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A Review Paper on Comparative study on analysis of high rise building structure with approximate method and softwares.

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ABSTRACT: The portal method is one of the common approximate methods in the analysis of statically indeterminate structures. This method is used to analyze the frames which subjected to lateral loadings such as wind, earthquake, and blast loadings. The portal method is still used in the planning phase of projects, preliminary designs, and quick checking for analysis. In this report an improvement is presented to make the portal method analysis more closer to the accurate analysis for one bay frames. In this work, the analysis by using the finite element method is carried out for a twenty seven building frames with various numbers of bays and stories. The outputs indicate that some improvements in the portal method will be useful to make this method more accurate. The improvements have been written in a new "modified portal method". In order to compare the results of the analysis after improvement, a typical five frames have been analyzed by using three methods: namely, portal method, modified portal method (presented in this report), and the finite element method via ETABS 2017. The analysis by using the modified portal method gave more accurate results than the basic portal method for the multi-story frames with one bay, but didn't improve the results for the frames with more than one bay.

Key Words: Portal Frame Method, Cantilever Method, Approximate method, ETABS, STADD PRO.

INTRODUCTION: Analysis of Multi Storey Building was taken as a project work of residential building. The structural analysis of Multi Storey building has been carried out using ETABS 2016. Analysis of Residential building consisting of G+20 floors has been carried out. All reinforced concrete structures are designed using M40 Grade of concrete, FE- 500 rebar and torsion steel FE345.

In this report, first the methodology is adopted for Analysis of residential building consisting of G+20 floors has analysis of Multi Storey Building, reduction of deflection using bracing system and optimization of beams and columns. The exposure condition is taken to be Moderate.

2. LITERATURE REVIEW:

2.1 Introduction:

For completion of search program we had did study of following research and made literature review as follows.

Prof. S .Vijaya Bhaskar Reddy et.al. [01]

Presented the research on "Comparative Study on Design Results of a Multi-storied Building using STAAD PRO and ETABS for Regular and Irregular Plan Configuration". In this study Structural Analysis and design are predominant in finding out significant threats to integrity and stability of a structure. Multi storied structures, when designed, are made to fulfill basic aspects and serviceability. Since Robustness of structure depends on loads imposed, it requires attention. All the challenges faced by structural engineers were taken as opportunities to develop software's such as STAAD PRO, ETABS & SAFE, SAP etc., with ease of use. Software's such as ETABS and STAAD-pro are leading commercial software's worldwide for structural analysis. The design results using STAAD PRO and ETABS of a rectangular RCC building, for both regular and irregular plan configuration, are obtained and compared. After Discussion of results and observation some of results are summarized. Based on the behavior of RCC frames on STAAD Pro and ETABS some important conclusions are drawn: Results of max vertical reactions of a 12-storey regular building. It has been concluded that the max reaction produced is 4572.12kN in ETABS and 4624.92kN in STAAD Pro due to load 1.5(Self +Dead +Live). It has been concluded that the maximum displacement is along x- direction and its value is 106.25mm (in STAAD Pro.) for irregular building and 53.47mm (in ETABS) along z-direction for regular building. So, more precise results are generated by ETABS which leads to economical design of the building. Design Results of sample beam and column of storey 6 from ETABS and Column 851 of storey 6 from STAAD Pro of 12 storey – regular building are taken for comparison. As per above table it has been concluded that the ETABS gave lesser area of steel required as compared to STAAD Pro in case of beam whereas in case of column steel calculated is same by both software's. Comparison of Storey Overturning Moments As per above graph it has been concluded that the storey overturning moment decreases with increase in storey height along x-direction for EQ length load and they are more in regular building than the irre111gular building. Maximum Steel Reinforcement of beam and column of regular and irregular building in ETABS. As per above table it has been concluded that the ETABS gave lesser area of steel reinforcement for irregular building as compared to regular building in case of beams and columns.

Abhay Guleria [02]

Presented a research on study on Structural Analysis of a Multi-Storey Building using ETABS for different Plan Configurations his study indicate that ETABS stands for Extended Three dimensional Analysis of Building Systems. ETABS is commonly used to analyze: Skyscrapers, parking garages, steel & concrete structures, low and high rise buildings, and portal frame structures. The case study in this paper mainly emphasizes on structural behavior of multi-storey building for different plan configurations like rectangular, C, L and I-shape. Modelling of15- stores 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 storey displacements are computed and then compared for all the analyzed cases. After this analysis researcher conclude that the analysis of the multi-storey building reflected that the storey overturning moment varies inversely with storey height. Moreover, L-shape, I-shape type buildings give almost similar response against the overturning moment. Storey drift displacement increased with storey height up to 6th storey reaching to maximum value and then started decreasing. From dynamic analysis, mode shapes are generated and it can be concluded that asymmetrical plans undergo more deformation than symmetrical plans. Asymmetrical plans should beadopted considering into gaps.

SayyedA.Ahad et.al. [03]

Presented a detail Analysis and Design Of Multistory Apartment Building Using ETABS.In this study researcher presented that Practical knowledge is an important and essential skill required by every engineer. For obtaining this skill, an apartment building is analyzed and designed, Located in Latur, Maharastra with (B+G+10) storey having a car parking facility provided at basement floor. The building has a shear wall around the lift pit. The modelling and analysis of the structure is done by using ETABS and the designing was done. Design of slab, stair case and an isolated footing are done manually. The design methods involves load calculations manually and analyzing the whole structure by ETABS. The design methods used in ETABS are limit state design confirming to IS code of practice. Along with analyzing and designing of this building, construction sites were also visited. After analysis researcher conclude that Analysis is done by using the software ETABS V15.2, which proved to be premium of great potential in analysis and design of various sections. The structural elements like RCC frame, shear wall and retaining walls are also provided. As per the soil investigation report, an isolated footing is provided. The design of RCC frame members likebeam and column was done using ETABS. The analysis and design was done according to standard specifications to the possible extend. The various difficulties encountered in the design process and the various constraints faced by the structural engineer in designing up to the architectural drawing were also understood.

Salonica Jennifer et.al. [04]

Presented a study on "Analysis and Design of Multi-Storied Building of Different Plan Configurations Using ETABS" In this study researcher indicate that ETABS is integrated software used for the structural analysis & design of buildings. This paper deals with the study of behavior of buildings under application of horizontal loads such as seismic loads & wind loads. The study focuses mainly on the effect of shape of a structure in resisting these lateral loads. Four different configurations are considered in this study namely: L-shape, I-shape, C-shape & rectangular shape. The analysis results of storey drift, storey shear, maximum storey displacement & over turning moment is noted down. After analysis researcher conclude that, The Regular building frames possess high shear force compared to irregular frames. According to results of analysis the stiffness irregular building experienced larger inter storey drift as compare to regular frame. It is seen that storey displacement of top storey is maximum among all the frames. The seismic performance of regular frame is found to be better than corresponding irregular frame in nearly all the cases, thus it should be constructed to minimize the seismic effect.

K. Kiran Mai et.al. [05]

Presented a detail study on "Analysis and Design of Residential Building C+G+7 using E-Tabs" In this study researcher indicate that the main steps of any building construction and planning is drafting, analyzing and designing the building. In the present days of improving science and technology, analyzing and designing of a building has been made easy by using ETABS software. ETABS software helps civil engineers to make their work easy and decreases time necessary for planning. The project going to be done is design of a multi-storey building which is going to be used as a residential. The building plan has been drafted using the AutoCAD software by the requirement and available area. The super structure i.e. the building frame has been analyzed and designed using the ETABS software. In the present project C+G+7 building consider to analysis and design for both gravity and lateral (wind and earth quake) loads as per Indian standards. By using the software building can be analyzed and we can check for any failures in the analysis and redesign them, so that we can prevent failures after construction. By using the output building can be constructed according to the design.Based on the analysis and design of multi-storied building, researcher conclude that our project deals with provision of earthquake resistant structure which is also economic. Minimum sizes of the beams and columns were provided as B230mmX450mm and C230mmX450 mm, after analysis only the failed column axes and dimensions were changed to C230mmX750 mm which comes under economic. Seismic analysis was done by using ETABS software and successfully verified manually as per IS 1893-2002.There is a gradual increase in the value of lateral

forces from bottom floor to top floor in software analysis. Maximum Shear force is 93.8KN and Maximum Bending Moment values is 79.5KN, which is acted at top floor of the building.

C.V.Siva Rama Prasad et.al. [06]

Presented a research on Analysis And Design Of G +20 Residential RCC Building By Using ETABS In Zone II, In this study he indicate that, Hyderabad being the 5th largest city in the country and developing city there is a rapid increase in construction field. So there is a need for multi storey buildings. So that for analysis and design of multi storey building, one requires concepts of structural engineering and also basic idea on theoretical and practical knowledge on planning and designing. In this project we mainly deal with analysis and design of multi storey building by using ETABS software, considering loads i.e., dead loads, imposed loads, wind loads and seismic loads. Hyderabad comes under zone II. Though there is no consideration of seismic loads in zone II we include it as we have taken G+20. Structures higher than G+5 are considered under seismic loading. After analysis researcher conclude that Hyderabad being the 5th largest city in the country and developing city there is a rapid increase in construction field. So, there is a need for multi storey buildings. So that for analysis and design of multi storey building, one requires concepts of structural engineering and also basic idea on theoretical and practical knowledge on planning and designing. In this project we mainly deal with analysis and design of multi storey building by using ETABS software, considering loads i.e., dead loads, imposed loads, wind loads and seismic loads. Hyderabad comes under zone II. Though there is no consideration of seismic loads in zone II we include it as we have taken G+20. Structures higher than G+5 are considered under seismic loading.

Shaik Akhil Ahamad et.al. [07]

Presented a research on Dynamic analysis of G + 20 multi storied building by using shear walls in various locations for different seismic zones by using Etabs, in this study he indicate that, Structural Engineers are mainly concerned with finding out the behavior of a structure when subjected to horizontal forces and adequate stiffness is required for the buildings which are high rise in order to con-front horizontal forces aroused by winds and earthquakes. To confront the horizontal forces i.e., lateral loads developed by earthquakes and to contribute more stiffness to the structure we use Shear walls,which are added to the interior of the proposed structure. This paper aims to study the usage of Shear walls at different locations in a G + 20 multi storied residential building and to study the nature of the structure exposed to earthquake by adopting Response Spectrum Analysis. The Multi storied building with G + 20 is analyzed for storey drift, base shear, maximum allowable displacement and torsional irregularity. The analysis and modeling for the whole structure is done by using prominent FEM integrated software named Etabs2015 in all the seismic zones of India prescribed by IS 1893 (Part-1) 2016. In this project the dynamic analysis is carried out on type -III (i.e., soft soil) for a irregular structure in plan in all the zones as specified and it is concluded that the structure with shear walls (i.e., Case C) placed symmet-rically will show better results in terms of all the seismic parameters when compared with the structures without shear wall (i.e., Case A) and with shear wall at one end (i.e., Case B).in this study he conclude that,It is studied that maximum displacement and storey drift values are found to be higher in seismic zone V for all the cases A, B and C when correlated to zones II,III and IV which indicates that displacement can be reduced by making the structure with uni-form stiffness. It is observed that the building with shear walls placed at four ends i.e., Case C , had given better results in terms of maximum displacement, storey drift and base shear, So that it is concluded that building with uniform stiffness proven better results. It is noticed that the parameter base shear shown maximum value in zone V when correlated with other seismic zones for cases A and C but for case B the value of base shear is more in zone IV when correlated with zone V and this indicates that the building with shear wall at one end subjected more lateral load and hence this building requires uniform stiffness. Torsional Irregularity is observed due to load case EQ + X in Glo-bal X-direction for Case C and for the remaining two cases i.e., and B the building remains safe with torsional irregularity which indicates that the building for the present study needs further stiffness in-order to reduce displacements in all the seismic zones of India.

Liaqat A. Qureshi et.al. [08] Presented a research on Seismic Analysis And Design Of High Rise buildings In Different Base Profiles This paper presents the comparison of computer-aided seismic analysis and design of high rise buildings in different types of soil conditions. The analysis of high rise reinforced concrete building is commonly simplified by assuming a fixed base and ignoring the effect of soil-structure interaction. However, the foundation flexibility affects the dynamic characteristics of high rise structures and influences their dynamics periods, base bending moment, and base shear force. In cases where the soft layers need to be considered on the load path to the strong layers, soil profile under the structure should also be considered in the analysis. The aim of this set of analyses is to present the influence of site condition (soil profile) on structural behavior. In the current study, a finite element formulation is made on structural engineering software ETAB (based on finite element methodology) for the dynamic analysis of a 20 storied residential apartment building subjected to earthquake ground motion accounting for soil-structure interaction. The effects of foundation flexibility on the dynamic behavior of the building are evaluated for various types of soil profiles. A typical example for this building is analyzed and the results for a range of soil static and dynamic parameters are presented. The detailed comparison of analysis & design of the model revealed the vital importance of soil investigation before seismic design and its effect on overall planning, design and construction of the projects especially in the earthquake sensitive regions. In this research researcher conclude that,Fundamental time period for the building modeled on soft soil profile is more than the building modeled on hard soil profile.In displacements and drifts due to earthquake, soft soil profile exhibits more of these values than hard soil in dynamic analysis. The moment and shear force of all columns and beams are gradually increased from hard soil profile SA to soft soil SD. Base shear and support reaction is gradually increased from hard soil profile to soft soil profile. There is no significant difference in column reinforcement from hard soil profile SA to softsoil SD except in very soft soil profile SE. Both positive and negative reinforcement of beams are increased from hard soil profile SA to soft soil profile SE.

Nirmal S. Mehta et.al [09]

Present study represents the analysis and design of ten storey residential building with basement. The building is considered in Ahmedabad (Gujarat) region. The sizes of various structural elements are decided after optimization. For analysis and design, building model is generated in ETABS 2013 software. The various parameters like Centre of mass, Centre of stiffness, displacement of building, storey drift and rotational displacement are considered for analysis purpose. It is observed that center of mass and center of stiffness are depending on the orientation of column. It is also observed that eccentricity in Y-direction is very high as compared to X-direction due to unequal mass distribution at top floor. In this research he conclude that Centre of mass and centre of stiffness of floor are depending on the size and orientation of column as well as shear wall. Eccentricity in Y direction is very high as compared to X direction due to unequal mass distribution at top floor. Maximum storey drift in Y direction is 0.095 mm. Maximum inter storey drift is under limit prescribed by IS 1893:2002.Maximum storey displacement in X-direction is 10.1 percentages higher than Y-direction.

Kona Narayana Reddy et.al. [10]

Presented a research on A Study on Multi-Storeyed Building with Oblique Columns by using ETABS. In this study he represent that Facing a large number of new-type complex structural system and progressively consummate earthquake-resistant theories, the conventional software can no longer meet the needs of calculation and analysis. Meanwhile, some international finite element programs, such as ETABS, were updating themselves but remained respective limitations. The Oblique Column are neither parallel nor at right angles to a specified line means they are slanted or Rotated at an angle. In this present work concerns with the elastic flexural buckling of doubly symmetric columns with oblique restraints under concentric loading. Oblique restraints cause coupling between the principal axis deflections and rotations, and the flexural buckling mode involves simultaneous bending about both principal axes. The present work deals

with a study on the Oblique columns of different shapes in high rise building. In this work a high rise building with Normal Columns & with different locations of Oblique columns is considered for analysis. In this paper, response spectrum & Linear Static analysis were executed combined with a Numerical Building Model by this program, which were also compared following the analysis results. The results of the analysis on the Axial forces, Base shear, Time period, Storey drift and Displacements are compared. The results are presented in tabular and graphical form. The results on the displacement are checked with serviceability conditions and are compared and presented in tabular form. In this study he conclude that, As the lateral loads are resisted by structure with Oblique columns, the top storey displacement is very much less in Oblique structure as compared to the simple RC Frame building. As time period is less, lesser is mass of structure and more is the stiffness. The time period is observed less in Structure with Oblique columns. This reflects more stiffness of the structure and lesser mass of structure. Structure provides more resistance in the oblique column building which makes the structural system more effective. From the above all models we will prefer symmetrical building because it gives better results than asymmetric building. The overall results suggested that Oblique column is excellent seismic control for high-rise symmetric Buildings.

B.Jaswanth et.al. [11]

Presented a research on Seismic Analysis of Multi-Storied Building with Shear Walls using ETABS, In this study he represented that Shear walls are structural members used to elongate the strength of R.C.C. structures. These shear walls will be construct in each level of the structure, to form an effective box structure. Equal length shear walls are placed symmetrically on opposite sides of outer walls of the building. Shear walls are added to the building interior to provide more strength and stiffness to the building when the exterior walls cannot provide sufficient strength stiffness. It is necessary to provide these shear walls when the tolerable span- width ratio for the floor or roof diaphragm is exceeded. The present work deals with a study on the improvement location of shear walls in symmetrical high rise building. Position of shear walls in symmetrical buildings has due considerations. In symmetrical buildings, the center of gravity and center of rigidity coincide, so that the shear walls are placed symmetrically over the outer edges or inner edges (like box shape). So, it is very necessary to find the efficient and ideal location of shear walls in symmetrical buildings to minimize the torsion effect. In this work a high rise building with different places of shear walls is considered for analysis. The multi storey building with 8 story's is analyzed for its displacement, strength and stability using ETABS-2015 software. For the analysis of the building for seismic loading with Zone-III is considered with soil III. The analysis of the building is done by using equivalent static method and dynamic method. In this study he conclude that ,The analysis of building with Core shear wall and edge shear wall shows that Shear wall at core shows stiffer behavior. When shear walls are provided on edge maximum storey displacement of buildings is increased comparing to when shear walls are provided on center portion. When dynamic analysis is done storey drift decreases. When shear wall is placed on edge time period of building increases. When shear walls are provided on edge storey drift of buildings is increased comparing to when shear walls are provided on center portion. For good seismic performance a building should have adequate lateral stiffness. Low lateral stiffness leads to large deformation and strains, damage to non-structural component, discomfort to occupant. Stiff structures though attracts the more seismic force but have performed better during past earthquake (Jain S.K. and Murty C V R, 2002). So from above results Building with shear wall at core proves to be a better alternative for building in earthquake prone area. Dynamic analysis reduces storey shear, storey displacement, storey drift etc; this shows that dynamic analysis gives improved estimate of forces and therefore analysis of building become more accurate as well as economical.

Vinod B.R1 Shobha R2 et.al [12]

Has presented study on Comparison between Analysis of a Portal Frame by E-TABS and Moment Distribution Method Portal frames are widely used in many civil engineering structures. Analysing these portal frames is a necessary but tedious and time-consuming task. Among the conventional methods, the moment distribution method is one of the simplest and easiest methods. ETABS, which is a modern method,

on the other hand is much faster and less tedious. In the present study, a comparative analysis of the moment distribution method and ETABS is carried out. The results obtained from both these methods are matched to tally their similarities and differences. In the present study, results obtained from ETABS and moment distribution method are compared. The maximum value obtained by Moment distribution method is 4.46kN-m and from ETABS is 4.4156kN-m.

Taghried Isam Mohammed Abdel-magid[1]*, Dr. Abdallah Khogali Ahmed [13]

presented study on research work a comparison was made between approximate and exact methods of analysis for tall buildings. One representative tall buildings system was chosen for comparison purposes, namely the Rigid Frame System. The proposed structure was modelled in a square plan area of 35×35m². The models were solely subjected to wind loads. Then, models were analysed using both approximate manual methods and a Finite Element based computer program. An Excel sheet was formulated and developed to carry out the approximate method procedure. Results for manual and computerized analysis were compared for three different building heights. The same structure was subjected to gravity loads in addition to wind loads, and was analysed and designed using the Finite Element based computer program. The design results were compared for three different heights. Obtained results indicated that manual analysis methods are reliable for buildings with heights lower than 25-storeys, especially for the higher storeys. Developed model would help in quick structural preliminary analysis, procedures and preparations of tall buildings.

Kavya H K1 [14]

A multistory building is a building that has multiple stories and typically contains vertical circulation in the form of ramps, stairs and lifts .Multi story building range from 2 stories to more than 150 stories. In this project we analyzed the 5-storey building using STAAD PRO and ETABS. The multistory building is designed using software STAAD PRO and ETABS & manually as per IS 456. The load used in the analysis are dead load (IS875-1987 part1), live load (IS875-1987 part2), wind load (IS875-1987 part3), seismic load (IS1893-1984 part1) and 25 load combinations are considered as per the IS875 (part5)-1987 code book The beams, columns and slabs are designed using software and by manual procedure, reinforcement details are compared. The foundation is designed by using STAAD Foundation software.

Pradeep D., Chethan V R, Ashwini B T. [15]

Multi-storey buildings are constructed for the purpose of residential, commercial etc., with open ground storey is becoming common feature. For the purpose of parking all, usually the ground storey is kept free without any construction except columns. Buildings which have discontinuity of columns and building having columns which transfer load to the beams in lateral direction are called as floating column building. A column is meant to be an upright member ranging from footing level and conveying the load to the lowest. The term floating-column is additionally an upright member that ends (due to subject field design/ web site situation) at its lower level (termination Level) rests on a beam that may be a horizontal member. The beams successively transfer the load to alternative columns below it. Such columns in structures will be analyzed and designed. Results are compared in the form of Storey displacements, Storey Shear with & without columns. Also the Zone wise results are compared using tables & graph to find out the most optimized solution. ETABS 2015 has been utilized for analyzing the above Building Structure.

Bala Krishna I[1], Sahithi K[2] [16]

Comparative study of wind dynamic effect on high rise building with different wind speeds. Rapid growth in population, and the land is not sufficient to provide shelter to everyone with low and midrise buildings. So that everyone is opting for high rise buildings for more comforts. But the major thing to be considered in High rise building design is wind effect. The main objective of this paper is to compare the wind forces with different wind speeds for dynamic loading on G+24 storey high-rise building for different zones with terrain category 2 using ETABS Software. It is performed on a building to identify the Gust factor, Lateral force, Inter story drift and Lateral displacement, Comparison of results which obtained from the software after assigning the data along both X and Y directions are plotted in graph

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