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Comparative Analysis of High Rise Building On Sloping Ground With Steel And RCC Bracing: Review

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Abstract:- A building with irregularities is susceptible to seismic damage, as evidenced by past earthquake incidents. To reduce the seismic damage to structures, it is crucial to detect the structural response to earthquakes, even in high seismic zones. The main goal of this study is to understand how the structure behaves in high seismic zone III. Other objectives include evaluating Story's overturning moment, Storey drift, lateral displacement, and design lateral forces. For comparison, a 14-story structure with four completely different shapes—a rectangle, a sloped ground, a sloped ground with steel bracing, and a sloped ground with RCC bracing—is used. With the aid of STAAD.Pro 2016, the entire set of models was examined. At this moment, Comparative Dynamic Analysis for each of the four examples has been looked into to assess the structure's deformation. Results & Interpretation: The findings show that, particularly in high seismic zones, buildings with extreme irregularity create more deformation than those with less irregularity. The story's overturning moment also changes inversely with the story's height. When compared to buildings with irregular shapes, the story base shear for regular buildings is the largest. Sloping ground, sloping ground with bracing in steel, and sloping ground with bracing in RCC are all present in a rectangular building.

Key Words: Story Drift, Lateral Displacement, Bending Moment, and Static and Seismic Force.

Introduction:- A high-rise building is a tall building, as opposed to a low-rise building, and is defined by its height differently in various jurisdictions. It is used as a residential, office building, or other function including hotel, retail, or with multiple purposes combined. Residential high-rise buildings are also known as tower blocks and may be referred to as

"MDUs", standing for "multi-dwelling units. A very tall high-rise building is referred to as a skyscraper.

High-rise buildings became possible with the invention of the elevator (lift) and less expensive, more abundant building materials. The materials used for the structural system of high-rise buildings are reinforced concrete and steel. Most American-style skyscrapers have a steel frame, while residential blocks are usually constructed of concrete. There is no clear difference between a tower block and a skyscraper, although a building with fifty or more stories is generally considered a skyscraper.

A building, or edifice, is a structure with a roof and walls standing more or less permanently in one place, such as a house or factory. Buildings come in a variety of sizes, shapes, and functions, and have been adapted throughout history for a wide number of factors, from building materials available to weather conditions, land prices, ground conditions, specific uses, and aesthetic reasons. To better understand the term *building* compare the list of no building structures.

LITERATURE REVIEW

The construction of reinforced concrete buildings with shear walls has become widely used in many countries. Research on the seismic behavior of the lateral support resistance with different models is described below, with an analysis of static load consideration.

Literature Review

(1) M.R.Wakchaure (2012) analyzed plan irregularity multi-storied buildings estimate seismic performance and effects of structural irregularity in stiffness, strength, T Section and Oval shaped irregular plan geometric forms which are repeated in areas such as Mumbai in ETABS 9.7v considering 35 and 39 storied buildings, to determine effect of plan geometric form on seismic behavior of structures with elastic analyses considering gust factor using dual system for structural analysis. Shear wall positions are located in the form of a core and columns are considered gravity as well as lateral columns. Two types of models namely strength and serviceability models are developed. In strength mode,l all the lateral systems (i.e., shear walls, bracings, coupling beams) are to be analyzed.

(2) Raul Gonzalez et al have analyzed damages caused by different plan irregularities during seismic events of different magnitudes, the geometric forms that are repeated more in urban (squared, rectangular, U- sectional section) modeled in SAP2000 considering one, two, and four levels to determine the effect of geometry in seismic behavior of structures with elastic analysis.

(3) Rucha. S. Banginwar Et al have studied the effects of plan configurations on the seismic behavior of structure by response spectrum method by using the Indian Standard Code (IS-code) of practice IS-1893(Part I: 2002) guidelines and methodology. The behavior of a building during an earthquake depends critically on its overall shape, size, and geometry. Buildings with simple geometry in the plan have performed well during strong earthquakes but buildings with U, V, and + shapesthe in plathe n have sustainable damage. In his work.In his proposed work the effect of plan configurations on the behavior of the structure of an already constructed building located in the same area during an earthquake is analyzed by the response spectrum method.

(4) S.K. Dubey and P.D. Sangamnerkar have analyzed the Behavior of asymmetric RC buildings. The main objective of their study is to understand different irregularity and tensional response due to plan and vertical irregularity to analyze T-shaped building while earthquake forces and to calculate additional shear due to torsion in the column. Additional shear due to tensional moments is considered because this increase in shear forces causes columns to collapse. So in design procedures, additional shear is taken into account.

(5) QaiserUzZaman Khan Et. Al. [2013], stated that usually buildings have irregularities in plan or at times in elevation as well which develops a damaging influence on the seismic performance of building. The paper discusses the comparative study of performance estimation of RC (Reinforced Concrete) Buildings with vertical irregularities (i.e., setbacks). A five-story vertically regular building is designed by equivalent static load method of seismic analysis with UBC (Uniform Building Codes) 1997. 9 vertically irregular models are generated from the regular building by omitting different stories at different heights creating setbacks. ETABs 9.7 nonlinear software is used for numerical solutions. Time History Analysis and Response Spectrum Analysis are performed for ground acceleration data of ElCentro (1940) earthquake. The complete study is an attempt to evaluate the effect of vertical irregularities on RC buildings, in terms of dynamic characteristics such as Story Displacement, Overturning Moment, Base Shear, Story Drift and Participating Mass Ratio.

In this paper, the preliminary results of a large parametric study, whose aim is the performance evaluation of irregularity in elevation for frame buildings, are shown. After the numerical investigation, the following conclusions can be made:

1. Concerning the irregularity established due to setbacks, that even a very large variation of irregularity distribution in elevation causes reasonable modifications of the seismic response with respect to the reference regular case.
2. Maximum story drift and story displacement will increase as the vertical irregularities increase in models.
3. The scale-up factor may 1.3 be adopted as the mean value ≈103% increase in maximum base shear observed for irregular buildings. Thus the response quantities may be modified by an increasing factor of 1.3.
4. The structural and architectural configurations should be observed keenly to attain the optimum performance of the building in terms of its seismic response.

(6) Dr. Uttamasha Gupta, ShrutiRatnaparkhe, Padma Gome,(2012)"Seismic Behaviour of Buildings Having Flat Slabs with Drops", compared the behavior of multi-story buildings having flat slabs with drops with that of traditional beam column slab structure and also studied the effect of part shear walls on the performance of these two types of buildings under seismic forces. The work provides a good source of information on the parameters of lateral displacement and story drift. For this purpos,e they considered six cases of multi-storey buildings.

Case-I: Building area 16 m x 24 m with 7 storeys. Part shear walls on the ground floor only.

Case-II: Building area 16 m x 24 m with 9 storeys. Part shear walls at the ground floor only.

Case-III: Building area 20 m x 30 m with 7 storey. Part shear walls on ground floor only.

Case-IV: Building area 20 m x 30 m with 9 storeys. Part shear walls at ground floor only.

Case-V: Building area 20 m x 30 m with 11 storeys. Part shear walls on the ground floor and first floor only.

Case-VI: Building area 20 m x 30 m with 13 storey. Part shear walls on ground floor only.

For all the six cases 3 models are to be compared. All the models are analyzed with part shear walls and without shear walls for zone III, zone IV, and zone V using Staad.Pro software. From the analysis

It is observed in all the considered models, the drift values follow a parabolic path along story height with maximum value lying somewhere near the middle storey.
In shorter plans drift values increase while in larger plans it decreases in the case of flat slabs with drop. Provision of flat slabs with drops in zones III and IV in place of beam slab arrangements, though, alters the maximum lateral displacement values, however, these all are well within permissible limits, even without shear walls. It is clear from the results that providing part shear walls is not enough in zone V to keep maximum lateral displacements within permissible limits, whether it is a beam slab framed structure or framed structure with flat slabs with drop. When beam slab arrangement is replaced by flat slabs with drop there is an increase in column reinforcement, howevthe er, presence of shear walls compfor ensates the increment resulted, but in larger plans only in all the zones. From lateral displacement view point, in master-slaves master slave approach may be adopted but in larger plans realistic analysis considering slabs at various floor levels should be carried out.
(7) Milind. V. Mohod (2015) In this paper, the seismic response of different shapes and plan configurations of structure in 3rd zones is studied with the help of STAAD.Pro software.
Equivalent static analysis as per IS 1893-2002 method was adopted to design buildings and overcome effect of earthquake on it

(8) Pralobh S. Gaikwad1 et al. (2015) Studies of Dynamic Effect on Unsymmetrical Building (Rcc & Steel). The main objective of earthquake engineers is to design and build a structure in such a way that damage to the structure during the earthquake is minimize. The paper gives the idea of dynamic analysis of Steel and RCC building with unsymmetrical configuration. The analysis is carried on model of G +9 stories of RCC and Steel building with un symmetrical floor plan. The analysis is by carried out by using E TABS Software.

The parameters such as story drift, story shear, and torsion are determined. For dynamic analysis response spectra method or time history method is used. Dynamic analysis should be performed for symmetrical as well as unsymmetrical buildings. Dynamic analysis is in the form of full nonlinear dynamic time history analysis. If the RCC and Steel building have unsymmetrical configurations, The tensional effect will be produced in both building and compared with each other to determine the efficient building under torsion.

(9) Mahesh N. Patilet al. (2015) studies of seismic analysis of multistoried buildings. The effective design and the construction of earthquake-resistant structures have much greater importance all over the world. In this paper, the earthquake response of symmetric multistoried building is studied by manual calculation and with the help of ETABS 9.7.1 software. The method includes seismic coefficient method as recommended by IS 1893:2002. The responses obtained by manual analysis as well as by soft computing are compared. From the data revealed by the manual as well as software analysis for the structures with seismic coefficient method conclusions are Calculation of seismic weight by both manual analysis as well as software analysis gives exactly same result. There isa slight variation in the values of base shear in manual analysis as well as software analysis. And also, there is a gradual increase in the value of lateral forces from bottom floor to top floor in both manual as well as software analysis.

(10) Neha P. Modakwar et al. (2014) The main objective of this study is to understand different irregularity and tensional responses due to plan and vertical irregularity and to analyze the cross shape and L shape building while earthquake forces acts and to calculate additional shear due to torsion in the columns. This study was initiated to quantify the effect of different degrees of irregularity on Structures designed for earthquakes using simplified analysis. The type of irregularity Considered was

(a) Horizontal Irregularity- Reentrant corner

(b) Vertical Irregularity - Mass Irregularity.

The main objective of this study is to understand different irregularity and tensional response due to plan and vertical irregularity and to analyze cross-shape and L shape building while earthquake forces acts and to calculate additional shear due to torsion in the columns. Summary of findings include; the Re-entrant corner columns need to be stiffened for shear force in the horizontal direction perpendicular to it as significant variation is seen in these forces. Significant variation in moments, especially for the higher floors about axis parallel to earthquake direction, care is needed in the design of members near re-entrant corners. From the torsion point of view the re-entrant Corner columns strengthened then at lower floor levels and top two floor levels and from the analysis it is observed that behavior of torsion is same for all zones.

(11) Nitin Bhosale, Prabhat Kumar, Pandey Mobile communication growth has increased from the last three years. Therefore, the need of communication towers and buildings has increased. The competition between mobile operators is also increased therefore the need of rooftop antenna has increased from last three years. The operators are adopting rooftop antennas now a day because it cost less than cost of land. In the present study, the comparison is shown in between ground tower members and rooftop tower at the same elevation.

(12) Pavan Kumar (2014) the main objective this paper is to study the seismic analysis of structure for static and dynamic analysis in ordinary moment resisting frame and special moment resisting frame. Equivalent static analysis and response spectrum analysis are the methods used in structural seismic analysis. We considered the residential building of G+ 15 storied structure for the seismic analysis and it is located in zone II. The total structure was analyzed by computer with using STAAD.Pro software. We observed the response reduction of cases of ordinary moment resisting frame and special moment resisting frame values with deflection diagrams in static and dynamic analysis. Results and Conclusion: the values for displacement in static analysis of OMRF values are more compared to that of dynamic analysis values of the same coAlsond also observe that the values for bending moment at dynamic analysis values are more as compared to that of static analysis SMRF structure. The static and dynamic analyses of OMRF & and SMRF values are observed. Finally, it can conclude that the results of static analysis in OMRF &and SMRF values are low when compared to that of dynamic analysis in OMRF & and SMRF values. Hence the performance of the dynamic analysis SMRF structure is quite good in resisting the earthquake forces compared to that of the static analysis OMRF & SMRF.

(13) Mohammed Yousuf et al. (2013) the main objective of earthquake engineering is to design and build a structure in such a way that the damage to the structure and its structural component during an earthquake is minimized. This paper aims towards the dynamic analysis of reinforced concrete buildings with plan irregularity. Four models of G+5buildingsg with one symmetric plan and the remaining irregular plan have been taker the investigation. The analysis of the R.C.C. building is carried out with the FE-based software ETABS 9.5. Estimation of response such as; lateral forces, base shear, storey driftand , storey shear is carried out. Fcross-sectionalonal variation in the columns section is considered for studying effectiveness in resisting lateral forces. The paper also deals with the effect of the variation of the building plan on the structural response building. Dynamic responses under prominent earthquakes related too IS 1893–2002(part 1) have been carried out. In dynamic analysis; the Response Spectrum method is used. The CQC (complete quadratic combination) method has also been employed for each model for estimation of dynamic response for 5%, 10%, 15%, and 20% damping and dynamic responses were compared.

(14) M. Santhosh, S. Pradeep, they carried out the project on "Seismic Analysis and Design of Multi Storey Building with Non Parallel Shear Wall System". The main focus of the study is to discuss the effectiveness of shear wall by considering different models. A G+5 storey building was considered which was located in the seismic zone V and the earthquake, They concluded from the analysis results that base shear for structure without shear wall was less when compared with the structures with shear walls due to reduced self-weight

(15)Prof.Vishwanath.B.Patil, Sunil Kumar Kalyani, there research was on "Effect of Shear Wall Sections on Multistory Building with Satellite Bus Stop Having Floating Columns With Top Soft Storey". They performed an investigation of columns in the ground level of G+12 multistoried building with soft ground floor as satellite bus stop and floating columns in the upper stories subjected to earthquake loading, they concluded that there was no effect in drift for the building with top soft storey when subjected to seismic loading. The storey acceleration was maximum for the building with no brick masonry infill in ground. And top storey, but having full brick masonry infill in rest of all stories with swastika shape shear wall at corners along x direction in response spectrum analysis and time history analysis. .

(16) Dr. E Arunakanthi, AMurali Krishna, there research was on "Optimum Location of Different Shapes of Shear Walls in Unsymmetrical High Rise Buildings". Their main work deals with a study on optimum location of shear walls in an unsymmetrical high rise building. They considered high rise building with different location of shear wall and different shapes (L, U, box, H, T, W) for analysis. There building configuration consists of 30 storeys for each model. The influence of the time period was significant on shape of shear wall and its position. The columns located away from shear wall had less shear force and high bending moments compared with columns connected with shear wall.

(17) Sanjay Sen Gupta. Their research was on "Study on Shear Walls in Multi Storied Buildings with Different Thickness and Reinforcement Percentage for All Seismic Zones in India''. The effect of different thickness and corresponding reinforcement percentages required for shear walls in multi storied building was investigated in this paper. From the results the following conclusions were made. The reinforcement percentage of shear walls at different locations for a shear wall of constant thickness.

(18) Ahmed Najim Abdullah Al-Askari, Prof N. V. Ramana
Rao. Their work deals with the "Study on The Optimum Location and Type of Shear Wall in U Shape Building under Different Types of Soils". A high rise building was considered for the analysis with shear wall at different locations. They concluded that the time period significantly influenced by the shear wall and its position and not by the different types of soils.

(19) Poncet, L. And Tremblay (2004) proposed the impact and effect of mass irregularity considering case of an eight-storey concentrically braced steel frame structure with different setback configurations. Methods used in present paper are equivalent static load method and the response spectrum analysis method.

(20) Devesh P. Soni (2006) considered several vertical irregular buildings for analysis. Various criteria's and codes have been discussed and reviewed in this paper. Vertical irregular structure performance and response is reviewed and presented. The studies suggested that for combined-stiffness-and-strength irregularity large seismic demands are found.

(21) Patil and Kumbhar (2013) considered ten story building and tested against nonlinear dynamic response under seismic effect. SAP 2000 is used as a software application tool in this paper. Five number of seismic time histories are used to compare results of considered cases.

(22) Aijaj and Rahman (2013) tried to analyse the proportional distribution of lateral forces involved in earthquake for individual storey due to changes in stiffness of vertically irregular structure.

(23) S.Varadharajan et al. (2013) reviewed existing works regarding plan irregularities and justified the preference of multistory building models over single storey building models.

(24) HimanshuBansaL (2014) analysed vertical irregular building with Response spectrum analysis and Time history Analysis. Irregularities considered are mass irregularity, stiffness irregularity and vertical geometry irregularity. The storey shear force was found maximum for the first storey and it decreases to minimum in the top storey in all cases.

(25) Harshitha. R (2014) studied dynamic behavior of high-rise building using IS1893-2002 code recommended response spectrum method and time history method STAAD Pro software is used to analyze the building models and it is found that the base shear obtained from Time history analysis is higher than Response Spectrum analysis. This is because of variation in amplitude and frequency content of the ground motions.

(26) M.A. Barkhordari, G. Ghodrati Amiri, M.R. Vafaeiand S.R. Massa Telecommunication towers are steel structure and their seismic response against seismic loads is different than concrete structure therefore an analysis is carried out against seismic loads on steel telecommunication towers in Iran. This analysis is done on a four-legged telecommunication tower of a height of 18 to 67 meters. The Dynamic, shear and vertical reaction of the tower are calculated.

(27) Shailesh S. Goral,Prof. S. M. Barelikar The telecommunication industry is the fastest growing

industry in human society and therefore it catches more attention than any other industry. The earthquake and wind analysis plays an important role in telecommunication structure like towers. Natural hazards like earthquake and wind storms are the major issues for the safety of towers. In this research the stead-pro software is used for the analysis of seismic and wind loads. The square shape plan and different bracing systems has been used in the design of these towers. Nonlinear dynamic method is used in the analysis of these towers.

(28) K. Jagan Mohan and C. Preeti Transmission towers consume about 28 to 42 percent of the transmission line cost. The requirement of electricity is increasing rapidly all over the world therefore to meet its demand economically development of light weight towers in use. In this paper, the effort is made to make cost-effective transmission line by converting the shape and type of transmission line structures. By Using STAAD PRO software analysis is carried on three towers. The wind load calculation is carried out and repeated again anginiform the analysis and design of the towers.

Seismic Behavior of Irregular Buildings on slopes in India

Ravikumar et al. (2012) studied two kinds of irregularities in building model namely the plan irregularity with geometric and diaphragm discontinuity and vertical irregularity with setback and sloping ground. Pushover analysis was performed taking different lateral load cases in all three directions to identify the seismic demands. All the buildings considered are three storied with different plan and elevation irregularities pattern. Plan irregular models give more deformation for fewer amounts of forces where the vulnerability of the sloping model was found remarkable. The performances of all the models except sloping models lie between life safety and collapse prevention. Hence it can be concluded that buildings resting on sloping ground are more prone to damage than buildings resting on flat ground even with plan irregularities.

Sreerama and Ramancharla (2013) observed that recent earthquakes like Bihar-Nepal (1980), Shillong Plateau, and the Kangra earthquake killed more than 375,000 people and over 100,000 of the buildings collapsed. Dynamic characteristics of the buildings on flat ground differ to that of buildings on slope ground as the geometrical configurations of the building differ horizontally as well as vertically. Due to this irregularity, the centre of mass and thecentere of stiffness does not coincide with each other and it results in a torsional response. The stiffness and mass of the column vary within the stories that result in an increase of lateral forces on the column on the uphill side and vulnerability to damage. In their analysis, they took five G+3 buildings of varying slope angles of 0, 15, 30, 45,and 60° which were designed analyzed using IS-456 and SAP2000 and further the building was subjected and analyzed for earthquake load i.e., N90E with PGA of 0.565g and magnitude of M6.7. They found that short columns attract more forces due to the increased stiffness. The base reaction for the shorter column increases as the slope angle increases while for other columns it decreases and then increases. The natural period of the building decreases as the slope angle increases and short column resist almost all the storey shear as the long columns are flexible and cannot resist the loads.

Patel et al. (2014) studied 3D analytical model of eight storied buildings was analyzed using analysis tool ETabs with a symmetric and asymmet models to study the effect of variation of the height of columns due to sloping ground and the effect of the concrete shear wall at different locations during earthquake. In the present study lateral load analysis as per seismic code was done to study the effect of seismic load and assess the seismic vulnerability by performing pushover analysis. It was observed that vulnerability of buildings on sloping ground increases due to formation of plastic hinges on columns in each base level and on beams at each storey level at performance point. The number of plastic hinges are more in the direction in which building is more asymmetric. Buildings on sloping ground have more storey displacement as compared to that of buildings on flat ground and without having shear wall. Presence of shear wall considerably reduces the base shear and lateral displacement.

Objectives Of Present Work

The objectives formulated at the start of this project are:

- To give a review of present literature about laterally loaded in High -Rise building.
- To gives analysis the high-Rise Building with sloping ground and different bracing.
- To analyse the structure interaction of a laterally loaded in sloping ground in shear wall parameters.
- To study this effect on the parameter's lateral displacement and storey drift.
- To compare the High-rise buildings for above parameters in zone III.
- To compare the High-rise buildings for above parameters in zone III.

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