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Analysis of heighted structures using different analysis tool A Review

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ABSTRACT

Structural analysis comprises the set of physical laws and mathematics required to study and predicts the behaviour of structures. Structural analysis can be viewed more abstractly as a method to drive the engineering design process or prove the soundness of a design without a dependence on directly testing it. To perform an accurate analysis a structural engineer must determine such information as structural loads, geometry, support conditions, and materials properties. The results of such an analysis typically include support reactions, stresses and displacements. This information is then compared to criteria that indicate the conditions of failure. Advanced structural analysis may examine dynamic response, stability and non-linear behavior. In this paper we are presenting literature survey related to utilization of different analysis tools for resisting lateral forces in tall structure.

In this paper we will conclude the summarize view of literatures considered in this study.

Keywords : Staad.pro, SAP2000, ETABS, Structural analysis, forces, moment, displacement.

I. INTRODUCTION

STAAD.PRO, ETABS and SAP2000 are three design software's to design and analyse any kind of structure in static and dynamic approach. However these software's will give different design and analytical results for the same structural configurations, this is due to their different analytical mechanism and the way they analyse the structure. This rise a need to do a comparative study between these two software to know the real advantages and disadvantages of these software's. In case of analysis and design of structures with geometrical irregularities there is much more need to compare design results of different software's to get safe as well as economical structures.

This paper carry out a comparative study of design results of ETABS and STAAD Pro software's by taking structural irregularities in account. During an earthquake, failure of structure starts at points of weakness. This weakness arises due to discontinuity in mass, stiffness and geometry of structure. The structures having this discontinuity are termed as Irregular structures.

Irregular structures contribute a large portion of urban infrastructure. Vertical irregularities are one of the major reasons of failures of structures during earthquakes. For example structures with soft storey were the most notable structures which collapsed. So, the effect of vertically irregularities in the seismic performance of structures becomes really important. Height-wise changes in stiffness and mass render the dynamic characteristics of these buildings different from the regular building. IS 1893 definition of Vertically Irregular structures.

we are providing literature review of journals, publications and citations published in past related to analysis of structures, seismic forces, analysis tools and utilization of innovative technique in structural analysis.

II. LITERATURE REVIEW

Richa Agarwal and ArchnaTiwari (2017) the research paper depicted a relative plan of three different structures as 5 storey, 10 storey and 15 storey with various earthquake zones namely II, III, IV, V (as per IS code 1893 and 456-2000) of building, modelling and analysis of the structure was using structural programming STAAD.pro and ETABS. The design result obtained gave lesser area of required steel as compared to STAAD PRO for the beam design result. Correspondingly the column design result also area of required was less in STAAD PRO software as compare to ETABS. Consequently, the final accomplish ETABS provided lesser area of steel as compare to STAAD PRO in both cases. S .

VijayaBhaskar Reddy and V.Madhu (2018) the research paper presented the detailed analysis on simulation tools ETABS and STAAD PRO, which have been used for analysis and design of rectangular Plan with vertical regular and rectangular Plan with Vertical geometrically irregular multi-storey building. This study was focused on bringing out advantages of using ETABS over current practices of STAAD PRO versions to light. It was observed that ETABS was more user friendly, accurate, compatible for analysing design. Results stated that Max reaction produced was 4572.12kN in ETABS and 4624.92kN in STAADPro due to load 1.5(Self +Dead +Live). The maximum displacement was along x- direction and its value was 106.25mm (in STAADPro.) for irregular building and 53.47mm (in ETABS) along z-direction for regular building. So, more precise results was generated by ETABS which leads to economical design of the building. The storey overturning moment decreases with increase in storey height along x-direction for EQ length load and they was more in regular building than the irregular building. The ETABS gave lesser area of steel reinforcement for irregular building as compared to regular building in case of beams and columns

Kai Hu et al (2012) In this paper, the response spectrum, time history and linking slab in-plan stresses analysis was executed combined with a practical project with inclined columns by several programs such as ETABS, SAP2000, MIDAS/gen and SATWE, and the main conclusions stated that all the results of response spectrum analysis calculated by different programs was basically similar, while ETABS may miss the statistic of oblique columns, which need to be paid attention to in future designs. The results of time history analysis by SAP2000 and ETABS was roughly similar. However, SAP2000 does not have the concept of “storey” which made the postprocessing much more complicated. Therefore, to the regular structure, ETABS was recommended; and to those gymnasium or space truss structures, SAP2000 has its irreplaceable advantages. As for the slab stress analysis, ETABS and MIDAS/Gen have their respective advantages as ETABS’s good at preprocessing with automatically line constraint and area division; and MIDAS/Gen does well in the post-processing such as the stresses combinations. Slab, as the important lateral force resistant component, should not be ignored in design works. Especially to

those complex structures, the slabs stress analysis at weaken positions is really essential.

Mahmad saber and D. GousePeera et al (2015) the research paper presented a detailed description for analysis and designing of structuring using various applications STAAD.Pro and ETABS. The analysis of a rectangular plan with vertical regular and rectangular Plan with Vertical geometrically irregular multi-story building was done using static analysis method. The conclusion stated that presentation of results from STAAD Pro and ETABS was quite different making it difficult for observations on the case of assigning loading parameters and design. ETABS gave lesser area of required steel as compared to STAAD PRO while designing beams. Similarly the column section required area of the steel similar both software's but in these case are considered in percentage 0.3% TO 0.5%. Form the design results of column; since the required steel for the column forces trendy this certain problem was less than the minimum steel limit of column (i.e., 0.85%), the amount of steel calculated by both the software's was equal. Therefore, comparison of results for this case is not possible.

Mohammad Kalim et al (2018) the research paper carried the modelling and analysis of RC framed structure using the modelling and analytical application Staad.Pro and Etabs. The design of a regular plan multi storey structure was done as per IS-456 & IS-875 and results from both the applications were prepared to provide more accurate and economical result. The results stated that ETABS gave lesser area of required steel as compared to STAAD PRO. Form the design results of columns, comparison of results for this case was not possible because of same Ast. Axial forces calculated by Staad Pro was almost similar to the axial forces calculated by etabs, so may adopt the analysis values for the design purposes. The analysis values in both software's Staad Pro and ETABS was almost similar but design values differed and uneconomical, so it's better to adopt the analysis values for manual design to have a economical design. Analysis was done by using ETABS and STAADPRO software successfully verified manually as per IS456. Usage of ETABS software minimizes the time required for analysis and design. STAAD.Pro software was more flexible to work compared to the ETABS software. The quantity of steel requirement was 9.25% less for the design of G+14 multi-storied building using ETABS compared with the STAAD analysis. The quantity of concrete requirement was same for the design of the multi-storied building using both STAAD and ETABS analysis. By the intensive study of "Comparative study on Analysis and Design of multi-storied building by both STAAD and ETABS software's" the "economical sections" was developed by ETABS software.

Sakshi A Manchalwar e.t al. (2016)The research paper aimed towards the comparative study of analysis and design of (G+2) where the design process of structural planning and design required not only imagination and conceptual thinking but also sound knowledge of structural engineering besides the practical aspects. It was important to first obtain the plan of a particular building i.e. position of particulars rooms. The position of columns, size of beams, and depth of slab was provided on the basis of structural requirement. Manual analysis of frames in selected plan was carried out by Kani's method and EXCEL sheet was prepared for analysis by Kani's Method also SAP2000-software was used and end moments of different span was validated with it. Results concluded that KANI's method has the capability to analyze any frame section as compared to other methods. Frame structures was rarely symmetric and subjected to side way, hence KANI's method was best and much simpler than other methods like moment distribution and slope deflection method. By comparing the final moments obtained from manual analysis, SAP analysis and EXCEL analysis was nearly same. So the calculations done manually and by sap and excel was correct and hence SAP software was beneficial for analysis of frames of building. manual and software

design the area of different elements of the building was same.

Lelisa Nemo Nura and Jay Prakash Pandit (2019) the research paper stated that both SAP2000 and STAAD.Pro are efficient structural software. Both have helped revolutionize the system of analysis and design of structures. They have played a great role in eradicating the very tedious analysis and design procedure by hand, with very high precision as well. The purpose of this thesis is not to draw a general conclusion of which software is better than which, but a suggestion according to a predefined criteria as to when a user shall use either of the software. From the criteria set to evaluate the software a clear picture can be drawn for what purpose certain software shall be used. The main difference in the application of the software can be noticed from the past chapters as; SAP2000 doesn't have a feature for designing continuum structural elements such as slabs, shells, and shear wall. The exclusion of such important feature in SAP2000 is probably a market strategy of CSI (producer of SAP2000) as to make users buy other CSI products which specialize in those areas such as SAFE. Through long years of experience on the market, both software packages have integrated user comments in order to polish the software functionality to a better precision and applicability. Thus precision of results for simpler structures was quite similar in case of both software.

P. D. Hiwase et al (2018) this paper mainly ponders upon the comparison of analysis procured from the design of regular multi-storeyed structures using these user friendly software's. In this paper, comparison of software's results with the manual calculations of a sample beam and column of the same structure was designed as per IS 456. The results concluded that design of a multistoreyed structure using ETABS and STAADPro provided conservative results on the part of designing. In the ETABS, it was found that the area which was calculated was less than STAAD.Pro. But the design of the structure was much easier using both the software. It was also concluded that there was a minor difference in the results of the manually done experiment and those done by software's, the results of latter being more accurate.

ArindamSahu et al (2016) The primary objective of the research paper was to develop a theoretical and practical basis for enhancing the performance of intrusion detection systems using advances in sensor fusion with easily available intrusion detection systems. This project introduced the mathematical basis for sensor fusion in order to provide enough support for the acceptability of sensor fusion in performance enhancement of intrusion detection systems. The conclusion stated that SAP2000 was the ideal software tool for users of any experience level, designing any structural system. Integrated modeling templates, code-based loading assignments, advanced analysis options, designoptimization procedures, and customizable output reports all coordinate across a powerful platform to make SAP2000 especially useful for practicing professionals. SAP2000 was also an excellent medium for education.

IshaBedi et al (2017) the research paper proposed analysis and performance of RCC Frame Structures using Staad.Pro, ETABS, and SAP. From the proposed research analysis, conclusion stated that Staad.Pro was much more efficient. The values of force derivative was low as Compared to ETABS and SAP. The maximum the value of Force derivative resulted in the maximum difference between the values of Staad.Pro, ETABS, and SAP.

Sachin Patil et al (2017) the research paper presented the analysis and design of a defined structure using ETABS and Staadpro and results were compared on basis of bending moment, shear force, base shear, axial force and steel required in the various section. The economic, safe and user friendly interface of the application was analyzed. Whileanalyzing results of columns and beams, conclusion stated that ETABS gave greater values of Shear Forces and Bending

Moments as compared to SAP2000. From the design results columns and beams, steel provided in ETABS was greater than that provided in SAP2000. Therefore, results stated that SAP2000 most economical and reliable design software in comparison to ETABS.

K VENU MANIKANTA and Dr. DUMPA VENKATESWARLU (2016) The main purpose of the research paper was to carry out a detailed analysis on simulation tools ETABS and STAAD PRO, which was used for analysis and design of rectangular Plan with vertical regular and rectangular Plan with Vertical geometrically irregular multi-storey building. This study was focused on bringing out advantages of using ETABS over current practices of STAAD PRO versions to light. It was observed that ETABS was more user friendly, accurate, compatible for analysing design results over STAADPRO.

Ramanand Shukla and PrithwishSaha (2017) in the research paper, analysis of a G+10 storied building having a very simple plan dimension in both STAAD Pro and ETABS was carried out. The research was limited to the basic comparison between their analytical results under vertical loadings and was further extended and horizontal load was applied and the plan position of lift wall (shear wall) is optimized in terms of developed horizontal base shear at different support positions. Results stated that among different plan positions, it was found that the model with a centrally placed shear wall is most efficient in terms of handling the base shear.

Balwinder Lal lotra and Dhirendra Singhal (2017)The aim of this paper was to conduct an in depth study of the major features of three structural analysis and design software programs STAAD Pro, SAP-2000 and ETABS software which are generally used. Each software program has its own features, analysis option, design and output options, limitations and advantages. It was necessary for the user to exploit all the advantageous feature of particular software program but also the software program should not be used beyond its applicability to avoid any catastrophic failure. Therefore, this paper presented the main features of all these software programs with the emphasis on applicability and limitations of these software. The conclusion stated that STAAD pro incorporates well provisions from various standards and therefore the results accordingly are more accurate. However, SAP and ETAB provides more flexibility in modelling the structures and in the design details. There were reports that these software many a times provides results which do not confirm the requirements of codal provisions. Such limitations of every software need to be explored and rectified for better confidence of the designer. Further, the software can be made more users friendly.

Rajeshwari Patil et al (2017) the research paper presented the modelling and analysis of3- storey's R.C.C. framed building using the SAP2000 software. Post analysis of the structure, maximum shear forces, bending moments, and maximum member displacement was computed. The structural elements was designed manually by using IS456 & SP16. The results concluded that the structural components of the building are safe in shear and flexure. Short term deflection of all horizontal members was within 20mm. Amount of steel provided for the structure was economic. Proposed sizes of the elements could be used in the structure. Maximum size of column and beam required was 230mm x 450mm. Maximum thickness of slab provided was 150mm.

V. Ramanujaneyuluet. al (2018) the research paper presented a comparative study on design and analysis of multi-storeyed building (G+8) using STAAD.Pro and ETABS softwares. The results were analyzed on parameters as shear forces, bending moments, deflections & reinforcement details for the structural components of building (such as Beams, columns & slabs). The structures was designed using IS: 456:2000 and IS 1893:2002 codes. The results stated that STAAD.PRO software was suitable for G+ 8 structures when compared to Etabs software. The time period and base shear of regular and irregular structure in

ETABS software was twice than that of STAAD.PRO software. After completion of design of the structure in both the software's, the design results showcased 0.4-0.5% more steel in ETABS. While comparing the results, the frame element of regular has shown maximum bending moments, shear forces and axial forces for different loading conditions in both software's.

III. CONCLUSION

In this review paper following outcomes has been observed:

1 It has been observed that authors in past analyzed structures using different analysis tool for maximum G+15 structure whereas in our study we are analysis for low rise, mid rise, high rise and G+20 tall structure.

2 In past researches authors generally adopted static analysis.

3 In past researchers studied the variation in terms of forces and moment.

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