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Effect of Superstructure Suffering in Highrise Structures on Seismic Load Analysis

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1.ABSTRACT

Seismic forces are the most serious and dynamic. Seismic loading is a basic concept of earthquake engineering which means application of an earthquake generated agitation to a structure. The seismic loading happens at the contact surface of the ground with the adjacent structures. The buildings have to be resistant to different types of loads like live load, dead load and especially seismic load. Although various approaches to make the building safe by minimizing natural period, increasing damping etc. are practiced, most common intervention for non-engineered building is strengthening by various measures. In order to investigate the feasibility of superstructure stiffening for high-rise buildings, analytical study is carried out for buildings of above ten storey high. The idea of superstructure stiffening is explored to enhance the effectiveness of this range of buildings to withstand the seismic forces and wind forces.The analysis is done using flexibility matrix method, moment distribution method and a computer aided software called STAAD Pro.For live loads,the design regulation to be considered IS 875 Part 1 and 2,the wind loads are taken from IS 875 Part 3 and the seismic loads are considered as per IS 1893:2016.STAAD Pro provides the modeling and defining of the structure,by using STAAD Pro various parameters are to be found out.

KEYWORDS:

Seismic loads, Stiffening, Moment distribution method, Staad pro, Flexibility matrix method, Superstructure, Dead load, Live load, Earthquake engineering, Wind forces.

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1.INTRODUCTION

Weather, load effects, and foundation settlement, among other things, cause buildings to deteriorate. If the structure is to withstand an earthquake, it must be safe under normal load and withstand lateral loads without collapsing. A vertical cantilever beam with its base fixed in the ground is the fundamental structural skeleton of a tall skyscraper. Vertical gravity loads, as well as lateral wind and earthquake loads, must be carried by the structure. Dead and live loads both create gravity loads. Lateral loads tend to snap or overturn the structure. As a result, the structure must have appropriate shear and bending resistance, as well as the ability to carry vertical loads. Moment-resisting frames and shear trusses/shear walls are the two fundamental types of lateral load-resisting systems in the category of interior structures.

1.1 SIGNIFICANCE OF SOFTWARE

This analysis and design software proved its worth by handling all of the varied obstacles that arose during the training process. Research Engineers International, based in California, is the publisher of this programme. It features a user-friendly GUL, visualisation tools, sophisticated analysis and design capabilities, and seamless interface with a variety of other modelling and design software programmes. For structural analysis, the software incorporates FEM concepts. The software allows for the full structure to be specified as a collection of its numerous pieces. As a result, we can discretize the structure. The software includes a user-friendly interface that makes modelling simple and accurate. STAAD.Pro has been the choice of design provisional around the world for static or dynamic, or pushover analysis of bridges, containment structures, embedded structures (tunnels and culverts), pipe racks, steel, concrete, aluminium, or timber buildings, transmission towers, stadiums, or any other simple or complex structure. It includes a cutting-edge user interface, visualisation capabilities, and international design codes, as well as a comprehensive and integrated finite element analysis and design solution. It may analyse any structure that is subjected to dynamic reaction, soil-structure interaction, wind, earthquake, or movement loads. STAAD. Pro is the industry's leading FEM analysis and design tool for towers, culverts, plants, bridges, stadiums, and marine projects with an array of advanced analysis capabilities including linear static, response spectra, time history, cable, and pushover and non-linear analysis, STAAD. Pro provides us a scalable solution that will meet the demands.

1.2 STAAD.Pro will eliminate countless man-hours required to properly load our structure automating the forces caused by wind, earthquake, snow, or vehicles. In addition, no matter what material we are using or what country we are designing our structure in, STAAD.Pro can easily accommodate our design our loading requirements, including US, European (including the Euro codes), Nordic, Indian, and Asian codes; even special codes ASCE52, IBC and the US aluminum code can be catered to.

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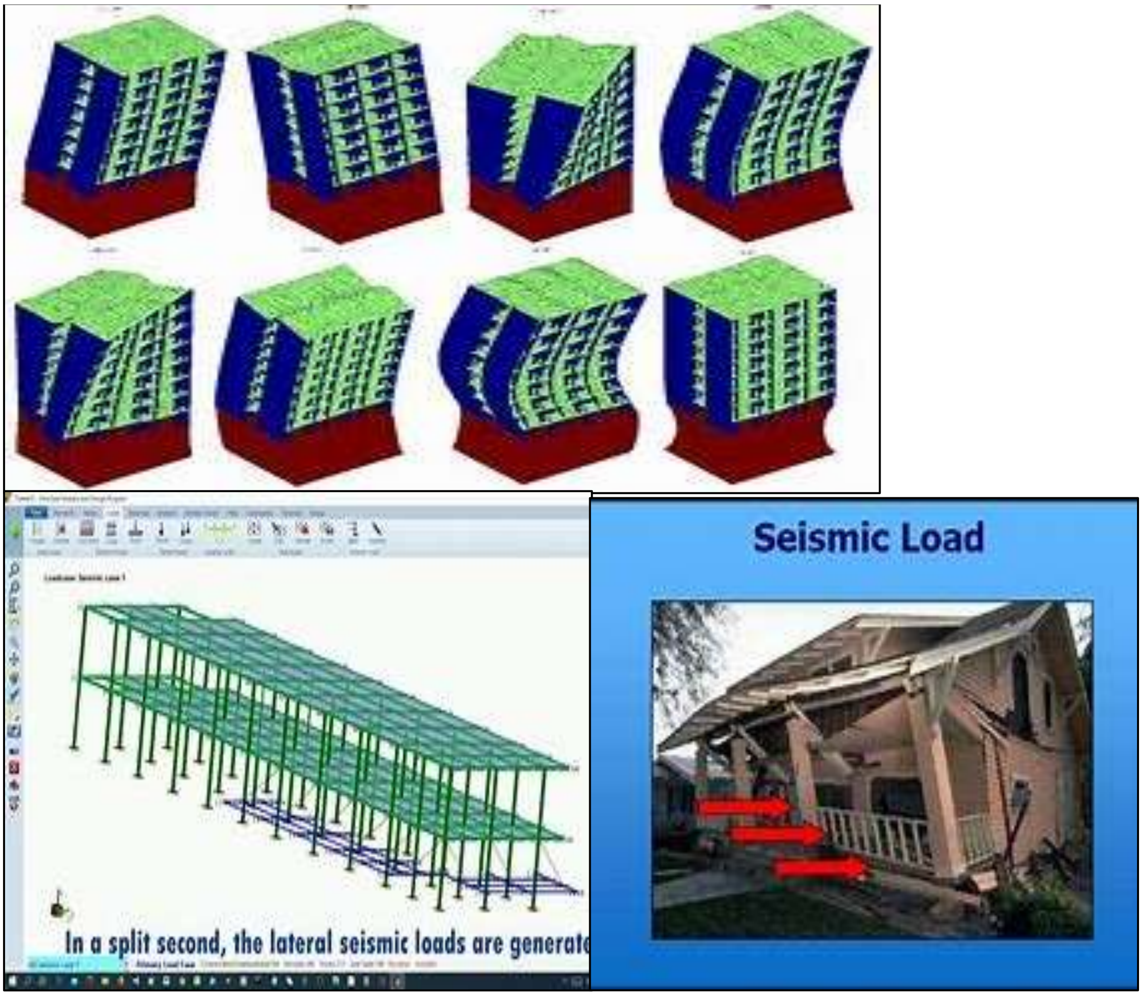
With an unparalleled quality assurance program open architecture or customization and a 25 year track record including such projects as the MCI stadium in Washington DC, Wimbledon Court No 1 in Europe and the tallest transmission tower in Asia, STAAD. Pro is the perfect workhorse for a design firm.

Once when the overall geometry of the structure has been specified, the section properties, of the individual member elements are specified. Thereafter, loading on the members are specified. Following this the support conditions relevant to the structure are specified as well. The input software can easily be inspected and modified with the help of STAAD editor The analysis can then be carried out. The results of the analysis provide us with the parameters needed to complete the structural design of the project. The necessary values can be extracted straight from the STAAD output file. This software also enables us to develop in accordance with many international norms of practise. The earthquake roads acting on the building are known as seismic loads. The buildings shake as a result of seismic loading. Buildings must also be constructed with living loads, dead loads, and wind loads in mind. STAAD Pro can be used to simulate the effects of seismic loading on a structure.



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2.LITERATURE REVIEW

Venu Malagavelli et al. investigated the use of ggbs and robo sand in high-performance concrete. Their research looked at the properties of M30 concrete using GGBS and ROBO sand as partial replacements for cement and sand (crusher dust). Both compressive and tensile strengths are measured on the cubes and cylinders. It was discovered that partially replacing cement with GGBS and sand with ROBO sand improved the concrete's strength significantly when compared to standard mix concrete.

Priyanka Soni et.al (2016) have analyzed multi-storey buildings of different shear wall locations and heights and studied the analysis of various research works involved in enhancement of shear walls and their behavior towards lateral loads. Six models of G+10, G+20 and G+ 26 storeys with storey height 3.5m, earthquake zone II are prepared by using STAAD.Pro V8i software and two locations of shear wall are considered. The different parameters such as interstorey drift, base shear and lateral displacement for all models have been studied. From the results, it is concluded that the deflection of the multi-storey building structure of location 2 is more as compared to location 1 for G+10, G+20 and G+26 storey building. Therefore location 1 of the shear wall is more efficient than location 2.

Mohd Atif et al. (2015) compared seismic analysis of a G+15 storey structure braced by bracing and shear wall. Zone II, Zone III, Zone IV, and Zone V are used to evaluate the building's performance. G+15, Ordinary RC moment-resisting frame The investigated structure is symmetrical (OMRF). The structure is modelled using the STAAD.Pro.V8i software. The software was used to retrieve the structure's time period in both directions, and an IS 1893(part1): 2002 seismic study was performed. For different earthquake zones, the lateral seismic forces of the RC frame are calculated using linear static methods according to IS 1893(part 1): 2002. Base shear, displacement, axial load, moments in Y and Z directions in columns and shear forces, maximum bending moments, and maximum Torsion in beams are all compared. According to the findings, shear wall elements are particularly effective in decreasing lateral displacement of the frame as a drift, and horizontal deflection in shear wall frames is substantially lower than in braced and planar frames.
According to Anshuman S. et al. (2011), the location of shear walls in multi-story buildings is determined by both elastic and elastoplastic behaviours. A fifteen-story building in zone IV has an earthquake load calculated and applied to it. Both STAAD Pro 2004 and SAP V 10.0.5 (2000) software packages were used to conduct elastic and elastoplastic evaluations. In both situations, shear forces, bending moments, and narrative drift were computed, and the location of the shear wall was determined using the results. The inelastic analysis performance point was found to be tiny and inside the elastic limit.

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3.Methods of Superstructure Stiffening

Structural stiffening can be achieved by the following methods:

1. by increasing column size
2. by providing shear walls
3. by providing bracings

4.Results

The structure was analyzed as ordinary moment resisting space frames in the versatile software STAAD.Pro. From the analysis, we get member end forces and support reactions. From this value we design the structure.

Seismic Load

Seismic loads, which were calculated by referring to IS 1893 and were added as nodal loads on the structure. Structural analysis is an integral part of any engineering project , in this process we predict the performance of a given structure under the condition of prescribed loading.

The characteristic performance in structural design usually are :

1.Stress resultant or stress (axial forces, shears and bending moments)

2.Deflections

3.Support reactions

5. Conclusion

The analysis of a structure involves the determination of these quantities caused by the given external effects or loads. since the frame of building is three dimensional that is space frame, manual analysis is time consuming and too long. hence we use STAAD.Pro to analyse the structure. In order to analyse in STAAD.Pro , we have certain steps to follow firstly generate the model geometry, specify member properties, specify geometric constants and specific supports and loads.

3.1. Modeling consists of structural discretization, member property specification, giving support condition and loading

3.2. The building site is located at Koratty, Thrissur. The plot of site consists of larger depth of clayey sand and fine sand and then rock. The strata of soil varies at different points of building. As per the report of soil , shallow foundations of any type cannot be provided in view of any heavy column loads, very poor sub soil conditions above the rock and high water table. Deep foundations installed into the rock have to be adopted. The report of soil

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recommends end bearing piles penetrated to the hard stratum. So the building foundation has to be designed as end bearing piles penetrated to the hard stratum.

Calculation of base shear for seismic analysis

The design seismic base shear is the total design lateral force at the level where inertia forces generated in the structure are transferred to the foundation, which then transfers the forces to the ground of the structure. The base forces are the sliding forces generated at the base of a structure especially due to seismic forces.Base shear of a building is directly proportional to its weight.

This can be calculated using the seismic zone's soil material,and building code lateral force equations.

Base shear value (V) is determined by combining the following physical factors:

Considering the soil conditions at the site.

- Close proximity to probable seismic activity sources (such as geological faults in the area).
- Probability of seismic ground motion in the area.
- It is taken into account the level of ductility and overstrength associated with various structural configurations and overall weight.
- When a structure is subjected to dynamic loads, the period of vibration is measured.

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