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Analysis of G+12 Building Subjected to Lateral Loads on STAAD PRO & AUTO CAD

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Abstract: ***In this paper we tried to solve the problem related to earthquake resistant building using the seismic analysis methods via software known as STAAD Pro. There is various kind of loads has been imposed on the structure and analyse one by one using the staad pro software. Loads are imposed and were matched as per our analytical assumptions such as zone 2 city Delhi on the hard type soil. Firstly, we have an experimental approach to the RCC Building frame structure analysis of STAAD Pro. Secondly, loads were calculated by the formula applicable in the efficient way loadings and analysis are done as per the IS 1893:2002/2005. Our main focus was the analysis of seismicity and lateral loads transformation on the RCC building frame on G+12 storey building located in zone-2 as per Indian standards which are an active region of seismicity in India.***
Keywords: STAAD Pro, seismic analysis, RCC Building, earthquake resistant

I. INTRODUCTION

There are many mitigation measures to save and protect our structure and minimize the damage and collapsing threat to our structure due to lateral and Earthquake forces such as.

1) *Floating Foundation:* The floating and levitating foundation keep the substructure of the building isolated from the superstructure part of the building and it one way of doing this by float the building above its foundation and lead-rubber bearings which can compromise solid lead core covered and its foundation with placing the steel plates in mid-section or between them hence steel bearing are added in the structure so that load transmission can be done in an efficient way. So, when the seismic activities likely to happen it keeps our building on a cushion or padded sheet of air and overcome that activity to its minimal effect. As well as this system has the inbuilt technology which included a sensor which can sense the seismic activity and these sensors can sense the level of seismicity and communicate with the air compressor that can create the layer of air between the foundation and base of the building.
2) *Shock Absorption:* It is similar to the shock absorber vehicles as we travel on the bike and whenever we get an obstruction in our way shock absorbers will not feel you any discomfort so this is the same technique which is used to make the structure earthquake resistant it slowdowns and reduces the magnitude of seismicity and fluctuated motions. So, Ideally this technique is used on each floor of the building and attached to one end of beam to the other of the column of that building in each of this couple they consist of shock absorber piston head moves inside out, of the cylinder whenever building moves in the horizontally this piston is moved against the lubricant provided in this which can transform mechanical energy into the bunch of heat.
3) *Rocking Core Wall:* To improve the seismicity resistant of our building we use this low-cost technique which works with the RC core to set into the heart of the building which is surrounded by the elevator banks. Many of the recently build skyscrapers are using this technique as this is an affordable way to reducing the seismic activity well it uses more effective when used as together with the base isolation technique. Base Isolation is elastomeric bearing which provided in the alternate layer of the building in the layers of steel provided and natural layers can also be used such as natural rubber or neoprene. These bearing allow the movement of building in the horizontal direction and reduced the stiffness and vertical rigidity of the building to implement into the highly effective and in a simple way.
4) *Pendulum Power:* This technique works on the principle of pendulum bob in which we suspended the huge mass to the top of the structure and this mass is supported by the cables which are made of steel and for dampening we use the viscous oily fluids at the place between the mass and building which protect it. In any kind of seismicity the huge bob of the pendulum moves in the opposite direction to balance the energy waves and each of the pendulum is tuned to syncing with the natural frequency of the structure and these systems are called as Mass Damper technique whose goal is to counter the resonating frequencies and reducing the dynamic response of the structure.
5) *Symmetry, Diaphragms and Cross- Bracings:* The one common criteria for design the seismic-resistant building to provide the structure in the very regular and symmetric way because the seismic wave can impact more in the irregular shaped building such as like L-shaped, J-shaped and T- shaped and split levelled structures it may be more aesthetical in appearance but it is not

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resisted in torsion produced by the forces. , Now the engineers are designing the symmetrical shaped structure to keep the balance between forces equally and uniformly Diaphragms are an integral part of the horizontal structures which work as the floor and roof of the structure. Engineers generally design the diaphragm on each of the deck and strengthen the structure horizontally so it can be distributed in a lateral manner with the structure parts.

Now the bracings are provided in the vertical frames used in building walls they rely on the truss structures for resisting the sideways motions. Cross bracing is an effective way in an X shape to the structure to build the truss wall well it is a popular technique to resist the seismic activity.

In the final statement, it is very complex to study the structural assessment for the powerful mechanism in earthquake engineering that uses detailed modelling of the structure which the depth analysis to get a better understanding of the building. So, Retrofitting is an old technology which enhanced designs or materials is important as rebuilding new structures from the ground level. So the ultimate and final goal is to resist the structure from the earthquake and save more lives as by preventing the building by collapsing.

a) There are different values of displacement between the analysis view of dynamic and static methods which is totally insignificant for the basement storey and it get different values to get moved to high in higher stories and high values are assigned to the dynamic analytical structures.

b) As it is necessary to provide an analytical method point of view from both static and dynamic way which is not sufficient for the high rise buildings.

c) As we compare our uniform structure to the other irregular shaped structures the storey drift is more and more valuable and it gets increase as we increase the height of the building storey by storey.

d) the Base shear is not more in the zone 2 constructed buildings and it is also an advantage that we chose the uniform shaped regular building frame on the hard type of soil. the

e) As we have already mentioned that our building is of regular and uniform shape as totally designed only for the analytically based understanding cause we know that irregularly shaped structure is more liable to deformations.

f) As the results above are obtained as per the equivalent static analysis are approximately uneconomical and the values of the displacements noted as higher than the dynamic analysis.

II. LITERATURE REVIEW

Vikrant Trivedi, Sumit Pahwa (2018) [1] examined the tall buildings and multi-storied structures. Their approach is under aerodynamic modifications, which also includes, modifications of building model and their corner geometry and its cross-sectional shape.

K. Prabin Kumar, M. Malyadri (2018) [2] they have done the analysis of the G+15 multi-storied structure all the calculations are according to the Indian standard code practices the use of gust factor methodology square used to measure the RCC high rise buildings according to the respective IS codes like IS: 1893 (Part I).

Jay Kumar Sah et. al. (2018) [3] the researcher observed the building structure on the seismically active zone with respect to the super as well as sub structure part of the RCC building frame. Researcher have analyze the structure which is of B+G+13 storeys with the each and every storey of height 8 ft. in the zone-III as all of the calculation is done on the V8i software named as STAAD Pro.

Akshay R. Kohli et. al. (2017) [4] analyzing the high rise structure on the bases of ultimate strength, their safety, serviceability, and economical process. In this report, the author analyzes the G+11 residential building by the influence of wind and earthquake pressure loads. The earthquake and wind loads must be limited for the structure stiffness factor because of multiple reasons they have been analyzing the whole building on stand pro with the help of various figures implied with lateral loads and also shown the deflection criteria. In the conclusion part, they have shown that short term deflections in the lateral directions should be within safe limits, the percentage of steel has to be increased up to 2% and it is still below permissible limits. Detailing norms should be studied properly.

Shanmugasundaram, Vidhyasagar G (2017) [5] they prepared their experimental results on the basis of recommendations to obtain across wind response of tall buildings as per IIT Kanpur Indian wind code IS 875 (Part 3) 1987. They introduced the applications of shear walls carried over on both sides of the building on reducing the deflection amount subjected to the building.

A. Kale, S. A. Rasal (2017) [6] analysis of various models and the results of experiments done on 45 story structure which shows that it is critical height for subjecting wind loads as well seismic too. But if the building is in the circular as well spheroidical shape is can resist the effect of wind and seismic both.

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Pushkar Rathod, Rahul Chandrashekar (2017) [7] they examined the four different structures of different dimensions such as rectangular T-, L-, I- shaped models and then comparing their results on the basis of forces and displacements so that a conclusion can be made on their sustainability under large deformations occur due to lateral forces. They came to the conclusion that on increasing story height stiffness of the story should be increased displacements on the nodes are proportional to their levels and it occurs lowest in case of rectangular shaped building. Worked on the centre of mass which is proportional to stories where the lowest value comes with L- shaped model. They said that most of the deformations will occur in irregular and asymmetrical models rather than symmetric models so that it could provide better stability.

Mohammed Ismail, et. al. (2017) [8] provides information regarding the design of reinforced column buildings in different zones of the earthquake region in Middle East Asian countries. The minimal variations occur in values of SF & BM before and after considering the seismic effect on the modelled building. The values of SF and BM become 5 times more than the original values and the value of axial forces similar to load due to gravity. They pass their judgment on the current situation of Saudi Arabia which shows the buildings are not considered earthquake loads and current design used are unsafe for better efficiency during the application of lateral loads.

Mahesh Ram Patel et. al. (2017) [9] they have analysed the problem of behaviour of high rise multi-storied building RC frame with the 3 other geometrical configurations as per the IS Code 875 (Part –III) under the effect of wind pressure. The select a model of building 3D geometry on the sloping ground and select 5 wind zones as per are 875 then they have made the different load combination mentioned 8 load combinations in X and Y directions and with the help of software STAAD Pro. They analyse the building frame and different sloping angle with respect to the wind zones and each load combinations they have studied other parameters such as bending moment, shear forces and axial forces etc. also.

Siluveri Shivaji et. al. (2017) [10] they have discussed about the analysis of symmetric high rise building with reference to earthquake loads to ensure the safety of multi-storeyed building form seismic actions generated from earth crust. They have used some analytical methods for this such as like equivalent load method for analysis and response spectrum method for their G+15 high rise structure build in zone-2 as per the IS code. The parameters such as BM (bending moment), AF (Axial Force) and deflection etc. are considered and used STAAD Pro. Software for calculating the wind speeds calculation and their effect on the building and comparing the most suitable system which resist the lateral forces. Then they designed the structure as per their best suitability for their sections which used in the structure.

Amresh. A. Das et. al. (2017) [11] they have discussed models evaluated by the various methods. They have noticed that seismic deformations are depended upon the frequency content of ground motion and its static as well as dynamic property hence to overcome this factor they have used the seismic response factor method. They have concluded that more deflection found in footing's moment, and column joint for the static state with respect to the dynamic state. As the height of structure increase, the bending moment of the building is also going to be increased and the results from the static analysis are approx not under our economy as the high value for dynamic is noticed.

III. RESEARCH METHODOLOGY

In the present study, an RCC G+12 multi-storeyed residential building is modelled for the analysis and design on STAAD Pro and AUTO CAD.

A. Loading Estimations

There are some basic loads consider in the design of the building such as dead load, live load, earthquake loads and wind loads. As we know the value of dead loads (DL) are calculated from the unit weight of the building material as it is mentioned in IS 1893: 2002. As we talked about the live load (LL) intensities for the different sections of the structure is obtained as per IS 875 (Part 2):1987. The load combinations which have consisted of Live Loading calculations have considered and recommended using the value of 3 kN/m^2 & the 25 -30 % load is then considered in the seismic load activity calculations. However, in this study, we have made load combinations and assign the earthquake loads assigned x and y-direction as EQL_x and EQL_y respectively as per IS 1893 (Part-1): 2002.

B. Methods and Tools for Analysis:

1) Creating a grid/ model
2) Defining

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a) Material; As we have defined our material which has used in building our modeled structure and we have also mentioned the unit weight values in it.
b) Section (beam, column, and slab) we have designed our all sections with the halo of LSM as per Indian standards. As we have assumed them as uniform because we have just used or model to define the behavior of our structure under the seismic and wind load combinations.
c) Load cases we have considered different load combinations in it.
d) Structural Analysis and Design of Residential Building for Earthquake Resistance
e) Load pattern: these patterns are different as per their vibrational equations if defined for them. Load combination
3) Assigning: Section, Load, Analyse the structure
4) Earthquake loads are calculated using the seismic coefficient method. Design of structural elements

C. Results Interpretation of Analytical Data

In the initial configuration of the total Lagrangian approach of formulation of data sheet the nodal displacements are usually referred and then they have converged lastly to the updated version of Lagrangian formulation sheet analytically. Relocation of nodal relative technique speaks to the position and the good information for the nodes of the frames building. As we proposed the strategy to measures the relative models to relocate them with respect to its adjoining nodal outline of references and they are still the same for a relative nodal relocations frame with respect to the outline reference for nodal adjoining. It may occur as the mishappenings for the little size components. As the results have come into the details and created the distortions suspicious as they yet to substantially apply for the framed structures which are experiencing the huge kind of mishappenings for the little size components. As a results, component details are created under the minimal distortions which are suspicion as yer for the vast dis-engagements of the figures, altogether the mistangled view of the conditions of harmony created as the basic framework is being outspoken by the help of diagram which is build up to overseeing conditions of the betterment of framework of RCC frame building structure. There are 2 computational which are characterized in the table below and one of them is forward grouping to utilise the way of succession to recoup the nodal in the Cartesian model work removal from the relative nodal is uprooting and navigated a chart from the hub of nodes towards the hubs of the terminal. The other possible way of succession is that to utilize the recuperated powers of nodes in the framework in very facilitated way out from the known nodal powers in irrefutably and arrange the building RCC frame and crosses from the terminal nodes toward the nodal base.

IV. CONCLUSION

As our paper this work is enable to consolidated the knowledge of the analysis and the designing of the structure during seismic effects. Since area is located in the zone-2 of our capital city New Delhi region and emphasis on the earthquake loads is done rather than the other kind of loads as our building height is not that certain value which is affected by the other lateral loads.

This work is partially analyse on the software known as STAAD Pro V8.i which is very useful in making the calculations more easier and less time consuming because in earlier days it was all done with the manual help and now it is done within a short span of time in this analysis design and detailing all the requirement of the buildings are calculated manually and values are kept as per the required field of work in the software.

Our detailed structural design of the building is more important as per the construction procedural aspects as per an engineer's point of view whose having the basic knowledge and must have experience in design this kind of the structure frames.

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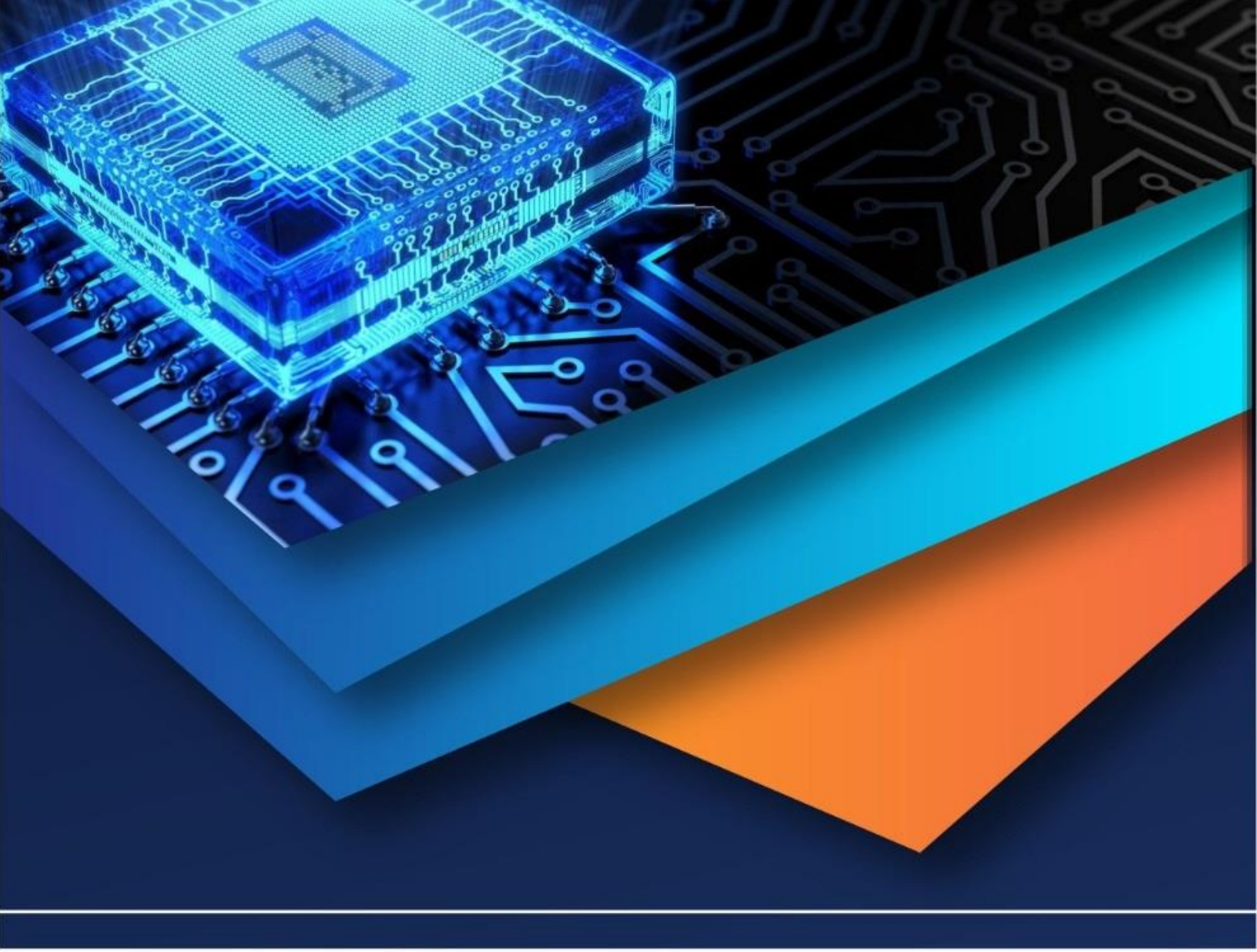
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