building codes and other regulations which make it mandatory that all structures in earthquake-prone areas in the country must be built in accordance with earthquake-resistant construction techniques, new constructions often overlook strict compliance to such regulations and building codes. A large number of buildings in India have been constructed without due consideration to earthquake loads. Further, the earthquake loads are also under continual revision in successive revisions of codes. Buildings also deteriorate with time and get damaged due to earthquake, flood, fire, blast, etc. All these circumstances require evaluation and retrofitting of existing building.

Key words: seismic, Earthquakes, construction techniques, deteriorate, retrofitting.

I INTRODUCTION

India's high earthquake risk and vulnerability is evident from the fact that about 59 percent of India's land area could face moderate to severe earthquakes. During the period 1990 to 2006, more than 23,000 lives were lost due to 6 major earthquakes in India, which also caused enormous damage to property and public infrastructure. The occurrence of several devastating earthquakes in areas hitherto considered safe from earthquakes indicates that the built environment in the country is extremely fragile and our ability to prepare ourselves and effectively respond to earthquakes is inadequate. During the International Decade for Natural Disaster Reduction (IDNDR) observed by the United Nations (UN)

in the 1990s, India witnessed several earthquakes like the Uttarkashi earthquake of 1991, the Latur earthquake of 1993, the Jabalpur earthquake of 1997, and the Chamoli earthquake of 1999. These were followed by the Bhuj earthquake of 26 January 2001 and the Jammu & Kashmir earthquake of 8 October 2005. In addition to recent earthquake in India,moderate earthquake near the East Nepal/India board (5magnitude), strong earthquake in Kashmir (5.6magnitude), moderate earthquake near the India/Tibet board (5.1magnitude) Uttaranchal, etc.
All these major earthquakes established that the casualties were caused primarily due to the collapse of buildings. However, similar high intensity earthquakes in the United States, Japan, etc., do not lead to such enormous loss of lives, as the structures in these countries are built with structural mitigation measures and earthquake-resistant features.

II OBJECTIVES AND METHODOLOGY

The following are the objectives of present work,

- To check the performance of LRB for Sensitivity of mass and stiffness on LRB isolator.
- To compare the performance of a base isolated structure with fixed base.
- To find out the response of the RC frames by time history analysis using finite element.
- To determine the parameters like frequency base shear force stiffness for vertical irregularity building.
- To determine the variation of natural frequency with respect to mass and stiffness etc.

(b)Methodology

- ETABS is a special-purpose computer program developed specifically for building structures. It provides the Structural Engineer with all the tools necessary to create, modify, analyze, de sign, and optimize building models.
- An engineering software product that caters to multi-story building analysis and design.
- Modeling tools and templates, code-based load prescriptions, analysis methods and solution techniques, all coordinate with the grid-like geometry unique to this class of structure.
- Basic or advanced systems under static or dynamic conditions may be evaluated using ETABS.

ETABS added computationally complex analytical options such as dynamic nonlinear behavior, and powerful CAD-like drawing tools in a graphical and object-based interface. Although ETABS Version 9 looks radically different from its predecessors of 30 years ago, its mission remains the same: to provide the profession with the most efficient and comprehensive software for the analysis and design of buildings. To that end, the current release follows the same philosophical approach put

forward by the original pro-grams, namely:
Most buildings are of straightforward geometry with horizontal beams and vertical columns. Although any building configuration is possible with ETABS, in most cases, a simple grid system defined by horizontal floors and vertical column lines can establish building geometry with minimal effort.

Many of the floor levels in buildings are similar. This commonality can be used to dramatically reduce modeling and design time. The input and output conventions used correspond to common building terminology. With ETABS, the models are defined logically floor-by-floor, column-by-column, bay-by-bay and wall-by-wall and not as a stream of non-descript nodes and elements as in general purpose programs. Thus the structural definition is simple, concise and meaningful. In most buildings, the dimensions of the members are large in relation to the bay widths and storey heights. Those dimensions have a significant effect on the stiffness of the frame. ETABS corrects for such effects in the formulation of the member stiffness, unlike most general-purpose programs that work on center-line-to-centerline dimensions. The results produced by the programs should be in a form directly usable by the engineer. General-purpose computer pro-grams produce results in a general form that may need additional processing before they are usable in structural design.

III Design of Lead Rubber Bearings

Lead rubber bearings (LRBs) are usually made of alternating layers of steel plates and natural rubber with a central hole into which the lead core is press-fitted. When subjected to lateral shear forces, the lead core deforms almost in pure shear, yields at low level of shear stresses, approximately 8 to 10 MPa at normal (20°C) temperature, and produces rather stable hysteretic deformation behavior over a number of cycles. One feature of the lead core is that it can recrystallize at normal temperature and will not encounter the problem of fatigue failure under cyclic loadings. Sufficient rigidity is always ensured by the LRBs for the structure under service loads. In this section, the design procedure for LRBs is outlined. Materials of lead rubber bearing modelled as bilinear model and consists of Rubber, steel, Lead cores, Mounting plate. (Steel mounting plate and top mounting plate)

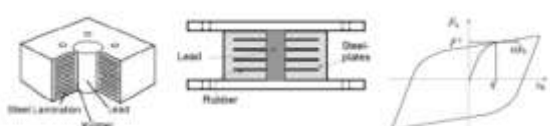

Fig 1: Lead Rubber Bearing

IV DESIGN CRITERIA (AS PER IS 1893-2002)

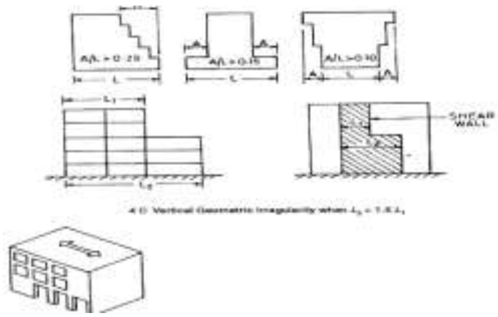

Fig 2: Geometrical irregularity in vertical direction.

V Modeling & Description

MODEL SPECIFICATION

BUILDING 1(with base isolator)

Number of stories = 12

Story height

Bottom storey = 3.1m

Other storeys = 3.1m

Link element = 0.4m

Number of lines along x = 5

Number of lines along y = 2

Storey width

Along x = 24m

Along y = 6m

Structural elements dimension

Beam size =0.45 x 0.6m

Column size =0.45m x0.1m

Slab thickness =0.20m

Wall thickness =0.25m

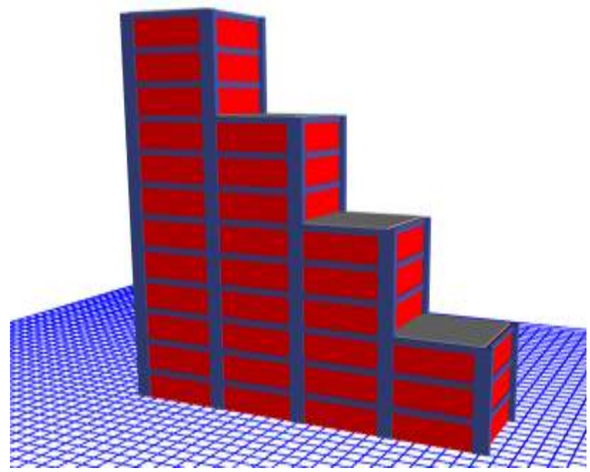

Fig 3: Vertically irregular buiding modeled in Etabs.

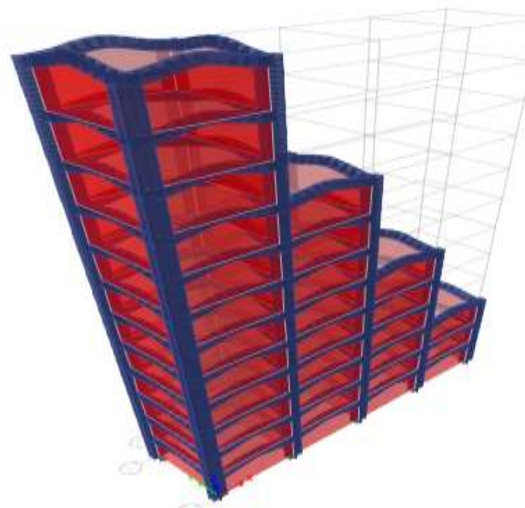

Fig 4: Vertically irregular buiding modeled in Etabs (Isometric view).

CONCLUSIONS

The symmetric and asymmetric fixed base and base isolated building will be compared for parameters such as maximum shear force, torsion etc. Effectiveness of base isolation is studied by considering bilinear model of the LRB. The vibration control technology is developed and its application is spread in various fields of engineering structures. Factories, hospitals and residential houses will be protected from environmental vibration

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