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DESIGN AND ANALYSIS OF MULTISTORY RC BUILDING IN DIFFERENT SEISMIC ZONES OF INDIA USING ETABS – A REVIEW

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Abstract

Neither the earthquake can be predicted nor it can be stopped as it is natural phenomenon. The only thing is effect of earthquake can be minimized. Earthquake itself is not vulnerable but the fragile and un-engineered structure cause the serious problems during earthquake. So to cope with this problem we need to take care for the construction of earthquake resistant construction. We can't construct earthquake proof structures as term engineering itself depicts economic i.e the project should be completed within the minimum budget including all the facilities. So we should think about minimizing the risk during such phenomenon. So the role of Civil/Structural engineers is to analyze and design of earthquake resistant structures. Here in India there are four seismic zones " zone II, zone III, zone IV and zone V". the paper aims to collect the information for design and analysis of buildings in different seismic zones and interpretation of the results obtained by ETABS software.

Keywords: earthquake, seismic zone, ETABS

Introduction

There is rapid trend of construction of high rise building in India. Despite the commercial use high rise buildings are used for residential form too. Apartment development is one of the choice of real state investors. Likewise for commercial use also there are numerous construction going on and planned to with multistory buildings. In one sense the trend is also a good because it save the nature and land. But we need to be aware about the natural disasters like earthquake which may cause loss of life and property. Before starring the construction we should be assured that the structure we are going to built should be capable to resist the earthquake load, wind load as well as imposed load. So in order to make sure about the all details about the structure it should be analyzed. This insures the all the components to incorporated throughout the construction. There are various structure analysis softwares available. As per the designers choice they are used. ETAABS, SAP, STAADPRO, SAFE, BIM, etc are few among them.

Literature Review

Abhay Gulena (2014): Analysis of rectangular , L , I and C shaped building is done in ETABS for 15 storey in seismic zone V. For beam bending moment was maximum in I-shaped building while share force was maximum in rectangular one. But for column maximum bending moment was for rectangular building in both the direction. Asial force was maximum in L-shaped building which is 54KN more than rectangular building in column. But shear force was maximum in I-shaped building in both the direction. We can say there is only minor difference in storey drift despite the shapes. There was 38.16 mm lateral displacement in L-shaped building for 15th storey which is maximum among all.

Mohammed Rizwan Sultan, D. Gouse Peera (2015): The buildings were analyzed by equivalent static force and response spectrum method in zone V of India. Storey overturning moments was maximum for rectangular building less to C shaped building. But the values for H and C shape building were identical. The same trend is followed in storey shear. 130mm displacement was attained in 15th storey in C shaped building while there was only 30 mm in rectangular building. L-shaped and C-shaped building have the dame storey drift and the drift is 10mm which is maximum at 8th storey. Regular buildings are more stable than irregular ones.

Nonika N, Gargi Danda De (2015): The authors has analyzed 16 storied building in ETABS in fout different seismic zones of India. For the same building there is only 23mm displacement in zone II but its 82.7mm in zone V. likewise there is also increase of base shear value that is 437.09 KN in zone II to 1573.51 KN in zone V. the storey drift is also high for the zone V with compared to other seismic zones. Lastly, authors has summarized that with the increase in modes, time period decreases.

Prakriti Chandrajar, Dr P.S Bokare (2015): For 10 storey building considering time history of Nepal earthquake (2015) and EI centro (1940). The displacement by response spectrum was 100mm but EI centro was 90mm and Nepal earthquake was 85mm. but for the base shear, at starting response spectrum is higher and later at 10th storey all three values meet at same point in both rectangular frame and T- frame building.

Richa Agarwal, Prof. Archana Tiwari (2017): Similar type building with varying storey (5 storey, 10 storey and 15 storey) was analyzed in four different seismic zones of India by ETAABS and STAAD Pro. For five storey building the axial force is same by both softwares and is continuously increasing from zone II to zone V but the result given by ETABS is slight less than STAAD Pro in shear force. The axial force, shear force and bending moment value is contiuuously increasing from zone II to zone V for five storied building and 15 storied building in both the softwares. But for 10 storey building there is sudden increase in shear force and bending moment from zone IV to zone V. The reinforcement in column in zone II is abuot 3 times less than in zone V.

Pradeep D, Chethan VR, Ashwini BT (2017): The authors has analyzed a normal building and a building with floating columns. For the regular (normal) building the maximum and minimum storey displacement was 24.7mm and -4.02mm but for building with floating column (model 3) it was less than model 1.the base shear value is also maximum for regular building than the building with floating columns. The same decreasing trend of base shear with increase in height is similar in all the models.

Narla Mohan, A. Mounika Vardhan (2017): From the table and graphs we found the base shear increase from zone II ‘802.6KN’ to zone V ‘2889 KN’. There is also increase in displacement of the building when we move from zone II to zone V. 0.1033mm was in zone II and it reached to 0.372 in zone V. Maximum storey drift is at the middle of the building.

Suchi Nag Choudhary, Dr. P.S Bokare (2017): G+10 storey building was analyzed in zone IV by STAAD Pro. the peak storey shear was maximum for base and 1st floor which is about 542.5 KN and is gradually decreasing with the increase in storey and to the 11th floor it was 60 KN.

3942.12 KNm was the maximum moment in 11th mode in all the directions and the moment was negative in 6th mode. The mass participation factor in 1st mode was 82.22% while it was reduced to o in 4th mode. Similarly there was 525.2 KN Base shear in 1st mode and o in 4th mode.

Siva Naveen, Nimmy Marian Abraham et al (2018): In this paper the authors have analyzed nine storied building with 54 irregular configuration by ETABS software. All the frames are subjected to seismic loads. Stiffness irregularity (vertical and horizontal) was found to have maximum influence on the building. From figure 3 it is clear that the maximum displacement is 18 mm at the top floor for stiffness irregularity [(S1-10) number of columns decreased from 28 to 12 but the length was increased to 0.458m from 0.229m]. And maximum storey drift was 11mm at 5th level for the same S1-10 case. It is not always true that changes in irregularities increase the response but sometimes decreases too. CSI and VGI resulted maximum response whereas re-entrant corner and VGI resulted less displacement responses.

P. Rajesware, Mr. A. Koti Neelakantam (2019): The paper presents with the increase in height the lateral force value is also increased and lateral force value of zone V is maximum in all floors. The storey displacement value in zone V is more than 3 folds to zone II in almost all stories. Also the storey drift is maximum at the centre of the building.

T. Srinivas, M. Abinay Raj (2019): 17 storey building was analyzed in ETABS in zone III and IV. From table 2 it is clear that storey drift is 0.001554mm in zone IV and 0.000647 in zone III. The stiffness of the building is more at zone III than in zone IV in all the floors. The base shear in zone IV is more than in zone III.

Ponnana Ramprasad, Madhusmita Moharana, Ch. Chandra Mouli (2019): The authors has analyzed G+20 building in ETABS adopting static, dynamic and progressive collapse analysis. Authors also added the result when we remove a column of ground floor of a building too. The base shear for static and dynamic seems to be slight greater in dynamic case but can be considered equal. The storey shear and overturining moment in static case is more than dynamic in all floors. In all cases base shear is equal. But the storey displacement in case I , dynamic analysis gave slight more than static. But in remaining cases static analysis gave more displacement than by dynamic analysis. Storey drift for static analysis is more than by dynamic analysis in all four cases.

Rakshit GM, Panendar Naik G, Swarna D, et al (2019): 21 storey building was analyzed by ETABS in different earthquake zones of India. Different cases were studied and interpreted in this paper. The base shear value was 4423.61 KN in zone V while it was 1231.67 KN in zone II. At 21st level there was 100mm more displacement at zone V than that of zone II in x-direction by earthquake load. The storey drift and storey shear in zone V was maximum in both the direction.

Mindala Rohini, T. Venkat Das (2019): G+15 storied building is analyzed by ETABS in zone III and zone V using time history and response spectrum method. Storey displacement in zone III is 0.28 at top floor which is same in zone V but in zone III the difference between Eqx and Rsx is about 0.06mm while in zone V is negligible. The storey drift is also maximum given by time history which is 0.000008m at 5th storey and is minimum by response spectrum (Rsz) which is 0,000005m at the same level in zone III. In zone V Rsx and Rsz are almost same at 5th floor and time history analysis has the maximum drift as in zone III. Storey shear is same in both the zones and time history has maximum value at 1st floor.

Md. Majid Raza, et al (2019): This paper presents static and dynamic (RSA) analysis for G+10 storey building by ETABS. From the table 4 the displacement of storey was 72.196mm at 10th storey in x-direction by static analysis method but by response spectrum method it was 62.031mm. for storey shear -74.33 tonf was given by static analysis method at 10th storey while by response spectrum analysis was showing 75.479 tonf for same storey in x-directioon. And in static method the shear is in only one direction that is in the direction of loading but in response spectrum analysis method shear is produced in both the directions.

Siddartha S. Ray, Alkesh S Bhalerao, Rahul Chaudrashekar(2020): The paper has presented analysis report for 15 storey building by ETABS and STAAD Pro in seismic zone III. Here the figure 1 shows 35mm deflection by ETABS whereas 36mm by STAAD at 15^{th} floor. Shear force was 2000 KN in ground floor which was 400KN more by ETABS and to the 15^{th} floor shear force was 250 by both the sooftwares. Deflection by ETABS was slight more than STAAD. There was only 5mm difference at 15^{th} floor. The displacememt and bending moment values tends to be identical whereas STAAD gave more shear force value. But axial force value was around 140 KN more by ETABS.

Nilenda Chakrabortty, Akshit Lamba (2020): The paper summarizes that the base shear in zone V is maximum of all and base shear in zone V is almost 73% more than that of zone II for the same building. The floor displacement of zone V is 40mm more than that of zone II. Reinforcement required in zone V is more with other zones. The difference is reinforcement required between zone V and zone II is more than 50%.

Conclusion

From this study that when we change the seismic zones all the parameters of the building will be changed. So thinking a similar type of building analyzed in one zone one cannot say the same building information to another zone. There is drastic change in the parameters when we move from zone II to zone IV.

Refrences

1. **Abhay Gulena (2014):** *"Structural Analysis of a Multi-Storeyed Building using ETABS for different Plan Configurations"* International Journal of Engineering Research & Technology (IJERT) www.ijert.org
2. **Mohammed Rizwan Sultan, D. Gouse Peera (2015):** *"DYNAMIC ANALYSIS OF MULTI-STOREY BUILDING FOR DIFFERENT SHAPES"* International Journal of Innovative Research in Advanced Engineering (IJIRAE) www.ijirae.com
3. **Nonika N, Gargi Danda De (2015):** *"SEISMIC ANALYSIS OF VERTICAL IRREGULAR MULTISTORIED BUILDING"* International Journal of Engineering Research & Technology (IJERT) www.ijert.org
4. **Prakriti Chandrajar, Dr P.S Bokare (2015):** *"Earthquake Analysis of G+10 Building using Response Spectrum Method and Time History Method - A Comparison"* International Journal of Science and Research (IJSR) www.ijsr.net
5. **Richa Agarwal, Prof. Archana Tiwari (2017):** *"Comparison of Design Result of Multi Story Structure using ETABS and STAAD PRO Software"* International Journal of Engineering Science and Computing http://ijesc.org
6. **Pradeep D, Chethan VR, Ashwini BT (2017):** *"SEISMIC ANALYSIS OF MULTI-STOREY BUILDING WITH FLOATING COLUMNS USING ETABS"* International Journal of Scientific Development and Research (IJSDR) www.ijsdr.org
7. **Narla Mohan, A. Mounika Vardhan (2017):** *"ANALYSIS OF G+20 RC BUILDING IN DIFFERENT ZONES USING ETABS"* International Journal Of Professional Engineering Studies
8. **Suchi Nag Choudhary, Dr. P.S Bokare (2017):** *"Dynamic Analysis of Multistory Building Using Response Spectrum Method and Seismic Coefficient Method -A Comparison"* IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 4 Issue 6 www.ijiset.com
9. **Siva Naveen, Nimmy Marian Abraham et al (2018):** *"Analysis of Irregular Structures under Earthquake Loads"* Elsevier www.sciencedirect.com
10. **P. Rajesware, Mr. A. Koti Neelakantam (2019):** *"SEISMIC ANALYSIS AND DESIGN OF MULTISTOREY BUILDING IN DIFFERENT SEISMIC ZONES BY USING ETABS"* International Journal of Engineering Research & Technology (IJERT) www.ijert.org

11 **T. Srinivas, M. Abinay Raj (2019):** "*Seismic Effect on Design of Residential Multi-Storey Building (Stilt+17 Floors) In Zone-Iii and Zone-Iv using Etabs"* International Journal of Engineering and Advanced Technology (IJEAT) www.ijeat.org

12 **Ponnana Ramprasad, Madhusmita Moharana, Ch. Chandra Mouli (2019):** *"Static, Dynamic and Pogressive Collapse Analysis of Multi Storey (G+10) Residential Building by ETABS Software"* International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-9 Issue-2S3 www.ijitee.org

13 **Rakshit GM, Panendar Naik G, Swarna D, et al (2019):** *"International Journal of Innovative Research in Science, Engineering and Technology"* www.ijirset.com

14 **Mindala Rohini, T. Venkat Das (2019):** *"Seismic Analysis of Residential Building for Different Zones using Etabs"* International Journal of Recent Technology and Engineering (IJRTE)

15 **Md. Majid Raza, et al (2019):** "Seismic Analysis and Design of G+10 RC Residential Building" http://ijesc.org/

16 **Siddartha S. Ray, Alkesh S Bhalerao, Rahul Chaudrashekar(2020):** *"Earthquake Analysis of Multistory Building"* International Journal of Advanced Science and Technology Vol. 29, No. 4, (2020)

17 **Nilenda Chakrabortty, Akshit Lamba (2020):** *"Analysis and Design of G+3 Building in Different Seismic Zones using E-tabs"* International Research Journal of Engineering and Technology (IRJET) www.irjet.net