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TO ANALYSE AND STUDY THE BEHAVIOUR OF MULTI-STOREY BUILDING IN DIFFERENT ZONES OF INDIA- A REVIEW

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Abstract: High rise buildings are mainly constructed & design to offer serviceability, stability &durability of structure to people who live in it. In India, several earthquake events demonstrate that, high rise structures are collapse & find vulnerable to earthquake damages. In Today's era it's a need of engineers to design earthquake resistant structure for different seismic zones to cut back the seismic damages in high-rise buildings. Structural configuration of high-rise multi-storeyed building either irregular or regular shows different behaviour during seismic condition. Present study is to investigate the Variation in behaviour of (G+10) multi-storeyed building structure having regular (Rectangular or Square) structural configuration in different seismic zone (zone II & IV) of India. The whole structures is examined using STAAD Pro(V8i) software to access parameters like support reactions, shear forces, axial force, bending moment, Base shear, seismic forces and displacement for two different seismic zone (zone II& IV) regular (Rectangular or Square) structural configurations using both method of seismic analysis static (Equivalent lateral) & Dynamic (Response Spectrum Method) for high rise(G+10) multi-storeyed building structure ***Index Terms* -structural configurations, seismic analysis, Equivalent Lateral, Response Spectrum Method.**

I. INTRODUCTION

In present scenario, transformation of India due to urbanization, modernization &industrialization represents the level of development of our country. Rapid development indicates the scarcity of land and increases the demand of high-rise buildings.

In today's era of modernization, major share in infrastructures are occupied by high-rise building structure and increases the demand of engineers & architect to plan & construct high-rise structures with more and more complex individual plan and elevation. The Indian subcontinent has suffered some of the greatest earthquakes &have most active seismic zone in the world. Prior decade, consideration of earthquake forces in structural design was neglected but today its consideration is significant one. Even though there is early advancement in field of seismic safety, moderate earthquakes in India are still became reason of thousands of people deaths and major property loss, representing the poor seismic performance of the existing infrastructure. There is a necessity: to build a more specialized environment for planning, analysing, designing, detailing and constructing earthquake resistant high- raised multi-storeyed structure by following seismic codal provisions. An earthquake-resistant high- raised multi-storeyed building has features like Good Structural Configuration, Lateral Strength, Adequate Stiffness, Good Ductility which required adequate knowledge and experience to achieve in different zones of India. Bureau of Indian Standards [IS 1893 (part 1):2002]has grouped INDIA into four seismic zones and same structure in different zone have different behaviour under seismic load and have varying requirements for effective seismic designs of high-raised structure because of categorisation of zone as per intensities or magnitude of earthquake.

Structural Analysis determines behaviour of structures so as to predict the responses of actual structures under the upgrading of predictable loading & outside environment during the service lifespan of structure. The present research describes the behaviour of (G+10) symmetrical high-rise multi-storey building structure under seismic analysis to withstand earthquake forces, which it will be subjected during an earthquake. Analysing the effect of Indian seismic zones mainly (Zone II (Mumbai) & Zone IV (Nagpur)) ONSAME (G+ 10) high-rise multi-storey building structure by the direct examination methodologies of static (Equivalent static lateral Force) and Dynamic (Response Spectrum techniques) is examined. The present analysis is done using STADD.Pro (V8i) which provides a much faster approach to structural analysis and designing with chances of minimum error according to the code 1893-2002-Part-1. the software being used gives the calculation of support reactions, shear forces, axial force, bending moment, Base shear, seismic forces and displacement, stress, strain &deformation or deflection for a structural components of building (such

as Beams, columns & slabs)The main parameters consider in this study to compare effect of Indian seismic zones(Zone II (Mumbai) & Zone IV (Nagpur)) on the seismic performance of (G+ 10) high rise multi-storey building structure with methods of seismic analysis. Analytical results are compared to achieve the most suitable earthquake resisting & economic structure against the lateral forces.

1.1 OBJECTIVE

1. Modelling of 10-storey building and application of different loads on STAAD-Pro.
2. The main objective is to check Seismic response on shapes of buildings via rectangular shape, and square shape in different Zones of India and design earthquake resistant multi-storeyed building on that basis using STAAD-Pro software.
3. Seismic analysis of multi-storied building before construction work using STAAD-Pro software
4. Study of reactions, shear forces, axial force, bending moment, seismic forces and node displacement during assigning process And restrained them by applying suitable property and material in different zones.

1.2 CODAL PROVISIONS: -

1. Dead Load – IS 875 Part I
2. Live Load – IS 875 Part II
3. Wind Load - IS 875 Part III
4. Seismic Analysis

a. IS 1893:2002 (Part 1)

Main code that provides the seismic zone and specifies seismic design force. This depends on the mass and seismic coefficient of the structure; the latter in turn depends on properties like seismic zone in which structure lies, importance of the structure, its stiffness, the soil on which it rests, and its ductility.

b. IS 13920, 1993

In India, reinforced concrete structures are designed and detailed as per the Indian Code IS 456 (2002). However, structures located in high seismic regions require ductile design and detailing. Provisions for the ductile detailing of monolithic reinforced concrete frame structures are specified in IS 13920 (1993). This code has been made mandatory for all structures in zones III, IV and V.

2. METHODOLOGY: -

1. Literature study (searching methods and techniques)
2. Problem formulation & objective (analysis of different shape of (G+10) building in different seismic zones).
3. Model generation (column beam size) for analysis of different shape of (G+10) building in different seismic zones.
4. Defining material property and load for analysis of different shape of (G+10) building in different seismic zones.
5. Perform Seismic analysis of different shape of (G+10) building in different seismic zones of India.
6. Obtain result for story deflection, stresses and shear force bending moment, axial force, reactions and displacement.
7. Compare results for all different models of (G+10) building in different seismic zones of India.

3. LITERATURE SURVEY: -

Mohaiminul Haque et.al [1] studied the Seismic Performance of RCC Multi-Storied Buildings after analysis. Among different structures, square and rectangular shaped regular & irregular structures, which are the most common shape structures in Sylhet have been chosen in this study. In this paper from the overall analysis it can be conclude that performance of buildings irregular in plan is more susceptible to earthquake load than regular shaped buildings.

D. R. Deshmukh et.al [2] Analysis and design of G+19 Story building using Stadd.Pro The design was based on Indian Standards on STADD. Pro and was then compared with respect to the one, made from the manual calculation. The design loads considered were dead load, live load, seismic load and wind load and were calculated on the basis of Indian Standards. It was seen that the load was maximum when applied in the x-direction (parallel to shorter span) and the deflection increases as the height of building increases. The data regarding take off for material was provided. The results obtained for base shear was 5% more in the

case of Stadd.Pro as compared to manually. It was concluded in the study that Stadd.Pro is versatile software which can be used to analyse a building and compute reinforcement.

Ankit Purohit et.al [3] Analysis is done using STAAD.Pro software to study the Seismic performance of G+12 Multi-storeyed Building in Varying seismic zone and Soil Type of India. These papers considered four cases. (Soft soil with zone V, Medium soil with zone V, soft soil with zone II and medium soil with zone II). After Analysis the behaviour of G+12 story building are tested for Parameters like deflection, stresses, bending moment and shear force against selected zone like V or II with varying soil type. These studies describe the behaviour and comparison of result values to set the standard thinking and policy for design engineers and researchers. The Deflection, Shear Force, Bending Moment, Beam End Forces, Displacement, Beam Stresses Sectional Force and Bending Moment are noticed maximum in Zone V for all above cases than Zone II analysis. In both cases the result of soil analysis shows that the displacement & Shear force value in soft soil is greater than medium soil. Bending moment is noticed lesser in soft soil than medium soil for all cases.

S.S. Patil et.al [4] Perform seismic analysis of high rise building by using program in STAAD Pro. By considering different conditions of the lateral stiffness system. Analysis is carried out by response spectrum method. This analysis gives the effect of higher modes of vibration and actual distribution of force in elastic range in good way. These results include base shear, storey drift and storey deflection are presented.

UmamaheswaraRao et.al [5] In this study model of G+7 Structure is analysed under seismic load by using STAAD.Pro software in different seismic zones (II, III, IV, V) of India. Consideration is done for all the basic parameters of earthquake responsible to affect Multi-storey building and analysed with Different Load combinations and try to fill the void of IS:1893-2002 doesn't provide the variations in steel quantity from zone to zone. Result shows comparison of Base shear, Floor Displacements, support Reactions and variation of steel quantity by zone to zone. Result declare that Base shear, Displacements, support reactions and steel quantity are Depends on zone factor, so these values are more in zone-v, zone-V is critical for the G+7 structure. Support reactions zone-V as higher value as compare to zone-II, zone-III, zone-IV. 6. Steel quantity of seismic zone-V is higher than 53.84%, 13.89% and 8.31% as compared to zone II, zone-III and zone-IV.

E. Pavan Kumar et.al [6] In these research the residential building of G+ 15 storey structure is analyse for seismic load by using method of static and dynamic analysis by considering ordinary moment resisting frame and special moment resisting frame in zone II. Equivalent static analysis and response spectrum analysis are the methods used in structural seismic analysis.The total structure were analyzed by using STAAD.PRO software. The result shows that response reduction of cases ordinary moment resisting frame and special moment resisting frame values with deflection diagrams in static and dynamic analysis. The special moment of resisting frame structured is good in resisting the seismic loads. Final result concludes that the results of static analysis in OMRF & SMRF values are low when comparing to that of dynamic analysis in OMRF & SMRF values. Hence the performance of dynamic analysis SMRF structure is quiet good in resisting the earthquake forces compared to that of the static analysis OMRF & SMRF.

Siddhartha S. Ray et.al [7] The study oriented towards comparison of behaviour of seismic performance of multi-storeyed structure in different zones of India by using STAAD-pro and ETABS (version 2017) two different software & by using two different seismic analysis techniques like equivalent static analysis and response spectrum analysis is carried out. Seismic performance of structures has been scaled up to match parameters of base shear defined by code are 1893(Part1):2016. The comparisons of results show that the value of displacement is same. Shear force shows a difference of 11.48% which is under the permissible limits. Only 3.45% difference is observed in the bending moments calculated from the software. But axial force shows a quite difference of 22.34% when calculated by different software.

Prof. Komal S. Meshram et.al [8] The present study deals with seismic analysis of multistoried residential building G+7. The dead load and live load applied and design for beam, column, slab and footing are obtained by analyzed Total structure by using STAAD-Pro software. the behavior of multistoried building by Equivalent Static Lateral Force Method is examined. The result shows the variation in calculation of base shear by manually and using STAAD.Pro Design Base Shear (Manually) = 2345.71 KN Design Base Shear (STAAD Pro)= 1634.43 KN . Finally, Conclude STADD. Pro is versatile software having the ability to determine the reinforcement required for any concrete section based on its loading and determine the nodal deflections against lateral forces and To consider Seismic forces and designed it as an earthquake resistant structure.

Ms. Waykule S.B et.al [9] In recent times, multi-storey buildings in urban cities were required to have column free space due to shortage of space, population and also for aesthetic and functional requirements. For this, buildings were provided with floating columns at one or more storey. These floating columns were highly disadvantageous in a building built in seismically active areas. The earthquake forces that were developed at different floor levels in a building need to be carried down along the height to the ground by the shortest path. Deviation or discontinuity in that load transfer path results in poor performance of the building. The behavior of a building during earthquakes depends critically on its overall shape, size and geometry, in addition to how the

earthquake forces were carried to the ground. Many buildings with an open ground storey intended for parking collapsed or were severely damaged in Gujarat during the 2001 Bhuj earthquake.

Sangeeta Uikey et.al [10] Here, Seismic Response Analysis of Tall Building Using STAAD.Pro Software Load calculations are done manually and analysis of whole structure by STAAD Pro Software is done by conforming Indian Standard Code of Practice & Limit State Design and manually checked the accuracy of the software with our results obtained. The results proved to be very precise and accurate. After that G+4, G+9, G+14, & G+19 storey building analyzed under seismic condition and designed and checked it for all possible load combinations (Dead, live, wind and seismic loads) for zone II & III for different soft, medium, hard soil. Codal provision to be followed has also been specified for design purpose with other important details. Parameter like storey drift and deflection comparision are given for different zone in different soil condition for G+4, G+9, G+14, & G+19 structure.

4. CONCLUSION

- Stadd.Pro & ETABS (version 2017) gives hardly any variation in results compared to the results computed manually.
- Irregular configuration of structure is more susceptible to earthquake load than regular shaped buildings.
- The variation of seismic load, wind load, shear force and bending moment with the height is showing a direct relationship
- Seismic zone-V have more value of Zone Factor and show critical behaviour during seismic analysis of G+7 structure. Steel quantity required for seismic zone-V is higher than 53.84%, 13.89% and 8.31% as compared to zone II, zone-III and zone-IV
- The behavior of a building during earthquakes depends critically on its overall shape, size and geometry, in addition to how the earthquake forces were carried to the ground
- Stadd.Pro allows you to follow the criteria of several design codes for eg. The Indian standards relating to loads, designs, analysis etc.
- Stadd.Pro is a much easier and faster way of analysing and designing a structure when compared to manual computation. .
- Stadd.Pro is a user-friendly way to analyse the structure as its GUI is very easy to work with and the software is quite versatile.

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