Time History Analysis of High Rise Structure using Different Accelerogram

Shashank R. Bedekar[1] Prof. Rakesh Shinde[2]
[1]P.G. Student [2]Assistant Professor
[1,2]Department of Civil Engineering
[1,2]Late G. N. Sapkal C. O. E., Nashik, Maharashtra, India

Abstract— Time history analysis is an important technique for structural seismic analysis especially when the evaluated structural response is nonlinear. To perform such an analysis, a representative earthquake time history is required for a structure being evaluated. This research paper describes the results of an extensive study on the seismic behavior of structure under two earthquakes (Bhuj, & Koyna). In this work an attempt is made to analyze high rise structure with the help of E-tab software. This work has selected Time History Analysis method. For analysis purpose high rise structure with G+25 stories has been selected. Time History of earthquakes at two places (Bhuj, & Koyna) are used for analysis of selected high rise structure. Comparative study is made between two selected places without & with provision of visco-elastic damper. In this work constant loading parameters are used for both cases, also same plan is used for various models of time history. Load combinations are taken from IS code.

Key words: Time History Analysis, High Rise Building

I. INTRODUCTION

Earthquake resistant design of engineering structures is one of the most important methods of mitigating risk of damage from future earthquakes. Such designs are based on the specification of ground motion which can be expected in the event of an earthquake. However, for earthquake-resistant design of some important structures like dams and nuclear power plants, located in seismically active areas, it is desirable to have a reliable site-specific design accelerogram. Available records of strong ground motion, after suitable modifications, have been used in the past for detailed dynamic analysis of engineering structures. However, synthetic accelerograms are now increasingly being used in earthquake engineering. Knowledge of regional and local seismicity and seismotectonics, a suitable earth model and source characteristics of the design earthquake are required for this purpose.

The Time History Response of a structure is simply the response (motion or force) of the structure evaluated as a function of time including inertial effects. The time history analysis in the advanced level of visual analysis allows four main loading types.

These include base accelerations, base displacements, factored forcing functions, and harmonically varying force input. Analysis of a structure, applying data over increment time steps as a function of:

- Acceleration
- Force
- Moment or Displacement.

Time history analysis is considered to be more realistic compared to response spectrum analysis. It is most useful for very long or very tall structures (flexible structures).

II. AIM OF THE PRESENT STUDY

In this report high rise building will be analyze for various parameters of time history. To find out critical condition & differences after comparing the analysis result for our selected high rise building is the aim of project.

III. LITERATURE REVIEW

A. Non-Linear Time History Analysis of Tall Structure for Seismic Load Using Damper (2014)

Waseem Khan [1], Dr. Saleem Akhtar [2], and Aslam Hussain[3] (Department of Civil Engineering, University Institute of Technology, Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal. M.P. India) has describes the results of an extensive study on the seismic behavior of a structure with damper and without damper under different earthquake acceleration frequency like EQ Altadena , EQ Lucerne, EQ Pomona, EQ Smonica and EQ Yormo.

The proposed procedure is placed the dampers on the floors of the ninth-floor and five-floor of a ninth story building frame then compare the different performance of structure with damper up to Ninth-floors, damper up to Fifth-floors and without damper of ninth-story building frame using SAP2000 V15. As per IS-1893 2002 non-linear time-history analyses of frame structure indicate that maximum displacement, maximum base shear and maximum acceleration effectively reduce by providing the damper in building frame from base support to fifth- floor and base support to ninth-floor comparison to as usual frame.

B. Dynamic Analysis of Multistoried Regular Building (2014)

Mohit Sharma [1], and Dr. Savita Maru [2] (Department of Civil Engineering, U.E.C, Ujjain, Madhya Pradesh, India) has mentioned that analysis and design of buildings for static forces is a routine affair these days because of availability of affordable computers and specialized programs which can be used for the analysis. On the other hand, dynamic analysis is a time consuming process and requires additional input related to mass of the structure, and an understanding of structural dynamics for interpretation of analytical results. Reinforced concrete (RC) frame buildings are most common type of constructions in urban India, which are subjected to several types of forces during their lifetime, such as static forces due to dead and live loads and dynamic forces due to the wind and earthquake.

Here the present works (problem taken) are on a G+30 storied regular building. These buildings have the plan area of 25m x 45m with a storey height 3.6m each and depth of foundation is 2.4 m. & total height of chosen building including depth of foundation is 114 m. The static and dynamic analysis has done on computer with the help of STAAD-Pro software using the parameters for the design as per the IS-1893- 2002-Part-1 for the zones- 2 and 3 and the post processing result obtained has summarized.

C. Earthquake Analysis of High Rise Building with and Without In filled Walls (2014)

Wakchaure M.R [1] , and Ped S. P. [2] (Department of Civil Engineering, Amrutvahini, College of Engineering, Sangamner, and Maharashtra.) has studied the effect of masonry infill panel on the response of RC frames subjected to seismic action is widely recognized and has been subject of numerous experimental investigations, while several attempts to model it analytically have been reported. In analytically analysis infill walls are modeled as equivalent strut approach there are various formulae derived by research scholars and scientist for width of strut and modelling. Infill behaves like compression strut between column and beam and compression forces are transferred from one node to another. In this study the effect of masonry walls on high rise building is studied. Linear dynamic analysis on high rise building with different arrangement is carried out. For the analysis G+9 R.C.C. framed building is modelled. Earthquake time history is applied to the models. The width of strut is calculated by using equivalent strut method. Various cases of analysis are taken. All analysis is carried out by software ETABS. Base shear, storey displacement, story drift is calculated and compared for all models. The results show that infill walls reduce displacements, time period and increases base shear. So it is essential to consider the effect of masonry infill for the seismic evaluation of moment resisting reinforced concrete frame.

1) Results:

Due to infill walls in the High Rise Building top storey displacement is reduces. Base shear is increased. The presence of non-structural masonry infill walls can modify the seismic behavior of R.C.C. Framed High Rise building to large extent. Arrangement of infill wall also alters the displacement and base shear the top of building displacements gets reduces. In case of infill having irregularities in elevation such as soft storey that is damage was occur at level where change in infill pattern is occur. The effect of slenderness ratio emphasion displacement of frame. As the aspect ratio goes on increasing the displacement, base shear and column forces increases.

D. Analysis of a Non-Proportionally Damped Building Structure with Added Viscoelastic Dampers (2000)

Jinkoo KIM [1], And Chang-Yong LEE [2] has stated that in the analysis of a structure installed with viscoelastic dampers the modal strain energy method has been generally applied to predict the equivalent damping ratios of the system [Lai et. al., 1995]. The method derives the equivalent damping ratios based on the assumption that the damping is proportional to mass and/or stiffness of the structure system. However the assumption of proportional damping may no longer be valid when the viscoelastic dampers are added to the structure. In this case the direct integration method provides the correct results, but it requires too much computation time and memory space to be applied in practice. There is, however, a reliable alternative procedure for the analysis of the non-proportionally damped structure; the complex mode superposition method which provides exact solution in less time than needed for the direct integration. Compared with the direct integration method, the complex mode superposition has several advantages not only for the efficiency of response evaluation but for the understanding of the modal characteristics of the non-proportionally damped structures.

In this study some of efficient analytical procedures are applied to obtain the seismic response of a non-proportionally damped building structure with added viscoelastic dampers; the complex mode superposition method, direct integration method combined with matrix condensation, modal strain energy method, and the method disregarding the off-diagonal terms of a transformed damping matrix. Special attention has been paid for the derivation of the complex modal superposition procedure, and the reliability of the approximate methods is checked by comparing the approximate solutions with those obtained from the complex mode superposition.

E. Comparative Study of Viscoelastic Seismic Damping Systems (1992)

Timothy Paul Jester [1] (Lehigh University Bethlehem, PA, USA) has stated that there are two types of viscoelastic (VE) seismic dampers for building structures, the VE diagonal damper and the VE passive mass damper which are studied in this thesis. The thesis reviews the relevant theoretical considerations in earthquake engineering and discusses the properties of VE materials important in damper design. It presents analytical equations for determining the damping added for each system. Finite element modeling of each system is used to determine the effectiveness of the dampers at reducing the seismic response of a prototype frame structure. Current design methods are reviewed, where possible. The effects of variation in the important design parameters are studied. For the VE diagonal dampers, these parameters include the stiffness of the supporting brace and the thickness of the VE material, whereas for the VE passive mass dampers, they included the damper mass, the number of dampers and the tuning frequency of the dampers. A method for designing a system of VE diagonal dampers is presented which uses the mass-normalized mode shapes to simplify previous methods. Stability problems in low frequency VE passive mass dampers are discussed and the feasibility of constructing them is considered. Several alternative designs and approaches are presented to deal with the problems.

It is concluded that both VE diagonal dampers and VE passive mass dampers were effective at reducing the seismic response of the prototype. The mass dampers were somewhat better at reducing the base shear and moment response. Mass dampers also appeared to have some advantages in design, including greater versatility, and better economy in the use of VE material.

F. Dynamic Analysis of Frames with Viscoelastic Dampers Modelled By Rheological Models with Fractional Derivatives

Roman Lewandowski [1], and Zdzis"aw Pawlak [2] has studied frame structures with viscoelastic dampers mounted on them are considered in this paper. Viscoelastic (VE) dampers are modeled using two, three-parameter, fractional rheological models. The structures are treated as elastic linear systems. The equation of motion of the whole system (structure with dampers) is written in terms of state-space variables. The resulting matrix equation of motion is the fractional differential equation. The proposed state space formulation is new and does not require matrices with huge dimensions. The paper is devoted to determine the dynamic properties of the considered structures. The nonlinear eigenvalue problem is formulated from which the dynamic parameters of the system can be determined. The continuation method is used to solve the nonlinear eigenvalue problem. Moreover, results of typical calculations are presented.

G. Modeling Viscoelastic Damping Insertion in Lightweight Structures with Generalized Maxwell and Fractional Derivative Models

R. Pirk [1], L. Rouleau1 [2], V. D´Ortona1 [3], W. Desmet1 [4], and B. Pluymers [5] (Institute of Aeronautics and Space (IAE)/Technological Institute of Aeronautics (ITA)

Praça Marechal Eduardo Gomes, 50, São José dos Campos, São Paulo, Brazil) has studied the effect of the damping addition due to viscoelastic (VE) material on the dynamic behavior of aluminum panels is assessed in this work. Dynamic Mechanical Analysis (DMA) tests are carried out, aiming at characterizing the rheological behavior of a VE compound. The Time-Temperature Superposition Principle (TTSP) is applied and the VE compound master curve is built over a large frequency range. As a result, the parameters for both, Generalized Maxwell Model (GMM) and Fractional Derivative Model (FDM) are determined. Distributed and local coatings of the VE material are applied to aluminum plates and the responses of these sandwich structures are calculated by using finite elements method where the VE behavior is modeled either with a GMM or a FDM. As a second step, tests are done by reproducing the same modeled configurations with the testing facilities of KULeuven. Numerical vs. experimental Frequency Response Functions (FRF) comparisons are done in order to validate the models.

H. Earthquake Mitigation Study on Viscoelastic Dampers for Reinforced Concrete Structures

Zhao-Dong Xu (Civil Engineering College, RC & PC Key Laboratory of Education Ministry, Southeast University, Nanjing 210096, China) has stated viscoelastic (VE) dampers are one of the most common earthquake mitigation devices. This paper addresses the mathematical modelling of VE dampers and the dynamic analysis of structures with VE dampers. In this paper, the equivalent standard solid model, a new mathematical model of VE dampers, is used to describe the influence of temperature on the energy absorption features of VE dampers. Elastoplastic time field analysis, frequency field analysis and shaking table tests are used to analyze responses of a 1/5-scale three-story reinforced concrete frame structure with and without VE dampers. Comparisons between the numerical and experimental results show that the VE dampers can be modeled by the equivalent standard solid model and that the VE dampers are effective in reducing the seismic responses of structures.

IV. METHODOLOGY

For analysis purpose high rise building of G + 25 floors has been selected. The building is RCC framed structure. Overall height of the building is 77.6 M. First 4 floors are for Parking

A. Model Description

A G + 25 story building plan is selected for the study. Same model is used for analysis of different time history.

Name of parameter	Value	Unit
Number of stories	25	Nos.
Storey height	2.9	m
Total height of the structure(above GL)	77.6	m
Length in long direction	31.60	m
Length in short direction	15.47	m
Thickness of Deck	150	mm
Dead Load (1) Wall (Siporex)	2.64	kN/m
(2) Floor finish	1	kN/m²
Live load	2	kN/m²

Table1: Key features of the structure

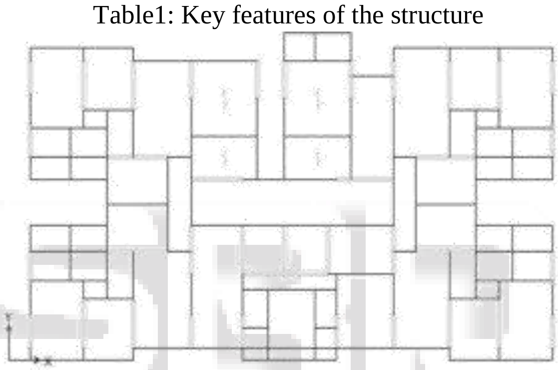

Fig. 1: Typical floor plan of building

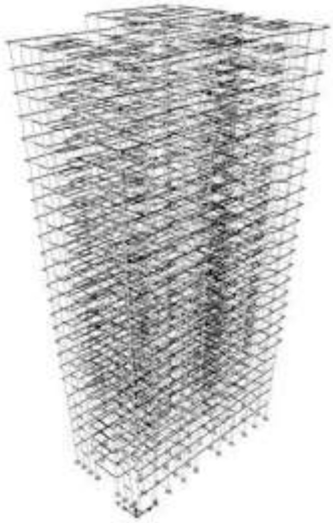

Fig. 2: 3-D view of building

B. Methodology of Work

1) Extensive literature survey by referring books, technical papers or research papers carried out to understand basic concept of topic.
2) Identification of need of research.
3) Formulation of stages in analytical work which is to be carried out.
4) Data collection.

5) Analytical work of modelling is to be carried out using software`.
6) Interpretation of results & conclusion.

V. THEORETICAL CONTENT

Damper is used in machines, car suspension system and clothes washing machine. Damping system in a building use friction to absorbs some of the force from vibrations.

A damping system is much larger and is also designed to absorb the violent shocks of an earthquake.

During august-2007 Peru earthquake, many multistory buildings in urban areas was collapsed and suffered wide spread damages. Post-earthquake observations revealed many deficiencies in these structures including non-adoption of seismic engineering practices and lack of seismic resistant features. The seismic performance of a building can be improved by energy absorbing device, which may be active and passive in nature. Dampers are the energy dissipating devices will be coming up in large number in future times.

In this regards nonlinear time history analysis are of paramount importance for seismic analysis. This motivation has led to this study on effect of dampers during earthquake for building frame, bridges, nuclear power houses etc. Damper is one of the important device by which the seismic performance of a building can be improved. When dampers are applied to the structure the seismic forces as absolute acceleration, absolute displacement, absolute velocity and base shear are reduced.

VI. CONCLUDING WORK

In previous research papers we can see comparative study between any two types of dynamic analysis. Also we can find specific analysis for selected building plan with changes in various locations, type, shapes of shear wall. In this proposed work we will analyze high rise structure for two different Accelerogram (Bhuj & Koyna). Comparative study between two time histories can be made without application & with application of visco-elastic damper at various levels.

REFERENCES

[1] Waseem Khan1, Dr.Saleem Akhtar2, Aslam Hussain3, "Non-linear Time history analysis of tall structure for seismic load using damper", International Journal of Scientific and Research Publications, Volume 4, Issue 4, April 2014.
[2] Mohit Sharma1, Dr.Savita Maru2, "Dynamic Analysis of multyStroried Regular Building", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 11, Issue 1 Ver. II (Jan. 2014), PP 37-42.
[3] Wakchaure M.R, Ped S. P, "Earthquake Analysis of High Rise building with and without In filled Walls", International Journal of Engineering and Innovative Technology (IJEIT), Volume 2, Issue 2, August 2012.
[4] SasaMitrovic, "Comparison between non-linear dynamic and static seismic analysis of structures according to European and US provisions", Bull Earthquake Eng DOI 10.1007/s10518-010-9199-1.
[5] BIS, IS: 456, Indian standard code of practice for plain and reinforced concrete, fourth revision, September–2000.
[6] BIS, IS: 1893 (part - 1), Indian standard code of practice for criteria for earthquake resistant design of structure, general provisions and buildings, fifth revision, 2002.

