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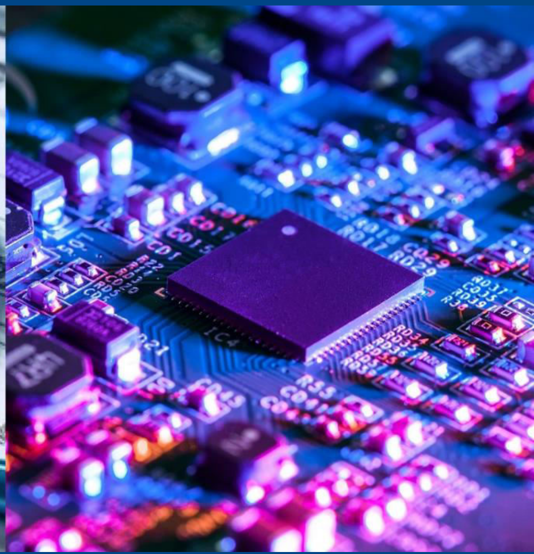

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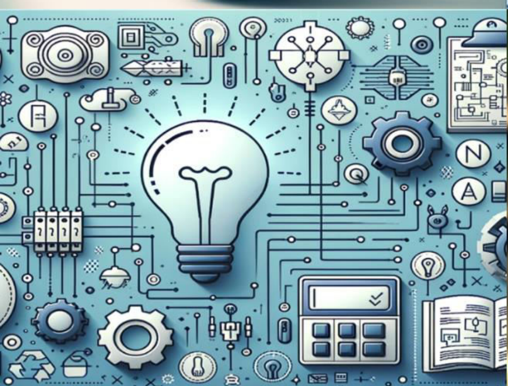

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Seismic Analysis of Regular and Irregular Buildings using ETABS

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ABSTRACT: The aim of this project is to assess the seismic analysis vulnerability and response of regular and irregular shaped multi-storey building context of India. Both linear and dynamic(response spectrum and time history) analysis has been performed to study the influence of shape of a building on its response to various loading. 10 s toried regular (rectangular, C shape and L-shape) shaped and irregular (combination of rectangular, C-shape and L-shape) shaped buildings have been modelled using program ETABS 2016 for Hyderabad (seismic zone 2), India. Effect of dead and live load on different shaped structure along with Time history method and dynamic response under response spectrum has been meticulously analyzed considering the mass of each shaped building is same. Comparative study on the maximum displacement of storey and center of mass of different shaped building due to static loading and dynamic response spectrum has been explored. The base shear, displacement, response spectral acceleration and the earthquake displacement is analysed in time history method following response spectrum method.

KEYWORDS: Regular and irregular shaped multi-storey building, Time history analysis

I.INTRODUCTION

Earthquake has always been threat to human civilization from the day of its existence, devastating human lives, property and man-made structures. The very recent earthquake that we faced in our neighborin country Nepal has again shown nature's fury, causing such a massive destruction to the country and its people. It is such an unpredictable calamity that itis very necessary for survival to ensure the strength of the structures against seismic forces. Therefore there is continuous research work going on around the globe, revolving around development of new and better techniques that can be incorporated in structures for better seismic performance Obviously, buildings designed with special techniques to resist damages during seismic activity have much higher cost of construction than normal buildings, but for safety against failures under seismic forces it is a pre-requisite Earthquake causes random ground motions, in all possible directions emanating from the epicenter. Vertical ground motions are rare, but an earthquake is always accompanied with horizontal ground shaking. The ground vibration causes the structures resting on the ground to vibrate, developing inertial forces in the structure As the earthquake changes directions, it can cause reversal of

such as-earthquake magnitude, proximity to epicenter, and the local geological conditions, which

stresses in the structural components, that is, tension may change to compression and compression may change to tension. Earthquake can cause generation of high stresses, which can lead to yielding of structures and large deformations. rendering the structure non-functional and unserviceable There can be large storey drift in the building, making the building unsafe for the occupants to living there. Reinforced Concrete frames are the most common construction practices in India, with increasing numbers of high-rise structures adding up to the landscape. There are many important Indian cities that fall in highly active seismic zones. Such high-rise structures, constructed especially in highly prone seismic zones, should be analyzed ad designed forductility and should be designed with extra lateral stiffening system to improve their seismic performance and reduce damgages

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II.DATA COLLECTION

Interaction between ground accelerations and structural systems are reported througH response spectrum Plots peak responses over time for range of single-degree-of freedom (SDOF) systems subjected to a particular base motion as a function of their natural frequency wl, or vibration period Ti. The resulting plot can then be used to pick off the response of any linear system, given its natural frequency of oscillation. Response spectra are used by earthquake engineers for analyzing the performance of structures in earthquakes, since many behave principally as single degree of freedom systems The purpose of the response spectrum is to know the response of a single degree of freedom system if the ground moves as per the given accelerogram. An accelerogram is the recording of the acceleration of the ground during an earthquake. Response may mean any quantity like acceleration, velocity or deformation The figure below shows the accelerogram for the earthquake that hit the El-Centro city in Imperial valley of California. Various Indian standard codes were collected from the department of civil engineering The earthquake data were obtained from the site Peer.berkeley.edu The earthquakes considered in this work are time history of ground motion as per IS 1893:2002

III.REGULAR& IRREGULAR BUILDINGS

>>>Back Ground of Regular Buildings

Structural analysis is mainly concerned with finding out the behavior of a structure when subjected to some action. This action can be in the form of load due to the weight of things such as people.furniture, wind, snow, etc, or some other kind of excitation such as an earthquake, shaking of the ground due to a blast nearby, etc. In essence all these loads are dynamic including the self weight of the structure because at some point in time these loads were not there. The distinction is made between the dynamic and the static analysis on the basis of whether the applied action has enough acceleration in comparison to the structure's natural frequency If a load is applied sufficiently slowly, the inertia forces (Newton's second law of motion) can be ignored and the analysis can be simplified as static analysis. Structural dynamics, therefore, is a type of structural analysis which covers the behavior of structures subjected to dynamic (actions having high acceleration) loading. Dynamic loads include people, wind, waves, traffic, earthquakes, and blasts. Any structure can be subjected to dynamic loading. Dynamic analysis can be used to find dynamic displacements, time history, and modal analysis. In the present study, Response Spectrum Analysis and Time History Analysis is performed to compare the results with Non Linear Dynamic Analysis. The criteria of level adopted by codes for fixing the level of design seismic loading are Generally as follows:

(a) Structures should be able to resist minor earthquakes (< DBE), without damage.

(b) Structures should be able to resist moderate earthquakes (DBE) without significant Structural damage but with some non-structural damage.

(c) Structures should be able to resist major carthquakes (MCE) without collapse.

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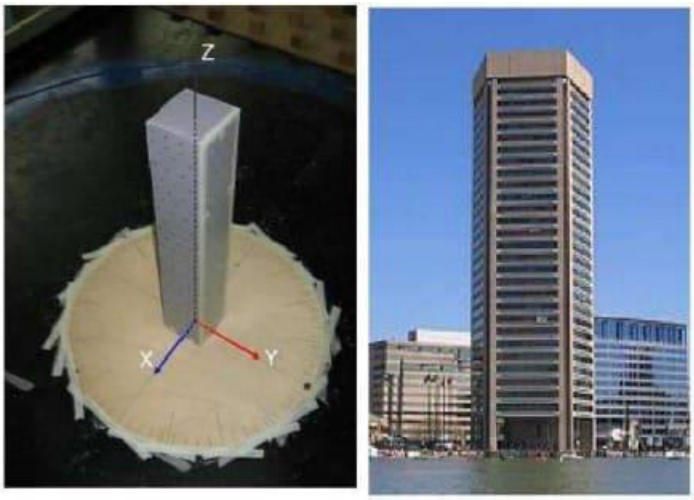

REGULAR BUILDING MODELS

3.1 Background of Irregular Buildings

Irregular buildings constitute a large portion of the modern urban infrastructure The group of people in constructing the building facilities, including owner, architect, structural engineer, contractor and local authorities, contribute to the overall planning, selection of structural system, and to its configuration. This may lead to building structures with irregular distributions in their mass, stiffness and strength along the height of building. When such buildings are located in a high seismic zone, the structural engineer's role becomes more challenging. Therefore, thestructural engineer needs tohave a thorough understanding of the seismic response of irregular structures. In recent past, several studies have been carried out to evaluate the response of irregular buildings. This paper is an attempt to summarize the work that has been already done pertaining to the seismic response of vertically irregular building frames. In the earlier versions of IS 1893 (BIS, 1962, 1966, 1970,1975, 1984), there was no mention of vertical irregularity in building frames. in the recent version of IS 1893 (Part 1)-2002 (BIS, 2002), irregular configuration of buildings has been defined explicitly. Five types of vertical irregularity have been listed as shown in Figure 1. They are: stiffness irregularity (soft story), mass irregularity, vertical geometric irregularity (set-back). in-plane discontinuity in lateral-force-resisting vertical elements, and discontinuity in capacity (weak story). NEHRP code (BSSC, 2003) has classifications of vertical irregularities similar to those described in IS 1893 (Part 1)-2002 (BIS, 2002). As per this code, a structure is defined to be irregular if the ratio of one of the quantities (such as mass, stiffness or strength) between adjacent stories exceeds a minimum prescribed value. These values (such as 70-80% for soft story, 80% for weak story, 150% for set-back structures) and the criteria that define the irregularities have been assigned by judgment. Further, various building codes suggest dynamic analysis (which can he elastic time history analysis or elastic response spectrum analysis) to come up with design. lateral force distribution for irregular structures rather than using equivalent lateral force (ELF) procedures

(1) Irregular building- (a) all framed building higher than 12 meter in zone IVth and Vth

(b) Those greater than 40 meter in zone IInd and IIIrd.

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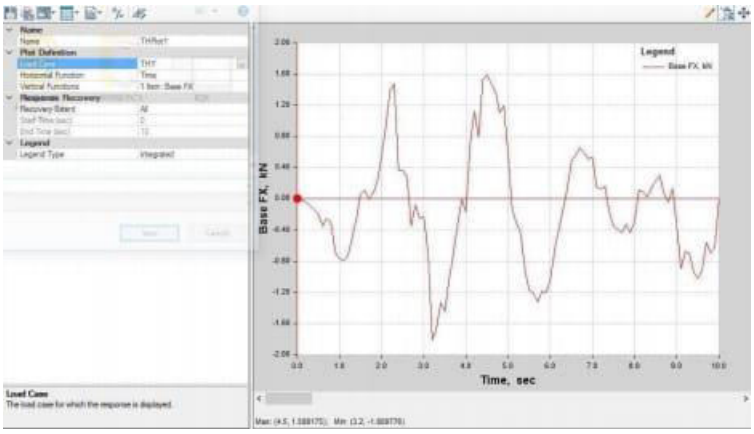
SHAPE OF IRREGULAR BUILDINGS

IV.SUMMARY AND CONCLUSION

4.1 Summary

Seismic Analysis of regular and irregular buildings have demonstrated that building structures have the capacity to manage without any harm the seismic constraints bigger than those they were intended for during design.



The building under study in this project was not existing, For the seismic design of structures most codes, indeed, indicate just a solitary configuration tremor which the building and its segments are required to maintain without breakdown

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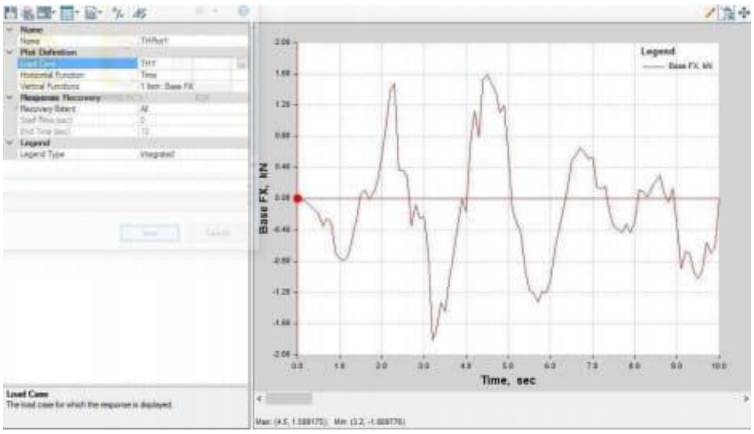
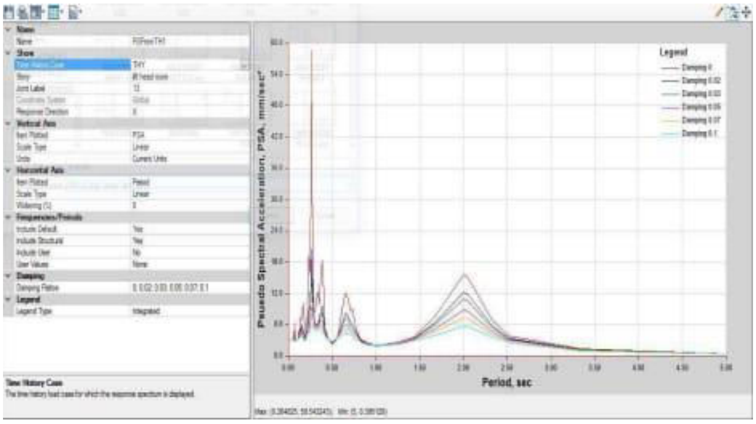
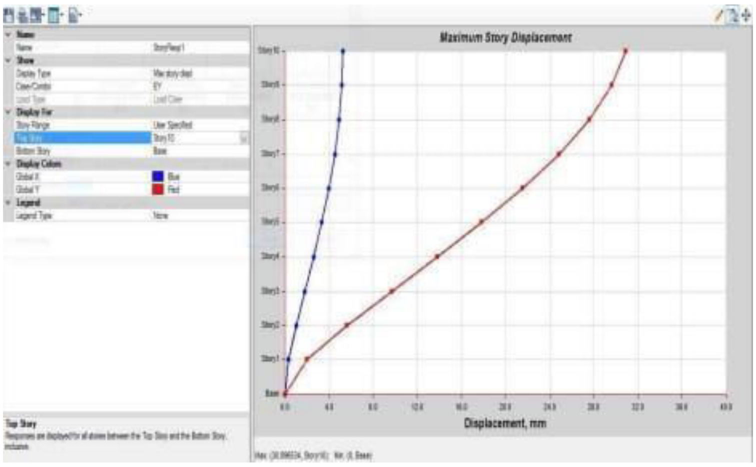




a large number of the seismic design codes have a tendency of downsizing the design forces to record for reserve strength parameter which is crucial and simplifies the analysis as wellTime History Analysis Method can help demonstrate how progressive failure in buildings really occurs, and identify the mode of final failure. In this study, regular and irregular results obtained from the time history analysis of the buildings was in the form of curves and graphs used as the parameter to assess this amount of shear, displacement, response, time of reaction is obtained



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V. CONCLUSION

Upon the RC buildings with different types Regular and Irregular building (taken in dimension) analysed in Time history method, Earthquake forces, Response spectrum in the seismic zone ii using ETABS Software 2016.

1. The base shear in regular building is 380.67 KN where as in irregular type Its value is 968,67
2. Here from the Base Shear curves, it is evident that magnitude of Base Shear decreases in regular type building.
3. Story displacement in regular building in X & Y direction is 1.22 mm and 2.05, in irregular building there is 1.90 mm in seventh story and 0.035 mm.
4.In irregular building displacement is varying in X and Y directions but in regular buildings it is same in both X & Y directions.
5. Response Spectrum Acceleration for regular building in X & Y direction is 0.264,397.2mm/sec2 and in irregular building it is maximum 0.266, 3503.79mm/sec2 minimum 3.33, 96.12 mm/sec2
6. Earthquake maximum displacement in regular building is 30.3 mm where as in irregular building it is 13.39 mm along X direction and 7.659mm in y direction it means in irregular building because of variation in both directions damage occurs more.
7. Time History in regular building in X direction maximum 10per sec, and min 0, in Y direction maximum 4.5 per sec & minimum 3.2 per sec.
8. Modal participating mass ratios are also satisfied in regular and irregular buildings.

The following are the major conclusions that can be made based on present work carried upon the RC buildings with different types Regular and Irregular building (taken in dimension) analysed in Time history method. Earthquake forces, Response spectrum in the seismic zone ii using ETABS Software 2016.

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