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A REVIEW ON SEISMIC RESPONSE OF HIGH RISE BUILDING HAVING DIAPHRAGM DISCONTINUITY

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Abstract — *Many buildings in the present scenario have irregular configurations both in plan and elevation. This in future may subject to devastating earthquakes. The present paper made an attempt to study two kinds of irregularities in the building models namely plan irregularity with geometric and diaphragm discontinuity and vertical irregularity with sloping ground and the parametric study of the structure had been carried out with analysis of different model with different diaphragm discontinuity and comparison of different structural parameters.*

Keywords-*Seismic, Irregularities, diaphragm Discontinuity ,Structural Parameters*

I. INTRODUCTION

The behavior of a building during an earthquake depends on several factors, stiffness, adequate lateral strength, ductility, simple and regular configurations. The buildings with regular geometry and uniformly distributed mass and stiffness in plan as well as in elevation suffer much less damage compared to irregular configurations. But nowadays need and demand of the latest generation and growing population has made the architects or engineers inevitable towards planning of irregular configurations. Hence earthquake engineering has developed the key issues in understanding the role of building configurations.[8]

Diaphragm discontinuity includes those having openings greater than 50% of the total diaphragm area or changes in the effective diaphragm stiffness of more than 50% from one story to the next story. Discontinuities in the lateral stiffness of the diaphragm are due to openings, cut-outs, adjacent floors at different levels or change in the thickness of diaphragm. Floor diaphragm openings are typically for the purpose of stairways, shafts or other architectural features. [7]

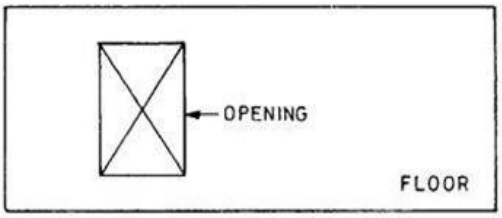

Figure 1. Diaphragm discontinuity

Diaphragm is used for reducing the degree of freedom of building. Use of diaphragm constraint for building structures eliminates the numerical accuracy problems. Assigning diaphragm is also useful in the lateral dynamic analysis of buildings. After assigning diaphragm constraint at each story, only three DOF's are considered; lateral displacement in two principal directions and one rotation. Diaphragm's can be modeled into three basic actions namely, rigid action, semi-rigid action and flexible action.[7]

According to IS 1893-2002 part 1, diaphragm is a horizontal, or nearly horizontal system, which transmits lateral forces to the vertical resisting elements, for example, reinforced concrete floors and horizontal bracing systems.[1] In structural engineering, a diaphragm is a structural system used to transfer lateral loads to shear walls or frames primarily through in-plane shear stress. These lateral loads are usually wind and earthquake loads, but other lateral loads such as lateral earth pressure or hydrostatic pressure can also be resisted by diaphragm action. Two primary types of diaphragm are rigid and flexible. Flexible diaphragms resist lateral forces depending on the area, irrespective of the flexibility of the members that they are transferring force to. Rigid diaphragms transfer load to frames or shear walls depending on their flexibility and their location in the structure. Flexibility of a diaphragm affects the distribution of lateral forces to the vertical components of the lateral force resisting elements in a structure. [9]

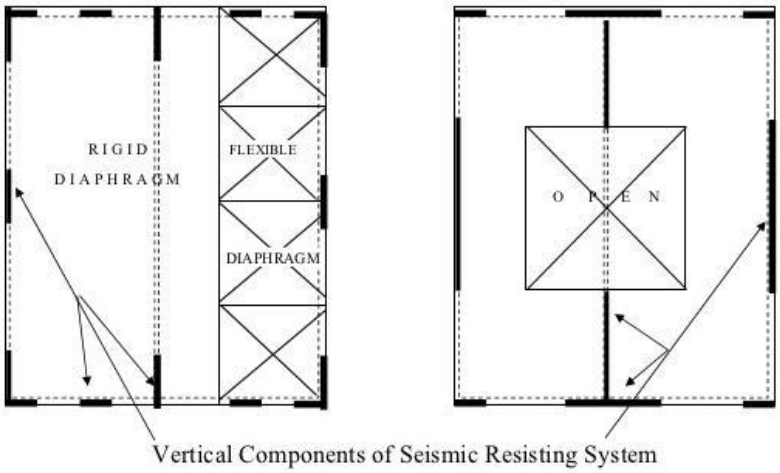

Figure 2. Types of Diaphragm

II. LITERATURE REVIEW

A. S Monish1, S Karuna, "A study on seismic performance of high rise irregular RC framed building", International Journal of Research in Engineering and Technology, Volume: 04 Issue: 05 , May-2015

S Monish1, S Karuna2[2]; "a study on seismic performance of high rise irregular RC framed buildings**".** In this paper attempt has been made to study two types of plan irregularities namely diaphragm discontinuity and re-entrant corners in the frame structure. These irregularities are created as per clause 7.1 of IS 1893:2002(part1) code. Various irregular models were considered having diaphragm discontinuity and re-entrant corners which were analysed using ETABS to determine the seismic response of the building. The models were analysed using static and dynamic methods, parameters considered being displacement, base shear and fundamental natural period. From the present study the model which is most susceptible to failure under very severe seismic zone is found, modeling and analysis is carried out using ETABS.
The method of analysis used for the present study are Equivalent static method and Response spectrum method.

The layout of the plan having 5 x 5 bays of equal length of 4m are considered. The building considered is an ordinary moment resisting frame of 20 storeys with different irregular configurations (H , C , + , L ,). The storey height is uniform throughout for all the building models considered for analysis. The software used for analysis of the frame models is ETABS 2013.
Results of analysis are discussed in terms of parameters such as displacements, base shear and fundamental natural periods.

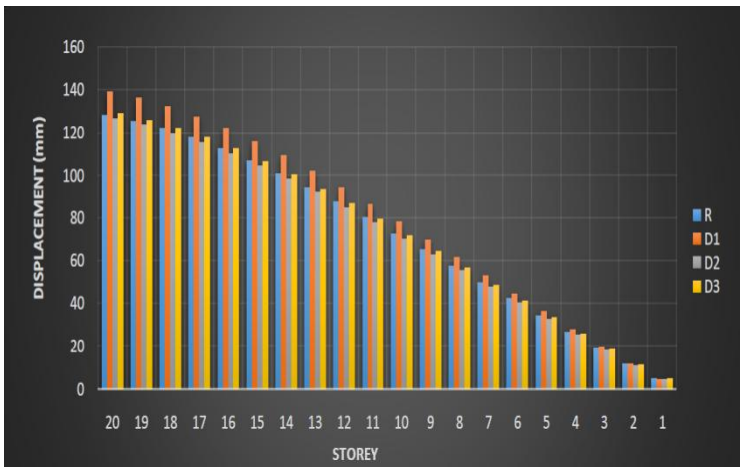

Figure 3. Graph of story v/s displacement (IJRET)

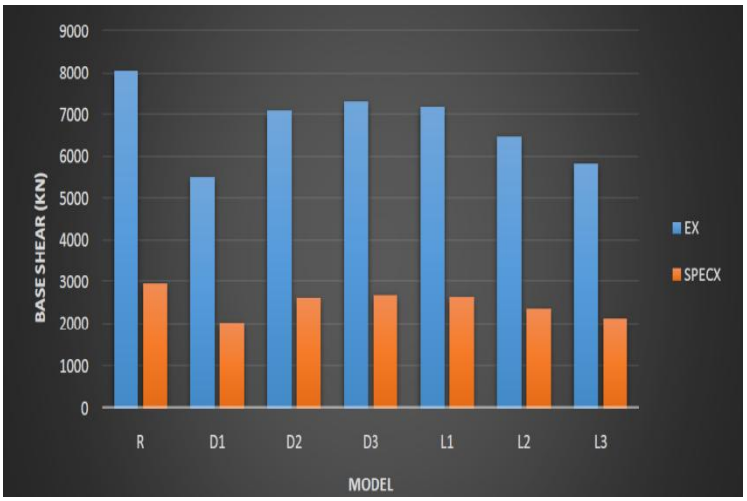

Figure 4. Base shear comparison of different model (IJRET)

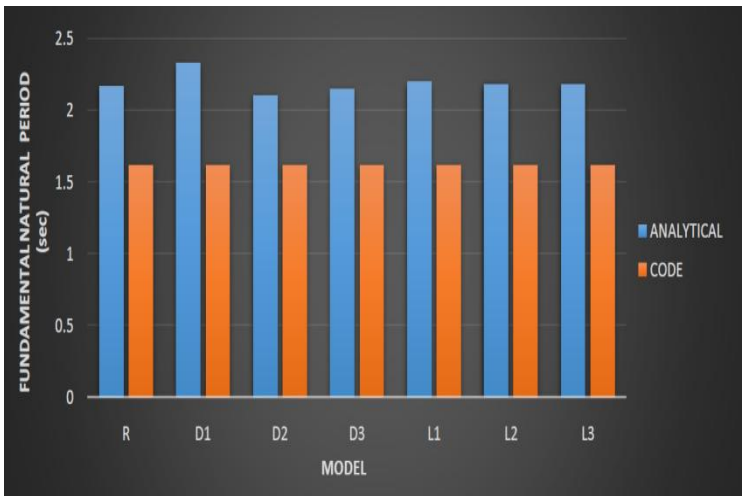

Figure 5. Comparison Of Fundamental Natural Period Of Different Model (IJRET)

The results obtained from response spectrum method are accurate, when compared with results of equivalent static method, since the method is based only on empirical formula. displacement increases with increase in storey in both methods of analysis. When comparing static and dynamic method of analysis the magnitude of base shear is more in linear static method which is an approximate value.[2]

B. Ravikumar C M, Babu Narayan K S, Sujith B V, Venkat Reddy D, Effect of Irregular Configurations on Seismic Vulnerability of RC Buildings, Architecture Research 2012, 2(3): 20-26

Ravikumar C M1, Babu Narayan K S1, Sujith B V2, Venkat Reddy D1[3]; " Effect of Irregular Configurations on Seismic Vulnerability of RC Buildings". The present paper made an attempt to study two kinds of irregularities in the building models namely plan irregularity with geometric and diaphragm discontinuity and vertical irregularity with setback and sloping ground. These irregularities are created as per clause 7.1 of IS 1893 (part1)2002 code. In Order to identify the most vulnerable building among the models considered, the various analytical approaches are performed to identify the seismic demands in both linear and nonlinear way. It is also examined the effect of three different lateral load patterns on the performance of various irregular buildings in pushover analysis. This study creates awareness about seismic vulnerability concept on practicing engineers. All model having different discontinuities was analysed and design using ETABS with equivalent static method and response spectrum method.

The Layout of plan having 5X4 bays of equal length of 5m. The buildings considered are Reinforced concrete ordinary moment resisting frame building of three story with different irregular configurations. Here stiffness of the infill is neglected in order to account the nonlinear behavior of seismic demands. The storey height is kept uniform of 3m for all kind of building models.

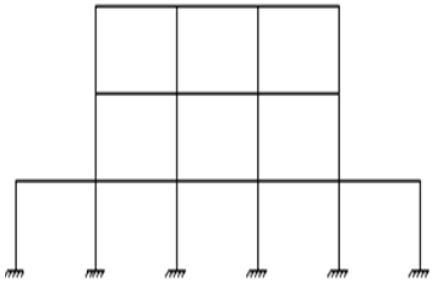

Figure 6. Model on plain ground (architectural research 2012)

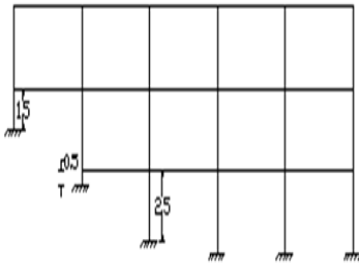

Figure 7. Model on sloping ground (architectural research 2012)

The performances of all the models except sloping ground are lies in between life safety and collapse prevention and the buildings resting on sloping ground are more vulnerable to earthquake. The equivalent static method doesn't consider the irregular effects in the building and since it depends only on empirical formula the results obtained will be abnormal in comparison to response spectrum method.[3]

C. P. Suneetha, 139h1d8713, Effect of Diaphragm Discontinuity, IJCSIET,ISSUE5-VOLUME2,SERIES4

P.Suneetha[4], "**Effect of Diaphragm Discontinuity**". Many buildings in the present scenario have irregular configurations both in elevation and plan. This in future may subject to devastating earthquakes. It is necessary to identify the performance of the structures to withstand against disaster for both new and existing buildings. Now a days openings in the floors is common for many reasons like stair cases, lighting architectural etc., these openings in diaphragms cause stresses at discontinues joints with building elements. Discontinuous diaphragms are designed without stress calculations and are thought-about to be adequate ignoring any gap effects. In the present study, a typical multi storey building is analyzed using commercial software sap2000 for nonlinear static (pushover) and dynamic (time history) analysis. All the analyses has been carried out considering and ignoring the diaphragm discontinuity and the results so obtained have been compared. This study is done for rc framed multi-storey building with fixed support conditions. The results of this report is based on one case-study. For the study purpose, an existing building plan in berhampur was taken which is meant for hospital. Even though this area is in seismic zone II, it is taken as zone v for study purpose. Building details are given below.

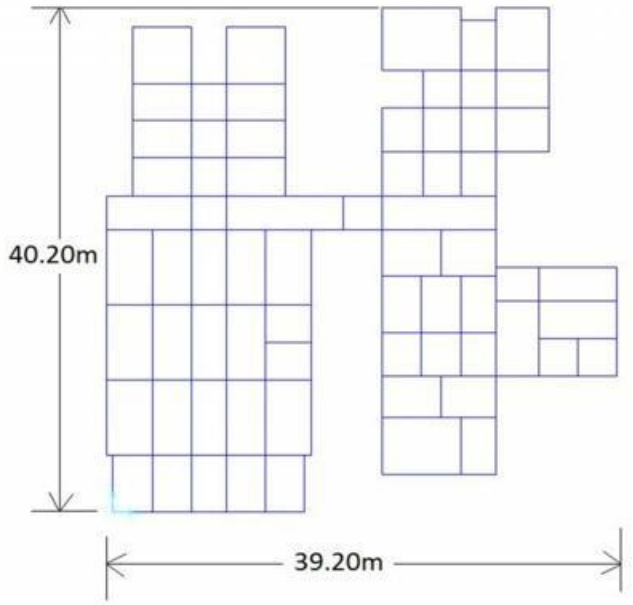

Figure 8. Plan of the building

Discontinuous diaphragm makes the building flexible. Fundamental period of building with diaphragm discontinuity is found to be higher than a similar building with continuous diaphragm. The empirical equation given in design codes (such as is 1893:2002) are good for building with continuous diaphragm.[4]

D. Vinod V, Pramod Kumar H V,Influence of stiffness discontinuous diaphragm characteristics on the seismic behaviour of RC structure, June 2017 IJSDR ,Volume 2, Issue 6

Vinod V, Pramod Kumar H V[5]; "Influence of stifffness discontinuous diaphragm characteristics on the seismic behaviour of rc structure." Structure In this present study, an attempt is made study the influence of various parameters associated with diaphragm on the seismic behavior of RC framed structure. Attempts are made to study the effect of discontinuities in the diaphragm namely 0%, 10%, 20%, and 30% openings with comparing the seismic behavior of four and eight story RC building. For this purpose, ETABS 2015, FE analysis software with Response Spectrum Analysis as per IS 1893 is used to assess the seismic behavior .Parameters such as Natural Time Period, Base Shear, Mode shape, Drift and Displacements and internal forces in members are used to compare the seismic performance.action is made on the seismic behavior of the multistory building by using diaphragm and there discontinuities. On the intention a regular four story and eight story building have analyzed and modeled by response spectrum analysis using ETABS 2015.lateral load analysis as per the seismic code IS: 1893 (Part 1)-2002 is carried out for regular building with rigid diaphragm by varying heights and even for the discontinuous diaphragm later an effort is made to study the effect of seismic loads and comparative study between the response spectrum analysis for both X and Y direction.
Results procured from the response spectrum method of analysis has got preceding values in both eight and for four story building. Natural time period is getting decreased as the percentage of openings. Maximum displacement for four and eight story building shown lesser displacement value in stiffness diaphragm compared to no diaphragm and with all types of openings. Maximum drift for four and eight story building shown lesser drift value in stiffness diaphragm compared to no diaphragm. These all results shows building with stiffness diaphragm are better to use in all multi story building for those areas which are prone to earthquake. 20% of opening is a better one when compared other condition.

E. Nonika. N, Mrs. Gargi Danda De , Comparative Studies on Seismic Analysis of Regular and Vertical Irregular Multistoried Building , IJRASET, Volume 3 Issue VII, July 2015

Nonika. N, Mrs. Gargi Danda De[6]; "Comparative Studies on Seismic Analysis of Regular and Vertical Irregular Multistoried Building." The main objective of this study is to understand the effect of elevation irregularity and behavior of 3-D R.C. Building which is subjected to earthquake load. In the present study, a 5 bays X 5 bays, 16 storied structure with provision of lift core walls and each storey height 3.2 m, having no irregularity in elevation and plan, is considered as the normal 3-D structure to compare with the irregular i.e. soft storey building. Both the regular and irregular buildings are assumed to be located in all zones. Linear dynamic analysis using Response Spectrum method of the irregular building is carried out using the standard and convenient FE software package. For this the behaviour parameters considered are 1) Maximum displacement 2) storey drift, 3) Base shear, 4) Time period.
The Base shear and lateral displacements are gradually increased with increase in zone factors for both the models. The lateral displacement is less in regular model compare to vertical irregular model. The regular model shows less displacement compare to irregular model. Base shear and lateral displacement will increases as the seismic intensity increases from zone-2 to zone-5 which indicates more seismic demand the structure should meet.

III. CONCLUSION

From the above literature we conclude that

1) Irregular structure configuration are affected severely during earthquake especially in high seismic zone.
2) Discontinuity in diaphragm shows that optimum percentage of opening will with stand the seismic forces in earthquake area and discontinuity diaphragm makes the building flexible.
3) Capacity of the building may be significant but the seismic demand varies with respect to the configuration.

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