ANALYSIS OF VIBRATION DUE TO SEISMIC WAVE ON (G+9) STORY RESIDENTIAL BUILDING WITH AND WITHOUT ELASTOMERIC DAMPERS BY RESPONSE SPECTRUM METHOD FOR ZONE 3

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ABSTRACT-Vibration induced on g+9 building are in form of relative displacement ,floor acceleration, story drift, soft story, and diaphragm, etc. are consider and analyse by response spectrum method for seismic zone 3 with the help of etabs software . In this paper we consider only flow path of the dissertation, theory behind them and literature review for g+9 building.

KEY WORDS- seismic zone, vibration, response spectrum, ETABS.

1. INTRODUCTI0N-

Vibration is the motion of a particle or a body or a system of concentrated bodies having been displaced from position of equilibrium, Vibration in structural system may result from dynamic wave such as wind, earthquakes, waterways, and operating equipments. Out of these earthquake are the most important in term of their enormous potential for damage to structure and loss of lives.

The basic concept of conventional earthquake analysis aims to provide an acceptable structural performance level during the earthquakes. This level is usually dictated by the importance of the building and by the local authorities. The most common design philosophy is a non-collapse requirement under strong and rare earthquakes, while structures are also expected to experience no damage under more frequent and weaker earthquakes.

A variety of approaches of earthquake protection has been proposed, including base isolation, passive dissipative devices, and active or semi-active control devices. The focus of this research is on passive dissipative devices, and more specifically on elastomeric dampers. Their main advantages compared to other types of dissipative devices include their contribution of both stiffness and damping to the structure regardless the type of external loading their low dependence on loading frequency compared to similar type of visco-elastic dampers, and their full recovery after the removal of the source which created the deformation.

1.1 RESEARCH OBJECTIVE -

Vibration on g+9 building is in the form of relative displacement, floor acceleration, interstorey drift, soft storey and diaphragm are analyze with and without elastomeric damper by response spectrum method .

In this thesis first make a model of g+9 building with fixed base on etabs software and analyse by response spectrum method. Second make a model of g+9 building with isolated base for isolation use elastomeric dampers (LRB) and manually design it, after designing put the result on etabs software and the vibration induced in both the case are compare.

2. LITERATURE RIVIEW:

2.1GENERAL -

The purpose of the dissertation is to elaborate the modelling and analysis of Response spectrum of lead rubber bearing and base isolation system through etabs software. A number of researches have been carried out and a gentle number of enquiries are available in the literature on the above topics. However those enquire that is related to the Natural Frequency, modes of structures, stress and strain, Finite Element Modelling and meshing.

(2.1.2) LITRATURE REVIWES FOR LEAD RUBBER BEARING

Table (1.1) LIST OF RESEARCHERS REVIEWS FOR LEAD RUBBER BEARING

Serial no.	RESEARCHER	YEAR	CONTENT
1	Christos a. basagiannis.	2018	Seismic design and evaluation of moment resisting frames using elastomeric dampers.
2	Ms.MinalAshok Somwanshi and Mrs. Rina N. Pantawane	2015	Seismic Analysis of Fixed Based and Base Isolated Building Structures
3	radmila b. salic , mihail a. garevski and zoran v. milutinovic	2008	Response of lead-rubber bearing isolated structure.
4	V. Kilar1 and D. Koren	2008	usage of simplified n2 method for analysis of base isolated structures
5	Amit Thakur	2015	design of base isolators for a 5-storeyed building with isolator's analysis in abaqus
6	A. B. M. Saiful Islam, M. Jameel, M. A. Uddin and Syed Ishtiaq Ahmad	2011	Simplified design guidelines for seismic base isolation in multi-storey buildings for Bangladesh National Building Code (BNBC)
7	Aamir Riyaz DarSimranjit Singh	2019	dynamic analysis of the base isolated tubular tall building system (leadrubber bearing) in etabs
8	Shen-Haw Ju, Cheng-Chun Yuantien and Wen-Ko Hsieh	2020	Study of Lead Rubber Bearings for Vibration Reduction in High-Tech Factories
9	M. Bello1, A.A Adedeji2, R.O. Rahmon3, and M.A. Kamal4	2017	Dynamic Analysis of Multi-Storey Building under Seismic Excitation by Response Spectrum Method using ETABS
10	Sai Gowtham Dasari, K. Srinivasa Rao	2020	Seismic and Time History Performance of RCC Framed Buildings with and without Passive Energy Dissipators

(2.1.3) LITERATURE REVIEW FOE LEAD RUBBER BEARING-

1. Christos a. basagiannis.- seismic design and evaluation of moment resisting frames using elastomeric dampers.

Summary: This study evaluates the characteristics of elastomeric dampers, and assesses their effectiveness in mitigating the effects of dynamic loading. As part of this evaluation a series of characterization tests were carried out in order to extract the main mechanical properties of the elastomer material in a range of strain amplitudes, loading frequencies, and ambient temperatures, since it has been proved that elastomeric materials depend on these parameters.

Based on the Generalised Maxwell Model, a new hysteretic model was developed and proposed in this thesis which is able to capture the behaviour of the material. As part of this model an equation was derived which describes the force-displacement relationship of the Generalised Maxwell Model for N Maxwell elements in time domain, and formed the basis for the proposed model.

2. Ms.MinalAshok Somwanshi and Mrs. Rina N. Pantawane- Seismic Analysis of Fixed Based and Base Isolated Building Structures.

Summary: This work deals with modeling and analysis of 13-storey rigid jointed plane frame for two cases. First case is fixed base and second case is base isolated. Modeling and analysis is done using E-TABS software for Bhuj earthquake ground motion records. Maximum vertical reaction is obtained from analysis in E-TABS software. Using this vertical reaction and total mass of structure lead rubber bearings are designed manually. Time-history analysis is carried out in order to evaluate floor response, accelerations and displacements during a ground motion. This paper intends to demonstrate how an isolation system can be efficient, evaluating its effectiveness for the building in terms of maximum shear force, maximum bending moment, base shear, storey drift and storey displacement reductions.

3. Radmila b. salic, mihail a. garevski and zoran v. milutinovic- response of lead-rubber bearing isolated structure.

Summary: A GF+7 storey, orthogonally almost symmetric, shear wall residential tower building has been studied in all details in order to clarify the influence of lead-rubber bearings (LRB) seismic isolation upon its seismic performance. The ambient vibration measurements of the building have been performed by 6 GPS synchronizedMICROMED's TROMINO seismometers, out of which 2 TROMINOs were fixed at the top of the building for providing GPS associated 3D ambient vibration recordings during the entire course of the measurement (4hours). Mobile set of 4 TROMINOs has been used to acquire GPS synchronized recordings at all 4 corners and each storey of the building.

Mode shapes, natural frequencies and damping ratios of the existing fixed-base building are obtained by ARTeMIS (Ambient Response Testing and Modal Identification Software) processing of the acquired signals and used for verifying the formulated analytical model.

The LRB seismic isolation system consisting of 32 LR bearings has been designed for maximum expected earthquake in accordance with USB-97 code provisions. Four different real-earthquake time history acceleration records were used to quantitatively define and compare nonlinear responses of fixed-base and LRB isolated structures. The paper details the results and findings of this study that result in substantial elongation of the fundamental period as well as reduction of interstory drifts, floor accelerations and base shear of isolated relative to fixed-base building.

4. V. Kilar1 and D. Koren- usage of simplified n2 method for analysis of base isolated structures.

Summary- The paper examines the usage of a simplified nonlinear method for seismic analysis and performance evaluation (N2 method) for analysis of base isolated structures. In the paper the N2 method is applied for analysis of a fixed base and base isolated simple four-storey frame building designed according to EC8. Two different sets of base isolation devices were investigated: a simple rubber (RB) and a similar lead rubber bearing (LRB) base isolation system. For each system a Soft, Normal and Hard rubber stiffness and three different damping values were used. The paper shows how we can obtain base displacement and top (relative) displacement for different bearing stiffness and selected damping. The target base displacement was determined as a intersection of the capacity curve of single degree of freedom system with rigid behavior of the superstructure and demand spectrum curve for selected damping of isolators. In the following step the pushover analysis of the whole isolated structure was performed up to the target base -displacement using constant load distribution. The results are presented in terms of base and top displacements and ductility factors for those base isolation systems which were not able to protect the superstructure. It has been shown in the paper that N2 method might be a valuable tool for design, analysis and verification of behavior of base isolated structures with different linear or nonlinear seismic devices. Nonlinear pushover analyses were performed with the computer program SAP2000.

5. Amit Thakur- design of base isolators for a 5-storeyed building with isolator's analysis in abaqus.

Summary- Forced vibration analysis was carried out on the framed structure by the use of computer program ABAQUS 6.13 and validating the same experimentally. The isolation system reduces the interstorey drift in the superstructure by a factor of at least two and sometimes by a factor of at least five. Acceleration responses are also reduced in the structure by an amount of although the amount of reduction depends upon the force deflection characteristic of the isolators. Better performance of isolated structure with respect to the fixed base structure is also observed in floor displacements, base shear floor acceleration relative to the ground(less acceleration imparted on each floor and their magnitude is approximately same in each floor), roof displacement. Introduction of horizontal flexibility at the base helps in proper energy dissipation at the base level and reducing the seismic forces in the super structure which are considered during design. For Comparison Building is designed with fixed base and with base isolator, and storey drift, displacement, velocity and acceleration are compared for both the structures. Then Manual Designing of the Isolator is done and analysis of that isolator is done in ABAQUS Software.

6. A. B. M. Saiful Islam, M. Jameel, M. A. Uddin and Syed Ishtiaq Ahmad- Simplified design guidelines for seismic base isolation in multi-storey buildings for Bangladesh National Building Code (BNBC).

Summary- Seismic base isolation is now a days moving towards a very efficient tool in seismic design of structure. Increasing flexibility of structure is well achieved by the insertion of these additional elements between upper structure and foundation as they absorb larger part of seismic energy. However in Bangladesh, this research is still young for building structures. Therefore, this is a burning question to design isolation device in context of Bangladesh. Effort has been made in this study to establish an innovative simplified design procedure for isolators incorporated in multi-storey building structures. Isolation systems namely lead rubber bearing (LRB) and high damping rubber bearing (HDRB) have been selected for the present schoolwork. Numerical formulation and limiting criteria for design of each element have been engendered. The suitability to incorporate isolation device for seismic control has been sight seen in details. The study reveals simplified design procedures for LRB and HDRB for multi-storey buildings in Bangladesh. The detail design progression has been proposed to be included in Bangladesh National Building Code (BNBC).

7. Aamir Riyaz Dar, Simranjit Singh- dynamic analysis of the base isolated tubular tall building system (lead rubber bearing) in etabs.

Summary- *In case of dynamic analysis of tall buildings, the various important dynamic characteristics of tall building namely, the natural frequency (ω,radians/second) or simply time period (T, seconds),lateral displacement, base shear and overturning moment of tall buildings using ETABS software. In this paper, an approximate procedure is generated to perform the seismic analysis of simple and tubular tall building system with base isolation (lead-rubber bearings) system and the outcome compared with the results obtained without base isolation (lead-rubber bearing) of tall buildings. Base isolation system is basically a passive control device which decouples the super structure from substructure resting ground motion by insinuating structural elements with low horizontal stiffness between the structure and foundation. This analysis of G+29 rigid joint plane RCC frame has for four cases. First case is simple RCC frame with fixed base and with base isolation (LRB), second case is simple tube RCC frame with fixed base and with base isolation (LRB), third case is tube in tube system RCC frame with fixed base and with base isolation (LRB) and fourth case is bundle tube system RCC frame with fixed base and with base isolation (LRB) .The effectiveness of base isolation in every cases is compared ETABS software and for design purpose of base isolated system 1893:2002 with simple frame and tubular system cases. This analysis is done by using (part1) and for seismic design of isolated structures (F.Naeim and J.M.Kelly).*

8. Shen-Haw Ju, Cheng-Chun Yuantien and Wen-Ko Hsieh- Study of Lead Rubber Bearings for Vibration Reduction in High-Tech Factories.

Summary- This paper studies the seismic and micro vibrations of the high-tech factory with and without lead rubber bearings (LRBs) using the three-dimensional (3D) finite element analysis.The soil-structure interaction is included using the p-y, t-z, and Q-z nonlinear soil springs, while the time-history analysis is performed under seismic, wind, or moving crane loads. The finite element results indicate that the moving crane does not change the major ambient vibrations of the factory with and without LRBs. For a normal design of LRBs, the high-tech factory with LRBs can decrease the seismic base shear e_ciently but will have a much larger wind-induced vibration than that without LRBs, especially for the reinforced concrete level. Because micro-vibration is a major concern for high-tech factories, one should use LRBs with a large initial stiffness to resist wind loads, and use a small final LRB sti_ness to reduce the seismic load of high-tech factories. This situation may make it difficult to obtain a suitable LRB, but it is an opportunity to reduce the seismic response without increasing the micro-vibration of high-tech factories.

9. M. Bello, A.A Adedeji, R.O. Rahmon, and M.A. Kamal- Dynamic Analysis of Multi-Storey Building under Seismic Excitation by Response Spectrum Method using ETABS.

Summary- In the year 2016 two earth tremors occurred in Kaduna State with moment magnitude of 2.6 and intensity 3 and it has been described as mini-earthquake by the center of geodesy and geodynamic Toro, the tremor caused a huge rock to cracks on three different spots on a large rock, located at Hayin Magina of the area. Aside that, many houses were affected, with visible cracks on their walls and other areas. The dynamic analysis of RC structures has to be carried out in other to understand the behaviour of the structure under seismic excitation. The main aim of this paper is to determine the maximum deflection of the building under earthquake excitation. To understand the behaviour of the structure under earthquake excitation**,** a dynamic analysis has been conducted using ETABS. A three-dimensional model of the structure was created to undertake the linear analysis. The properties (section and material) of the model are assigned. After this, the dynamic analysis is performed. From the response spectrum analysis performed according to EC8 with a ductility value of q=1.5 in the building by applying the SRSS spectra along both directions (X and Y) of the building in the structural axes, the maximum response displacement and storey drift is at storey four in Y direction of the building.

10. Sai Gowtham Dasari, K. Srinivasa Rao- Seismic and Time History Performance of RCC Framed Buildings with and without Passive Energy Dissipators.

Summary- In the present study, an RC framed building is modelled and analysed under Southern Sumatra and Chile earthquakes to evaluate the performance of the structure and its elements with and without energy dissipators. For the study, a model (G+19) with and without energy dissipators is modelled in ETABS. The seismic force is applied based on the time history data of the models pertaining to Southern Sumatra and Chile Earthquake. Response Spectrum analysis has been carried out to find the lateral displacements, storey shear and Base shear for the model with and without dampers. The lateral displacement, storey drift, storey shear and Base shear are found to less for the model with Linear FVDs when compared to the model with Non-Linear FVDs and without FVDs.

CONCLUSION: vibration due to seismic wave on multistory building are depends on the force exerted during the earthquake and mainly depends on quality and quantity of earthquake. In my case for that situation we will use the elastomeric dampers for reducing effect of seismic energy at that time buildings are safe for some amount. In this paper the thought of some researchers are examine and learn the knowledge behind them.

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