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RESEARCH ARTICLE

ANALYSIS AND DESIGN OF A MULTI-STOREY BUILDING BY USING STAAD PRO: A REVIEW

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Abstract

A review of the analysis and design of a multi-storey building with STAAD Pro is carried out. Planning is done by using AutoCAD and load calculations were done manually and then the structure was analysed using STAAD Pro. The dead load, imposed load and wind load with load combination are calculated and applied to the structure. Overall, the concepts and procedures of designing the essential components of a multistory building are described. STAAD Pro software also gives a detailed value of shear force, bending moment and torsion of each element of the structure which is within IS code limits.

Introduction:-

Due to the huge populace growing and the absence of land, people have shifted from rural to urban areas and are currently building large-scale houses in small areas. The purposeful design of a building is very important and requirements vary from building to building. Analysis and design of multi-story structures by using STAAD Pro. Design of reinforced element by using IS456:2000, and loads are calculated according to dead loads, imposed loads, and wind loads IS 875: 2000 (Part-1,2 and 3). For the design of building steel required as per IS 800:2007. Planning and design processes require not only imagination and conceptual thinking but also a deep knowledge of civil engineering sciences and practical aspects supported by new design code, by-laws, integrated design, insights and decisions. The standards are intended to ensure and improve safety and to ensure a balance between economy and safety. The design process begins with a design project, mainly meeting its functional requirements. The structural style creates a structure that is safe, functional and durable, technical, economical and simple. To be able to carry out a precise analysis, the structural loads, the support conditions and the intensive properties must be determined.

Literature Review:-

Various research papers have been published on building planning and analysis is on tall buildings by using the STAAD Pro. The research papers have been gathered and are as follows.

The study of seismic and wind load response of G+40 storey RCC high rise building. The structure is inspected against the base shear and roof displacement and they are in permissible limits (Ramaraju et al., 2013). An RCC high rise building G+30 stories combined seismic load and wind loads. In the top beam of the structure requires more reinforcement required for static analysis as compare to dynamic analysis. Deflection and shear bending are less in static analysis compare to dynamic analysis. In column area of steel is always less for static load compared to

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dynamic load (Kulkarni et al., 2016; Raju et al., 2015). The study of bending moment and shear force of the structure. These buildings have an area of 25x45m with a floor elevation of 3.6m.

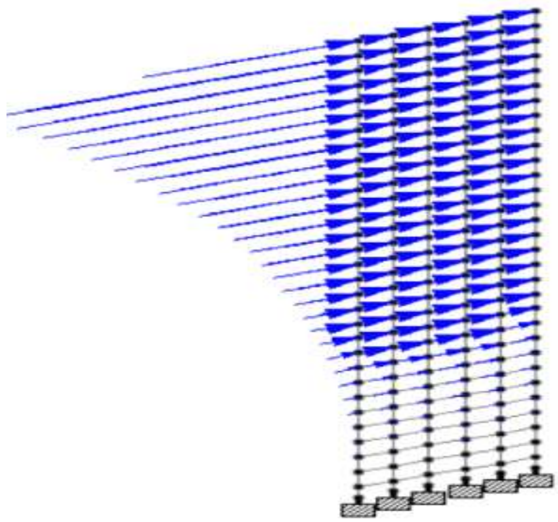

Fig.1:- Earthquake Loading (Dynamic Loading).

Examination of stability, non-linear behaviour of a structure shown in fig.1. For high rise (G+30) building it is very important to resist the critical sagging moment and hogging moment (Sharma and Maru, 2014). The planning, analysis and design of the G+20 multi-storey residential building. The dimensions of structural members are specified and the loads such as dead load, live load and wind load are applied. Shear and deflection tests are examined for beams, column and slab and they are safe with both theoretic and practical work (Sanjaynath and Kumar, 2018). Analysis and design of the G+19 Story building using STAAD Pro. The load was maximum when applied in the x-direction (parallel to shorter span) and the deflection increases as the height of the building increases. For base shear was 5% more in the case of STAAD Pro as compared to manually (Deshmukh et al., 2016). The wind load in structure is more critical for tall structures than the earthquake load. Analysis G+11 storied structure is taken into account and loads like wind, static load and results are calculated and related to wind or without wind load. Deflection is maximum in wind load as compare to without wind load (Trivedi and Pahwa, 2018). A building [G+10] has the planning involves load and many load combinations also analyzing the entire building by STAAD Pro with help of limit state method. From the result verification as shown in fig.2 (Kumar et al., 2019)39.

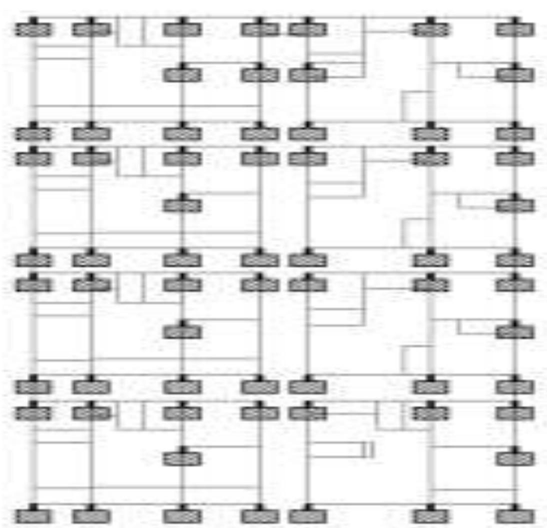

Fig.2:- Plan of the G+10 Structure.

An effort is made within the project and a designing of a tall rise structure a G+8 framed structure with the seismic load and wind loads. The analysis is done by static methods and the design is completed following guidelines of IS: 456:2000. Research designed to withstand these two moments and hogging and critical moments and beams include the provided shear and flexural reinforcement along the length of the beam (Kumar et al., 2018; Uddin et al., 2018; Madhurivassavai et al., 2016). Studied the structural and seismic analysis of G+7 structure using the STAAD Pro software shown in Fig.3. Various seismic data are required to perform a seismic examination of the structures during this study. obtain design showed less in STAAD when compared to manual design. The steel quantity was increased by 1.517% related to conventional design. The earthquake load is done by the seismic response spectrum as give values. Base shear = 2345.71kN manually and with the help of STAAD Pro= 1634.43kN. There was no need for a shear wall and braced column as the base drift at every storey is 0.0 hence the structure was safe under the drift condition (Kumbhare et al., 2019; Gireesh et al., 2017).

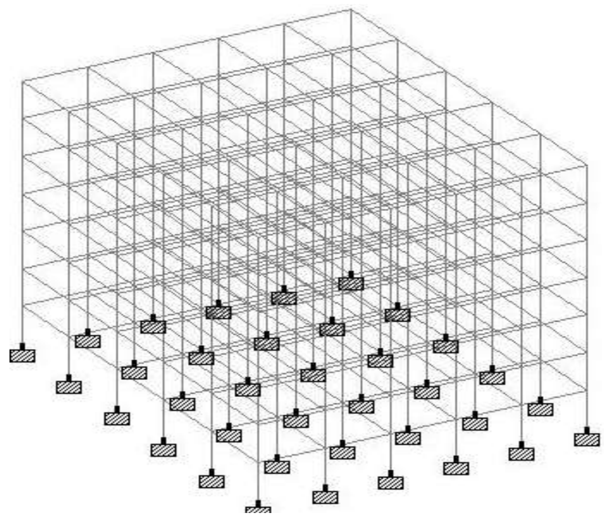

Fig.3:- Full structure.

Error! Reference source not found. The current paper is concerned with the construction of a G+6 Floor residential building. The design of beams, columns, as well as self-weight and impose load, is applied. STAAD Pro gives the list of failed members and also a better section of the member shown in fig.5. (Seva et al., 2013; Deevi et al., 2017).

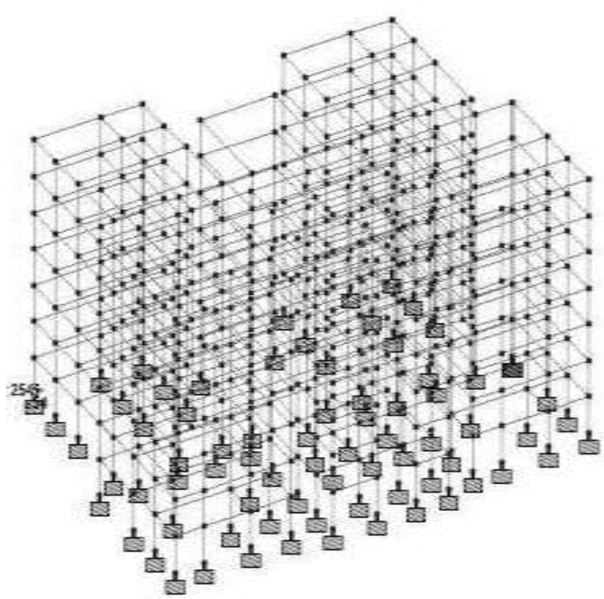

Fig.4:- Skeletal structure of the building.

The design G+5 floor building taken into consideration structural analysis is planned using STAAD-Pro.

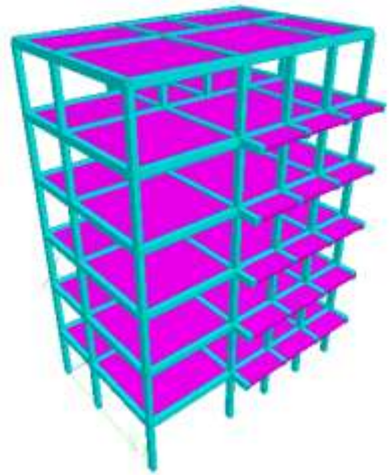

Fig.5:- Multi-storied building model in STAAD Pro.

The load utilized in the analysis are dead, live, wind load, seismic load, and 25 load combinations are implemented. According to the codebook IS-875, beams, columns and slabs are designed using the software. Fig.5. Structure analysis determines force and displacement and foundation analysis is calculated using STAAD Foundation software (Nagakanya et al., 2018; Sivaji et al., 2019). Effects of seismic load were monitored by calculating base shear and displacement of the elements, they also take checks like one-way shear, two-way shear and they are within the IS code limits (Anuja and Nagasai, 2019). Vertical loads contain permanent load and Horizontal load contains wind forces, so this building is designed under IS875 for dead loads, direct loads and wind loads. The structure is analyzed for extreme and smallest bending moment and shears force by experimental methods according to IS 456:2000. It is noted that in terms of software development, the percentage of steel is higher (Sudheer, 2017). The author then considered a 3-D RCC frame with 5 bays on the X-axis and 4 bays on the Z-axis. The soil height was 3 m. This design was subjected to its own weight, self-weight, impose load, and load due to wind as suggested in the various load cases presented in the paper (Mohan et al., 2017). The work is continued for 2-D and 3-D frames with different loading conditions shown in fig.6. The planning method used in the STAAD Pro is limit state method and analysis is the finite element method that complies with the Indian code of conduct (Saleem and Kumar, 2017).

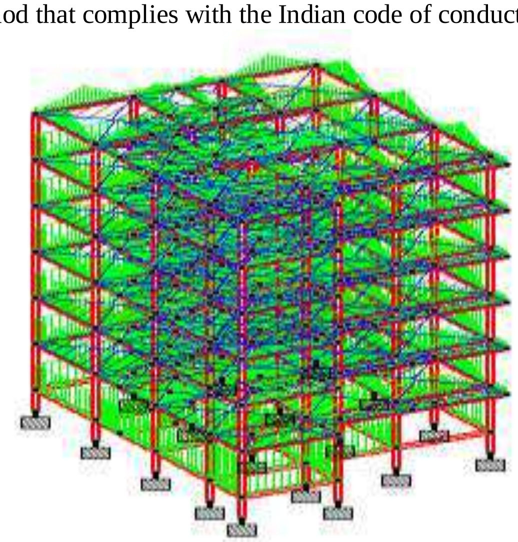

Fig.1:- Assigned loading.

The analysis and design of C+G+5 domestic building & commercialized building based on the criteria defined by the IS codes on STAAD Pro software. The dead and live load hence the load combination generated was 1.5(DL+LL) after the building was done for the resulting shear forces and bending moments were studied. The results of these analyses were also compared with the manual calculation of sample and column beams of the same beam, and these elements were manually designed ethically to IS 456-2000. The horizontal deflections were within 20mm and the structure was safe and economical (Hugar et al., 2016; Aman et al., 2016). The G+5 floor planning of the building was done by using AutoCAD, and the analysis of structure was done in STAAD Pro. The project considered the load cases on basis of the Indian standard codes IS1893:2002 for seismic load, IS 875 Part-3 for wind loads, IS 875 Part-1 for dead loads and Part-2 for live loads. The combinations of these loads were generated based on IS 875 Part-5. And the design was done based on IS 456:2000. The graphical input generation provided by STAAD Pro allows the generation of a graphical model of the structure are shown in fig.7, (Anoop et al., 2016; Varalakshmi et al., 2014).

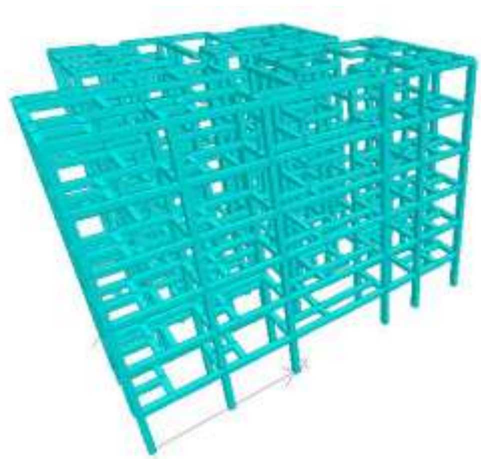

Fig.7:- 3D rendered view of the building from STAAD Pro.

Has designed and analysed G+4 Building using STAAD Pro. This structure was exposed to all kinds of loads under the load case (fig.8) details of STAAD Pro. In post-processing mode, the effort on the building after the design is completed, examine the values of the share force, bending moment and deflection is checked (Babitha and Nagendra, 2018).

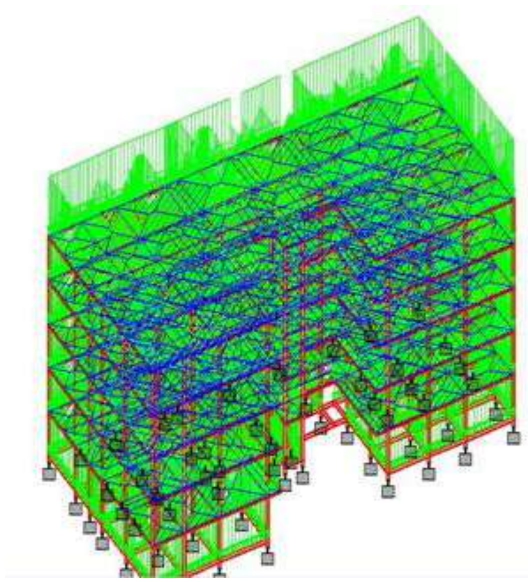

Fig.8:- Slab dead load distribution.

Analysed and Designed a G+3 Multi-storey building using STAAD Pro. They considered Dead load, live load, combination and wind loads in the designing process. The preparation is completed as per Indian standard and code provision of the SP-16 and SP-34. The building frames are analyzed of shear force, bending moment and moments deflection and footing reactions are calculated (Bhosle et al., 2018; Rajan and Lakshmi, 2017). The G+2 floor analysis and building were initially designed for all thinkable load combinations. Analyzing a simple two-dimensional frame and manually tested the precision of the software using the results. Variation of the area of steel is a maximum of 5 percentage in between calculation software and manual (Bandipati and Venkateswarlu, 2016). The paper covers the design & analysis of the G+1 RCC building frame by Moment Distribution method, IS code coefficient method. The area of steel is 785.5 mm^2 (Ahmed et al., 2015). Structural designing requires an in-depth structural analysis in which forecasting of the building is predicated. But it is not always conceivable to try to in manual design hereafter the requirement for software design tools was found. That several tools are established, amongst which the foremost use is STAAD Pro which consents the structural and seismic analysis before it is construction. For high rise buildings, it is quite possible to use STAAD Pro for computing the loads and its grouping and analyzing the structure and designing the structure-based to analysis (Vats, 2019). Has explained that Structural loads, assist conditions, and intensive properties should be determined to perform a precise analysis. The results of such analysis usually grab support responses, stresses, and displacements. Under normal working conditions, the damage and splitting must not be larger for the structure. A maximum factor of safety should be considered in load combinations so the structure won't fail during natural hazards or because of overloading (Kumar and Sanjaynath, 2018). The earthquake-resistant of G+15 RC framed structure is an analysis and design. They calculate responses of a structure exposed to earthquake excitation. Seismic knowledge zone units required and checked during this study to perform seismic excitation expressed in terms of seismic load analysis of structures, seismic response of structures, element forces, joint displacements, and types of support reaction forces (Kumar and Malyadri, 2018). Has mentioned that in this paper analyse and design an apartment located on the B+G+8 floor. The building has shear walls around the elevator pit. The structure is designed and analyzed using STAAD Pro and cross-checked by manually. Construction of beams, columns, slabs, shear walls, stairs, walls, storage tanks and insulation foundations will be performed in the paper (Khan, 2016). The author is an analysis and design of an Apartment with (B+G+4) storied building. All the structural components were designed manually and compare by using STAAD Pro. The analysis and design were done according to standard specifications (Sreeshna, 2016). Paper presents various constraints on design and construction practices and provides feedback on overcoming the constraints and making the structure safer to soak up seismic forces. The software used to design, construction methods/practices, use of resources, types of structures, experiments in seismic research, quality control parameters, etc. (Dharane, 2014).

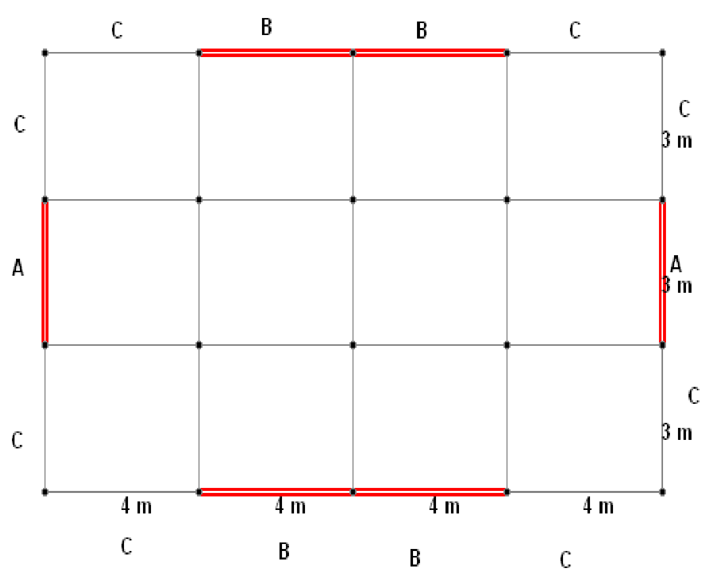

Fig.9:- Location of brace frame and shear wall.

This paper describes a seismic analysis of tall buildings using the program at STAAD Pro with dissimilar situations of the lateral stiffness system. Some replicas are designed to brace frame, a shear wall shown in fig.9 is complete with the reaction spectrum method. The effect of the devices on vibration and the actual circulation of forces on the elastic is very good (Patil et al., 2013). Has said that project efforts to know the B+G+2 structural performance of wide-ranging components within the multi-storied building. Footings are calculated and built on the bearing capacity of the soil. The segment is check for the components manually and using E-TABS software for the post-analysis of building, extreme shear force, bending moment and extreme storey displacement are least (Deshpande et al., 2017). A residential building of (G+10) as shown in fig.10 by using the most economical column method. self-weight, impose load are applied also design for beam & columns, the footing is obtained by ETABS. Safety requirements must be so that the building is ready to serve its purpose with the maintenance cost.

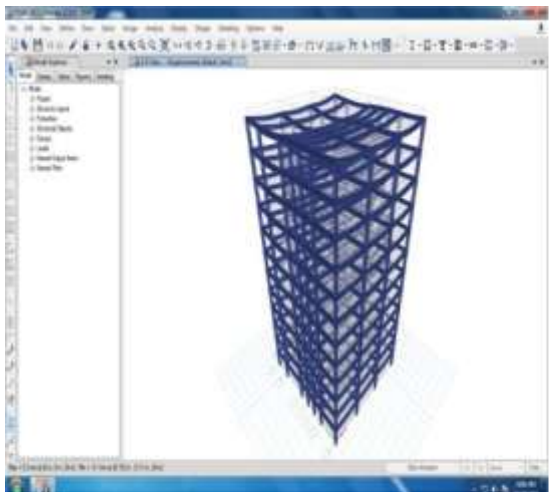

Fig.10:- Columns and beams details.

For the structure design, construction, we have accepted a finite state analysis method and designed the structure. IS:456-2000 (Mallikarjun et al., 2016). Construction of earthquake-resistant buildings (G+7) is calculated by manual and ETABS software. The seismic constant method as based on IS 1893:2002. The result obtained by manual analysis compared to the soft computing area unit. This paper provides a complete guideline for manual likewise software analysis of the seismic coefficient method. Base shear is slightly higher in software analysis (Patil and Sonawane, 2015). The comparison of STAAD Pro and E-TABS for the G+11 high rise building. The project deals mainly with the relative analysis of the outcomes derived from the daily design and a concept (according to IS 1893) of a multi-storey structure when calculated by STAAD-pro, e-tabs software individually.

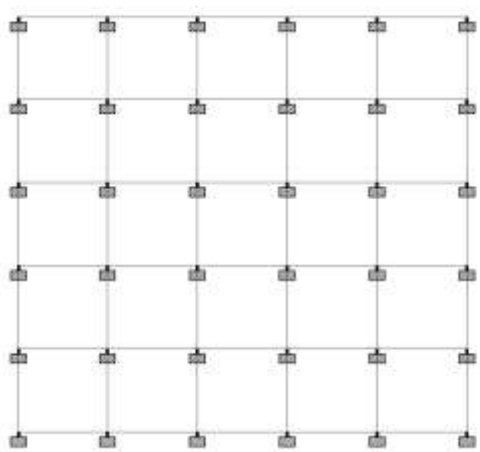

Fig.2:- Plan of the regular structure considered.

The amount of steel required for the beam is lesser in ETABS and column steel required is equal in both the software (Prashanth et al., 2012).

Conclusion:-

Many investigational, analytical, performance and relative works have been done by many researchers related to the design of high-rise buildings. For the planning of the structure, the self-weight, imposed load, load due to wind and seismic load are considered with load combination. The analysis of building is figured by manual also simultaneously it has been checked through STAAD Pro.

STAAD Pro has a function to calculate the required reinforcement for the concrete section. Shear reinforcement is intentionally designed to withstand all shear forces and torsion moments. The columns for axial and beams are designed flexure, shear and torsion are designed with the help of IS code.

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