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"SEISMIC ANALYSIS AND DESIGN OF G+10 STORY BUILDING IN DIFFERENT SLOPING GROUND CONDITIONS"

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Abstract: Due to the lack of flat land in mountainous places, the bulk of structures are built on the slopes of the hills, with irregular structural layouts and foundations at various heights. Such structures have unique structural and building issues. Building on a sloped surface must contend with powerful earthquakes. The effects of step-like inclination geology on structures have not been thoroughly examined before. In contrast to slopes and ravines, this sort of surface geology has received little attention from scholars. The non-symmetric geometry of step-like inclines, which complicates explanatory layouts and generally permits site-specific numerical re-enactments, is one explanation that is feasible. The fundamental difficulty for the structural designers is the seismic failure of structures built on these sloping lands.

Keywords - mountainous, structural, unique, complicates, explanatory, fundamental.

I. INTRODUCTION

Structures on the earth are generally subjected to two types of load i.e. static and dynamic. Static loads are constant with time while dynamic loads are time varying. In general majority of the civil structures are designed with the assumption that all applied loads are static. The effect of dynamic load is not being considered because the structure is rarely subjected to dynamic loads, more its consideration in the analysis makes the solution more complicated and time consuming. This aspect of neglecting dynamic forces may sometimes become the cause of disaster particularly in case of earthquake

II. OBJECTIVES OF THE PRESENT STUDY

To carry out the seismic analysis of a multi storied building situated in seismic zone V as per IS 1893-2016 on sloping ground having angle of inclination 0°,10° and 20° on soft, medium and hard strata.

To carry out the seismic analysis of a multi storied building situated in seismic zone V as per IS 1893-2016 on filled slope ground (level ground) having soft, medium and hard strata.

To compare the seismic responses of the above buildings as horizontal displacement, bending moment, shear force, torsion and storey drift in order to study its seismic behaviour.

III LITERATURE SURVEY

Kumar et al. (2017); studied on "Analysis and Comparison of Step Back RC Frame Building on Sloping Strata and Plain Strata".They studied and analyzed G+ 10 story RCC building. A comparison has been made with the building resting on level ground. The modeling and analysis of the building has been done by using structure analysis tool ETAB 2015. The seismic analysis was done by the response spectrum analyses have been carried out as per IS: 1893 (part 1): 2002. The results were obtained in the form of top storey displacement, Storey drift, Base shear and over turning moment. They observed that the Overturning moment is same till story 4 because column height is same , but after story 4 it overturns due to column variation

and also overturning moment gradually decreases for step back configuration on sloping ground compare to step back on flat ground for load. Hence they concluded that Base shear is more for sloping strata than plain strata and the over turning moment gradually decreases on sloping ground than compare to flat ground in both D-con 7 and D-con 9.

Zafar et al. (2018) studied the combined effects of earthquake-triggered landslides and ground shaking on sloping ground. They carried out Dynamics characteristic of hill buildings in both horizontal and vertical directions.They have shown that results in center of mass and center of stiffness of a story not coinciding with each other and not being on a vertical line for different floors. They also analysed that when a multistoried building are subjected to lateral loads, these buildings are generally subjected to significant torsional response.

Khan and Singh (2019) ; studied and analyzed of multistoried building (G+4) on sloped ground by considering gravity loads and seismic loads (response spectrum method used) and also includes slope stability analysis. The modeling has been done by providing different elevations at foundation level and analysis of building has carried out by using finite element software such as Staad. The material properties of concrete and steel are assigned according to the IS standards. The analysis has been carried out in the software. The reactions at the base of the building are taken from the software separately. The same reactions are further used for the analysis of slope to get the factor of safety by using software for varying sloping angles (0 to 30 degree). From this study it is observed that there is decrease in the factor of safety with increasing sloping angle and also noted that there is increase in the reactions with increase in sloping angle in both the cases i.e. gravity as well as seismic conditions.

Keneror and Halhalli (2020) studied multistoried building on slopy ground of 0 and 24 degree.They analyzed G+20 storey building by using E-TAB and evaluate the seismic parameters such as story displacement, ground deviation, period of oscillation. They concluded that there is increased insertion of the shear wall to resist side loading.

III. DESIGN METHODOLOGY

IS 1893 adopted a design philosophy to ensure that structures possess minimum strength to

I. Resist minor earthquakes (DBE value-0.18g) without damage.
II. Resist moderate earthquakes (DBE) without significant structural damage.
III. Resist major earthquakes (MCE value-0.36g) with sever structural damage.

The code considers the ductility in the form of a response reduction factor (R). It recommends different Importance factors (I) to consider the usage of the building.

The code recommends two methods for calculating the design base shear of the building of analysis namely:

(i) Equivalent static load method and
(ii) Dynamic analysis ,

In equivalent static load method design horizontal coefficient (A) has to be found out using the seismic zone factor (Z). Importance factor (I). Response reduction factor (R) and spectral acceleration coefficient (Sa/g) obtained from the response spectrum curve for the specified soil type and the structures fundamental time period.

The dynamic analysis is recommended for buildings of 40m in height situated in zones IV and V and for irregular buildings of 12m or more in height situated in zones IV and V.

Code recommends response spectrum method of dynamic analysis with complete quadratic combination (CQC) method used for modal combination.

IV. STRUCTURAL MODELING

Earthquake response analysis is an art to simulate the behavior of structure subjected to an earthquake ground motion based on dynamic model of the structure. The correct analysis will depend upon the proper modeling of the behavior of materials, elements and structure. It is important to select an appropriate and simple model to match the purpose of analysis.

A lumped mass model is simple and most used for practical design of multistory building. It reduces the substantial amount of calculation. A two plane frame model is been used for building having symmetrical plan and torsional response are expected to be small. The model connects all the plane frames in one principal direction by assuming the identical horizontal displacement of floor

V FIGURESANDTABLES

Figure 1 Methods of analysis

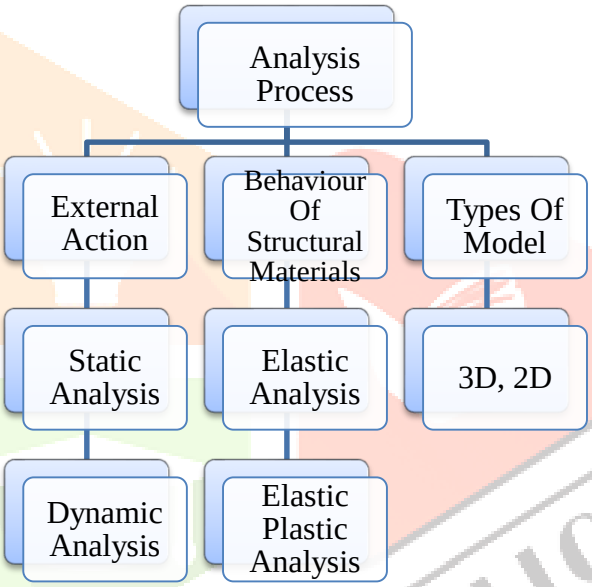


Figure 2. 3-D rendered view of RC G+10 building

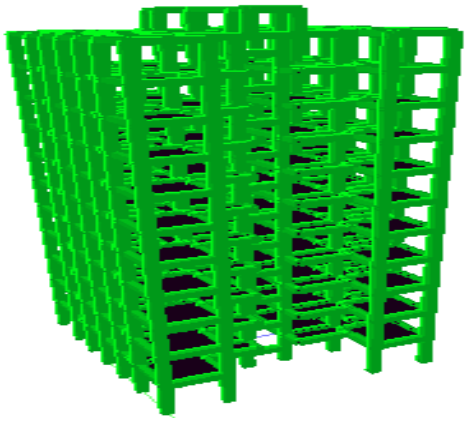
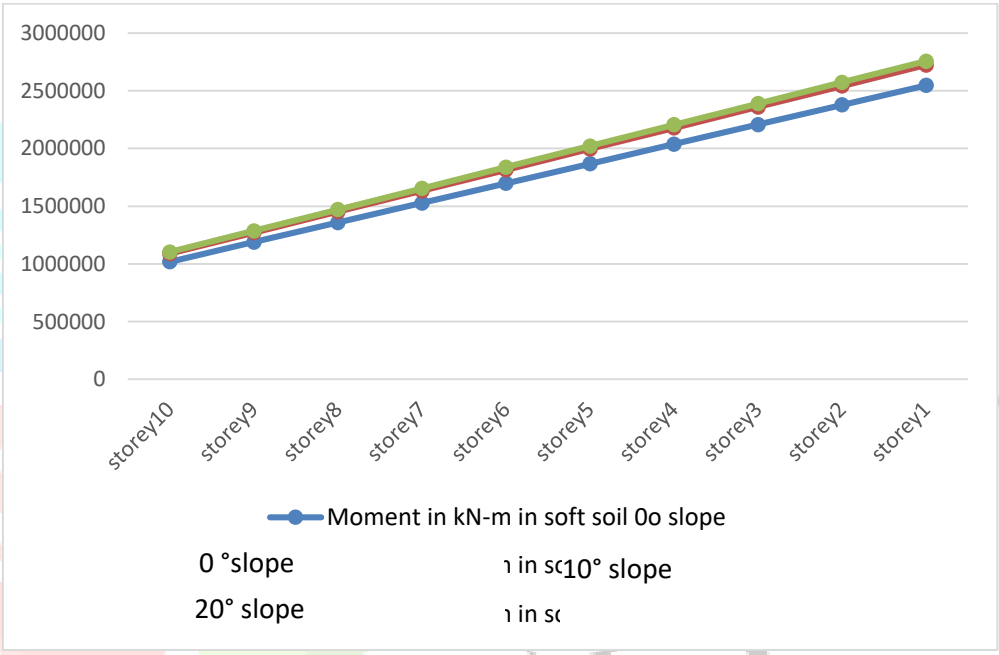


Table 3.2 Material data

Material	Weight (kN/m^3)	Modulus of elasticity (E) (kN/m^2)	Shear modulus (G)	Poisson ratio	Coefficient of thermal expansion
Steel (fe = 415)	78.5	2×10^8	76884615	0.3	11.7×10^{-6}
Steel (fe = 345)	76.9	2×10^8	80769230	0.3	11.7×10^{-6}
Concrete (fck = 25)	25	25×10^6	10416666.7	0.2	9.9×10^{-6}
Masonry	20	11×10^6	521739.13	0.15	7×10^{-6}

Graph: 1. Maximum bending moment (kNm) in soft soil



VI.CONCLUSIONS

In the present work the seismic analysis of a multi storied building situated in seismic zone V as per IS 1893-2016 on sloping ground having angle of inclination 0°, 10° and 20° on soft, medium and hard strata is analyzed. The seismic analysis of a multi storied building situated in seismic zone V as per IS 1893-2016 on filled slope ground (level ground) having soft, medium and hard strata is also studied. The seismic responses of the above buildings as horizontal displacement, bending moment, shear force, torsion and storey drift in order to study its seismic behaviour are investigated.

VII.ACKNOWLEDGMENT

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