ANALYSIS AND DESIGN OF STRUCTURAL COMPONANTS OF (G+10) STOREY RCC BUILDINDING USING ETABS

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ABSTRACT: In this paper, structural behavior of multi-story building for different plan configurations like rectangular C L and I-shape. Modeling of 10- story R.C.C. framed building is done on the ETABS software for analysis. Post analysis of the structure, maximum shear forces, bending moments and maximum story displacement are computed and then compared for all the analyzed cases.in this review paper old paper references are studied and a conclusion is drawn for carrying a future work .

I. INTRODUCTION

The following papers were studied for carrying out the research work carefully whose abstract and works are described in the paper briefly.the main focu was to understand the simulation analysis of ETAB software which was clarified from the paper of Purnima D., Sanjay S.J. and Yajnodbhavi H.M. (2017). Then after research papers were taken to understand the specifications of the multistories building.also papers are reviewed for earthquake factor study.

P. Kalpana R.D. Prasad and B. Kranthi Kumar (2016)

In there research paper of "Analysis of Building with and without Shear Wall at Various Heights and Variation of Zone III and Zone V,it explains that In seismic design building there are various methods to ensure stability against lateral forces caused by earthquake. Most commonly used systems is shear wall. The reinforcement concrete shear wall is one of the most reliable systems to make the structure resistant against lateral forces. Shear wall imparts stiffness to the structure which minimizes the damage caused by the earthquake and provides enough strength.. In this paper four models were analyzed in which two models are with shear wall and rest of two models are with shear wall for different heights. In shear wall models, shear wall are placed at corners. All 4 models with and without shear wall were analyzed through STAAD Pro. v8i by using response spectrum method. And calculate the lateral displacement, storey drift and base shear

Ravi Kumar, K. Sunder Kumar and BadipatiAnup (2017),

In there research paper of "Analysis and Design of Shear Wall for an Earthquake Resistant Building using ETABS" it explains that Shear walls generally used in high earth quake prone areas, as they are highly efficient in taking the loads. Not only the earthquake loads but also wind loads which are quite high in some zones can be taken by these shear walls efficiently and effectively. To determine the solution for shear wall location in multi-storey building based on its both elastic and elasto-plastic behaviors. The earthquake load is to be calculated and applied to a multi-storied building of plan 26mx26m and 10 no. of (G+9) floors with 40 meters height.

For this model, results are calculated and analysed for the effective location of shear wall. The design above is verified for this same structure using extended three dimensional analysis of buildings (ETABS) software. The results are compared

Conclusions from The Work

1) Thus shear walls are one of the most effective building elements in resisting lateral forces during earthquake.

2) Not only for its strength and also in order to accommodate huge number of population in a small area are tall structures with shear walls considered to be most useful.

3) ETABS is the advanced software which is used for analysing any kind of building structures. By its fast and accuracy it can easily analyse buildings up to 40 floors. Shear wall design is separately done in this software with different combination of loads.

4) ETABS can analyse any building structure with pre-determined load conditions and load combinations for shear walls regarding IS codes.

5) So, for designing of building shear wall structure if we use ETABS software then it analyse the building easilyand give the fast resultswith accurate data.

II. RECOMMENDATIONS FOR FUTURE SCOPE

Shear walls are considered to be a gift to the future construction industry. Scope of shear walls in construction field is immense. It's since their arrival in market there topic was always a topic of interest. Shear walls are the structures usually build to balance lateral loads acting on the structure. Where the lateral loads are most predominantly wind and earth quake loads. And predominantly earthquake loads are more intense in their effect on the building structures. Earthquakes are becoming more intense due to the key reason that is ground water depleshement. Hence in order to overcome the diverse effects of earthquake it is always best to save ourselves from future disasters. Shear walls are quick in construction, as the walls doesn't need any special brick arrangement or plastering they are very quick in their construction. It just requires an effective form work and very few skilled labours. It was estimated that a 20 floors building can be built within six months which is most astonishing. At the same time ETABS software which gives the speed analysis and results will helpful to compare the manual design. Not only for the quickness in its work and resistance to earthquakes, shear walls are also build for defence purpose. Presently The Hindustan Prefab Limited (HPL) is executing various locatable prefab structures for paramilitary forces especially for the CRPF in Karnataka, Uttar Pradesh, Chhattisgarh and Bihar among others. We are using "Shear

Wall" technology with thermal curing –a fast track technology– for KMDA for construction of houses in Kolkata, chairman and managing director HPL JaiveerSrivastava said.

Jay Kumar Sash, Perm Shankar Singh and Chimney Kumar Kudu (2018),

In there research paper of "Analysis and design of the seismic resistant multistory building with shear walls and raft foundation it explains that The earthquakes occurring in different parts of the world including Nepal and India have caused damage to structures, properties and loss of human lives.The recent high-intensity earthquake of magnitude in Gorkha, Nepal 7.8 on April 25,2015 has caused damage to public buildings and loss of human lives.Thus, the necessary steps are to be taken to minimize the loss of life and property for planning and designing earthquake resistant structures following the seismic codal provisions as the earthquake cannot be prevented.Practical knowledge is an important and essential skill required by every engineer. For obtaining this skill, a multistorey building is analysed and designed, located in Zone III with B+G+13 storeys with a 3-meter height for each storey having a car parking facility provided at basement. The building has a shear wall around the lift pit. The structure is modelled and analyzed using STAAD.Pro V8i.Design of beam, column, slab, shear wall, and raft foundation by SAFE are done. The saving of time is must important factor for structural engineer as there is the tough competition in today's rapidly urbanized market and to cope with the scarcity of land, an attempt is made here for the "ANALYSIS AND DESIGN OF SEISMIC RESISTANT MULTISTOREY BUILDING WITH SHEAR WALLS AND RAFT FOUNDATION" using STAAD.Pro.

The main objective of the study is:

1. To design an earthquake resistance multistorey building and analyze its structural member.
2. To analyze the building using STAAD.Pro V8i and design the raft foundation by SAFE.
3. To get the practical knowledge to plan and complete the project on earthquake resistant framed structural multistorey building

III. METHODOLOGY

A multistorey residential building is analysed and designed, located in Zone III with B+G+13 storeys with a 3-meter height for each storey having a car parking facility provided at basement. The dimensional model is created from the plan with 25×25m dimensioned plan having 5×5 bays and total height 45 m. The building has a shear wall around the lift pit. Here, we have taken the Ordinary moment resisting frame building in earthquake zone III with response factor 3 and importance factor 1. Then, the analysis is of the structure and design of the members with reinforcement details for B+G+13 residential building RCC frames according to the specified criteria is done. In order to determine the design earthquake force and distribute along different floor levels and elements of the building, static analysis is done. Design of beam, column, slab, shear wall, and raft foundation are done. For this purpose, STAAD.Pro V8i is used. In this method the earthquake force is applied at the nodes or joints of the building and calculated. Limit state method following IS codes is used for the analysis in STAAD.Pro V8i. Sseismic code IS:1893-2002 is used for earthquake design.

Purnima D., Sanjay S.J. and Yajnodbhavi H.M. (2017),

In there research paper of "Seismic analysis of RC residential multi-story building for different locations of shear wall" it explains that In the present situation of metropolitan urban areas tall structures are assuming an imperative part as there is lack of area. Step by step trek in the area rates are confronting interest for the tall structures. So as to complete activities of tall structures part of basic investigation should be finished. As the tallness of the structure builds, the lateral strengths like quake and wind powers overwhelm. The primary point of the present Paper is to excuse the position for the shear wall for a G+9 Residential building by considering the heap case such quake, twist by Response spectrum method for different type of buildings, for example, Symmetric building, Plan irregular building and with RC surrounded structures by finding the shear walls at distinctive positions, for example, Shear wall at the internal center of the model, Shear wall at the fringe side edges and Shear wall at the corner edges for all the structures by considering the parameters like Maximum Story Displacements and Maximum story Drifts investigating both by the static and element examination systems by the procurement of programming bundle ETABS-2013

From there studies they completed certain objectives

1. To study the effect of lateral load resisting systems for a regular high rise building.
2. To study the effect of lateral forces on high rise irregular structure.
3. To analyze a regular and irregular structure without placing the shear wall, and analyzing the same structure by placing the shear wall at different locations like at the inner core, side edges and straight walls.
4. To study the effect of positions of shear wall by changing the zones of the structure like for zone 2, zone 3, zone 4, zone 5.
5. To study the parameters like storey displacements and storey drifts forces in response spectrum analysis method.

Conclusions

For Symmetric Building

There is considerable reduction in displacement in x and y direction by the shear wall introduced at type-3 model for all– the load combinations considered. Therefore type-3 is best model compare to other type models. There is drastic reduction in Storey drifts in x and y very low in bottom stories, very high at the middle stories and finally– decreases towards the upper stories. After observing all the graphs, it can be generally said that drift ratio in upper Storey is generally more, less in lower stories and maximum being middle stories. Direction in type-3 model for all the load combinations considered. Therefore type-3 model is best shear wall located model compare to other type models.

For Plan Irregular Building

There is considerable reduction in displacement in x and y direction by the shear wall introduced at type-3 model for

all– the load combinations considered. Therefore type-3 model is best compare to other type models. There is drastic reduction in Storey drifts in x and y direction in type-3 model for all the load combinations considered.– Therefore type-3 model is best model compare to other type models.

SCOPE FOR FUTURE WORK

Study by considering the different type of irregularities.– Study the same work by Time history analysis.–

MODELLING considered

In General There are many software packages available for the structural analysis. One of the most commonly adopted is computers and structures Inc. Developed programs like STAAD-PRO, ETABS, SAP, etc. to facilitate the structural engineers to easily model, analyze and design the buildings and its components.

Model Description

The building considered is a G+9 Residential Building for all types of models of same overall height of 30 m with each storey height of 3 m. The below table gives the plan of different types of models considered Symmetric Building & Plan Irregularity

Analysis using ETabs

Entire dissertation work starting from modelling, analysis is carried through ETABS-2013 software package. The basic mechanism of the program is very simple. The user initially defines all the material properties, section properties, load patterns, load cases, load combinations, response spectrum functions. The material properties include defining grade of concrete and reinforcing bars. The sections properties include defining beam sections, column sections, slab sections, wall sections etc. Defining Material Properties, Sectional Properties and Loads

The above paper was respectful enough to carry out the work further

Piyush Tiwari, P.J. Saluki,

In there research paper of "Earthquake Resistant Design of Open Ground Story Building" it explains that Open ground building (OGS) has taken its place in the Indian urban environment due to the fact that it provides much needed parking facility in the ground storey of the building. Surveys of buildings failed in past earthquakes show that this types of buildings are found to be one of the most vulnerable. Presence of infill walls in the frame alters the behavior of the building under lateral loads. However, it"s common industry practice to ignore the stiffness of infill wall for analysis of framed building. Design based on such analysis results in under-estimation of building moments and shear forces in the columns of ground storey and hence it may be one of the reasons responsible for the failure observed. IS code 1893:2002 allows the analysis of open ground storey RC framed building without considering infill stiffness but with a multiplication factor of 2.5 in compensation for stiffness discontinuity. As per the code" The columns and Beams of soft storey building are to be designed for 2.5 times the storey shears and bending moments calculated under seismic loads of bare frames. However, as experienced by the engineer at design offices, MF of 2.5 in not realistic for low and mid rise buildings. This calls for assessment and review of the code recommended multiplication Factor for low rise and mid rise OGS buildings. Therefore objective of this study is to check the applicability of multiplication factor of 2.5 and to study the effect of infill strength and stiffness in seismic analysis of OGS buildings. Three Different models of existing RC framed building with open ground storey located in Seismic Zone V is considered for the study using commercial Etabs Software. Infill Stiffness with openings was modeled using a Diagonal Strut approach. Linear and Non-Linear analysis is carried out for these models and results were compared.

Arther H. Nilsson, Darwin, Charles W. Dolan, Design of Concrete Structures. 14th ed.

In there research paper of 14th edition of the classic text, Design of Concrete Structures, is completely revised using the newly released 2008 ACI (American Concrete Institute) Code. This new edition has the same dual objectives as the previous editions; first to establish a firm understanding of the behavior of structural concrete, then to develop proficiency in the methods used in current design practice.

Design of Concrete Structures covers the behavior and design aspects of concrete and provides updated examples and homework problems. New material on slender columns, seismic design, anchorage using headed deformed bars, and reinforcing slabs for shear using headed studs has been added. The notation has been thouroughly updated to match changes in the ACI Code.

The text also presents the basic mechanics of structural concrete and methods for the design of individual members for bending, shear, torsion, and axial force, and provides detail in the various types of structural systems applications, including an extensive presentation of slabs, footings, foundations, and retaining walls.

DESIGN OF COMMERCIAL BUILDING USING ETABS

The innovative and revolutionary new ETABS is the ultimate integrated software package for the structural analysis and design of buildings. Incorporating 40 years of continuous research and development, this latest ETABS offers unmatched 3D object based modelling and visualization tools, blazingly fast linear and nonlinear analytical power, sophisticated and comprehensive design capabilities for a wide-range of materials, and insightful graphic displays, reports, and schematic drawings that allow users to quickly and easily decipher and understand analysis and design results. From the start of design conception through the production of schematic drawings, ETABS integrates every aspect of the engineering design process. Creation of models has never been easier - intuitive drawing commands allow for the rapid generation Analysis and Design of Shear Wall for an Earthquake Resistant Building using ETABS (IJIRST/ Volume 4 / Issue 5/ 011) All rights reserved by www.ijirst.org 74 of floor and elevation framing. CAD drawings can be converted directly into ETABS models or used as templates onto which ETABS objects may be overlaid. The state-of-the-art SAP Fire 64-bit solver allows extremely large and complex models to be rapidly analysed, and supports nonlinear modelling techniques such as construction sequencing and time effects (e.g., creep and

shrinkage). Design of steel and concrete frames (with automated optimization), composite beams, composite columns, steel joists, and concrete and masonry shear walls is included, as is the capacity check for steel connections and base plates. Models may be realistically rendered, and all results can be shown directly on the structure. Comprehensive and customizable reports are available for all analysis and design output, and schematic construction drawings of framing plans, schedules, details, and cross-sections may be generated for concrete and steel structures. ETABS provides an unequalled suite of tools for structural engineers designing buildings, whether they are working on onestory industrial structures or the tallest commercial high-rises. Immensely capable, yet easy-to-use, has been the hallmark of ETABS since its introduction decades ago, and this latest release continues that tradition by providing engineers with the technologically-advanced, yet intuitive, software they require to be their most productive. Procedure for design of shear wall for 10 storey buildingFirstly click on the ETABS icon .A window appears which shows a different tip every time you open the software. This window provides us 3 options. You can click on previous or next tip to checkout some more tips or else click ok to move further. Change the units at the right bottom to KN-m or any other as per your convenience. Click on file option to create a new file or to open an already existing file When you open a new file another window appears which again contain 3 options Choose. edb– Default. edb and– No–

New model selection

First option helps us to select an already existing file–

Second helps us to create a new file and–

The third displays the grid data and story data–

As we are creating a new file, we click on default.edb A new window appears which has Building plan grid system and Story data. In grid dimensions we can either use uniform spacing or we can customize the grid spacing. We have to provide no of lines in x and y directions as per the columns and beams used in the plan. In the story dimensions, we have simple story data and custom story data. In simple story data, use the defaults or specify values for the number of stories, typical story height, and bottom story height. The value specified for the typical story height will be used for all stories in the model, except the bottom story whereas in custom story data we can manually define story names, story levels of non-uniform height, and story similarity. After providing the entire data click on grid only in structural objects and then click on ok. Now the screen is divided into two equal halves in which one is plan view and the other is 3-D view of the provided data. We can change the view options to plan,3D or elevation views. We can select any of the stories as per the work to be done on that particular story. At the right corner we change the story options to either similar or all stories. This makes us to save time i.e. if we are working on a particular story, then that is transferred to remaining stories or similar stories as per the option selected. The top story is selected as default story. After the entire grid data and story data is provided, then we have to define the properties of the material that is used.

RECOMMENDATIONS

From the above studies work on ETAB will be carried on a model of (G +10) building.also results will be confirmed and compared with manual operations in the futher research paper.

REFERENCE

[1] P. Kalpana R.D. Prasad and B. Kranthi Kumar (2016) “Analysis of Building with and without Shear Wall at Various Heights and Variation of Zone III and Zone V,” IJERA, Volume 6, Issue 12, Part-2, pp.05-11.

[2] Ravi Kumar, K. Sunder Kumar and BadipatiAnup (2017), “Analysis and Design of Shear Wall for an Earthquake Resistant Building using ETABS”, IJIRST, Volume 4 Issue 5, PP 5-11.

[3] Jay Kumar Sash, Perm Shankar Singh and Chimney Kumar Kudu (2018), “Analysis and design of the seismic resistant multistory building with shear walls and raft foundation,” International Journal of Advance Research, Ideas and Innovations in Technology, Volume 4, Issue 2, PP 2348-2356.

[4] Purnima D., Sanjay S.J. and Yajnodbhavi H.M. (2017), “Seismic analysis of RC residential multi-story building for different locations of shear wall”, International Journal of Science Technology & Engineering,” Volume 3, Issue 11, PP 54-62

[5] Piyush Tiwari, P.J. Saluki, “Earthquake Resistant Design of Open Ground Story Building”, International Research Journal of Engineering and Technology, ISSN: 2395 0056, Volume: 02 Issue: 07-Oct-2015.

[6] Winter-Urquhart ‘O’Rourke-Nilsson: Design of Concrete Structures. 7th ed

[7] Arther H. Nilsson, Darwin, Charles W. Dolan, Design of Concrete Structures. 14th ed

[8] Prajapati, R.J. and Patel, V.R. (2013),” Effect of different position of shear wall on deflection in high rise building", International Journal of Advances in Engineering & Technology, IJAET,Vol.6, No.4, pp. 1848-1854.

[9] Raju, K.L. and Balaji, K.V. (2015), “Effective location of shear wall on performance of building frame subjected to earthquake load”, International Advanced Research Journal in Science, Engineering and Technology, Vol.2, No.1, pp. 33-36.

[10] Ravi kumar, C.M. et.al. (2012),” Effect of Irregular Configurations on Seismic Vulnerability of RC Buildings”, Architecture Research, Scientific & Academic Publishing, pp. 20-26.

[11] [11] Reddy, N.J. et.al. (2015),” Seismic Analysis of Multi-Storied Building with Shear Walls Using ETABS-2013”, International Journal of Science and Research, IJSR, Vol.4, No.11, pp. 1030 – 1040.

[12] [12] Singh, R. et.al.(2014),” Seismic behavior of buildings having vertical irregularities”, Universe of Emerging Technologies and Science, Vol.1, No.5

