SEISMIC ANALYSIS OF MULTI-STOREY BUILDING FRAME ON SLOPING GROUND

Miss. Archana Dubey[1], Mr. Jayant Lonare[2], Prof. Saurabh Pathare[3]

[1]M.Tech Student VMIT, Nagpur
[2]M.Tech Student VMIT, Nagpur
[3]Professor, Dept. of Civil Engineering, GWCET, Nagpur, Maharashtra, India

---***---

Abstract - *The construction in hilly regions is generally constrained by local topography resulting in both vertical and horizontal irregularities in the buildings, causing irregular variations of mass and stiffness of the buildings. This causes a significant variation of dynamic behavior of such buildings when compared to buildings constructed on a flat land, which is not addressed in detail by the existing codal provisions that mainly focuses on the regular buildings [8]. Therefore, more research is essential to understand seismic behavior of such buildings and provide corresponding changes in existing codal provisions.*

Key Words: 0^0, 15^0, 30^0, 45^0 Inclined slope, Drift, Displacement, base shear

1. INTRODUCTION

Seismic forces acts more sever in hilly regions due to the structural irregularity. Also it has been studied that the earthquake actions are prone in hilly areas. In India, for example, the north-east states. The behaviour of buildings during earthquake depends upon the distribution of mass and stiffness in both horizontal and vertical planes of the buildings. In hilly region both these properties varies with irregularity and asymmetry. Such constructions in seismically prone areas make them exposed to greater shears and torsion. Hill buildings are different from those in plains. They are very irregular and unsymmetrical in horizontal and vertical planes. Hence, they are susceptible to severe damage when affected by earthquake ground motion.

The approach and the accuracy of analytical results depend upon the idealization of geometry of the structure and the loading on the structure.

The present work aims at providing an analytical approach for finding out the displacements, storey drifts, natural frequency, time period, base shear for a multistore building resting on a sloping ground.

1.1 Objective

To study the variation of base shear with respect to variation in number of bays, hill slope angle, storey height for different configurations of building frames.

To compare top storey displacement, base shear, for step back and set back configurations, compare response of step back, set back configurations on sloping and levelled ground.

To study the variation of top storey drift with respect to variation in number of bays, hill slope angle, storey height for different configurations of building frames.

1.2 Methodology

Review the existing literature and Indian design code provision for designing the Multi storey building.

Select a building model for the case study.

Modelling the selected building with varying ground slope . Models need to consider four seismic zone conditions as mention.

Design the frame as per IS 456 and IS 1893.

Linear analysis of the selected building model and a comparative study on the results obtained from the analyses.

Finally the observations of results and discussions.

2. WORKDONE

A RCC medium rise building of G+5 stories with floor height 3m subjected to earthquake loading in Zone IV, V has been considered .In this regard, ETABS-2016 software have been considered as tool to perform. Displacements, axial forces, shear force, bending moment, storey drift and base shear have been calculated for three different columns to find out the effect in the building.

A multi-storey framed building on sloping ground Seismic Zone V is selected for the present study. The building is symmetric in plan and in elevation.

2.1 Building Description

Plan Dimension - 25MX25M

Number of Stories - G+5

Total Height of building - 18.45

Height of each storey – 3

Size of column - 300X500 mm

Size of Beam - 300X500mm

Thickness of Slab – 150

Thickness of wall – 230

Seismic zone – V

Soil condition – MEDIUM

Importance Factor – 1

Response Reduction – 5

Damping of Structure - 0.05

Live Load - On Roof = 1.5 KN/M^{2},
On floor = 3 KN/M^{2}
Floor Finish - 0.5 KN/M^{2}

2.2 Analytical Frame

Effectiveness of soft storey has been studied with the help of four different cases.

Case1- Bare Frame Building with 0^{o} slope

Case2- Bare Frame Building with 15^{o} slope

Case3- Bare Frame Building with 30^{o} slope

Case4- Bare Frame Building with 45^{o} slope

As diagrammatic example of above cases are shown below.

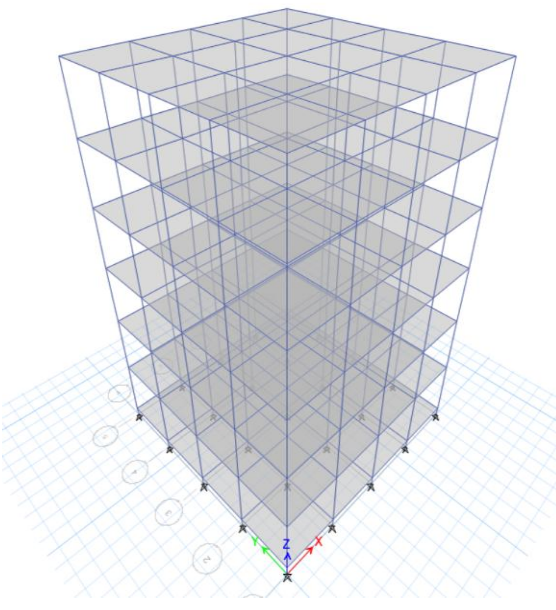

Fig -1: Case 1

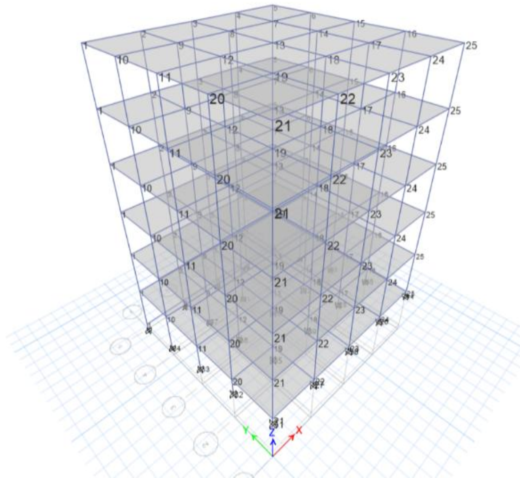

Fig -2: Case 2

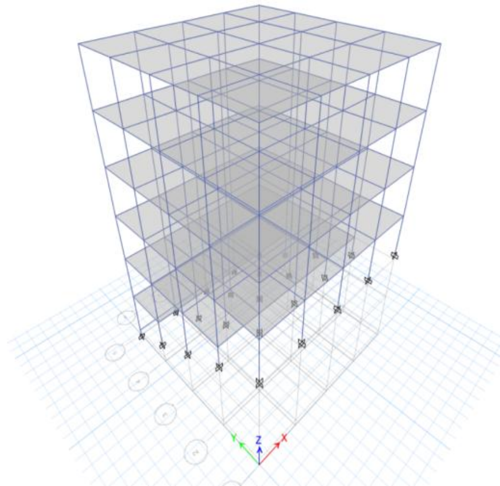

Fig -3: Case 3

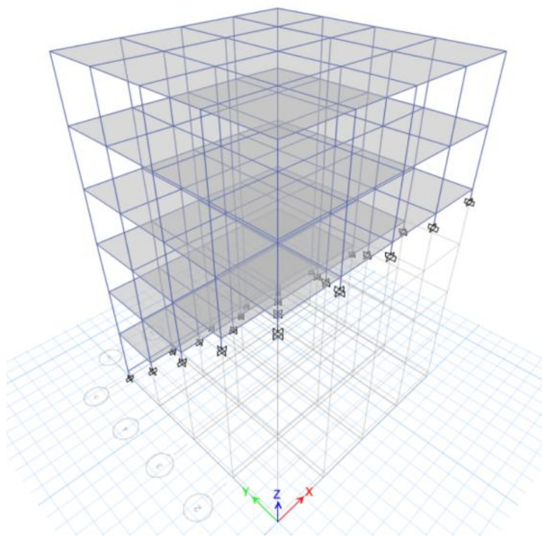

Fig -4: Case 4

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 09 | Sep 2020 www.irjet.net p-ISSN: 2395-0072

3. Analysis & Comparative Result

3.1 Displacement

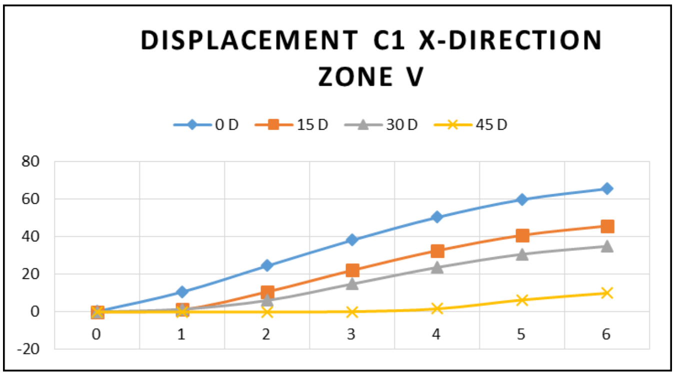

Chart -1: Displacement

From the above graphs displacement profiles it is observed that large displacement occurs in case-I building (case I). Displacement is occurred in the case of flat surface foundation.

According to the observation made from the graphs plotted it is clear that as the slope of the ground goes on increasing displacement is decreased. Minimum displacement is observed in case 4 i.e. 45 degree inclined.

3.2 Storey Drift

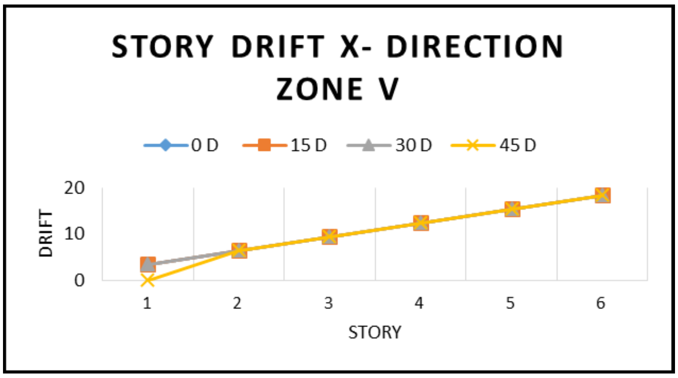

Chart -2: Storey Drift

However, the storey drift profile becomes smoother right for all cases indicating large stiffness and less ductility demand. As graphical representation indicated graph of storey drift and storey is linear gradually increasing as we go to higher storey.

As all the models are analysed without brickwork there is no stiffness in the frame. Therefore higher storey drift is observed.

3.3 Axial Force

The maximum axial forces in the three columns in longitudinal and transverse direction is considered for analysis in seismic zone V

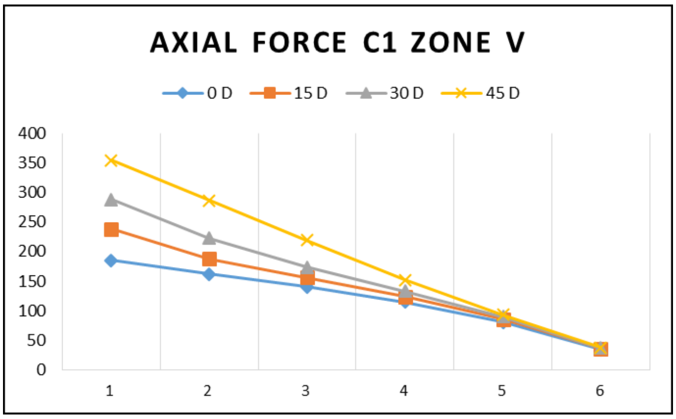

Chart -3: Axial Force

It is observed that the force gradually decreases from ground floor to top floor

As per graphical representation, it is observed that column 13 gives maximum axial force as compared to C1 & C15.

3.4 Base Shear

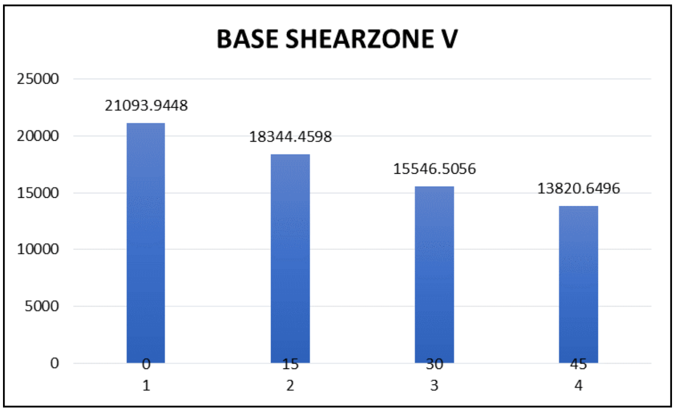

Chart -4: Base Shear

Plots of the base shear in longitudinally are made for four models, all imposed on the same graph. The base shear is directly proportional to weight of structure.
Maximum base shear is observed in 0^0 slope inclination bare frame, as this building has maximum weight of the structure. Minimum base shear is occurred in the 45^0 inclined slope case, as this building has minimum weight of the structure.

4. SUMMARY

Graphical representation of various data is covered in this chapter and observations are framed. Accordingly conclusions are written based on interpretation of graphs and research paper. On sloping ground the displacement of building shows the same behavior as of regular building.

The displacements value gets smaller as the slopes increases due to curtailment of column.

Use of bottom ties gives effective response of hilly building.

REFERENCES

Narayan Kalsulkar† , Satish Rathod "Seismic Analysis of RCC Building Resting on Sloping Ground with varying Number of Bays and Hill Slopes"

Pawan Pawar Asst. Prof. Deepa Telang A Comparative Study on Seismic Analysis of Multistorey Building Resting on a Sloping Ground and Flat Ground

Umakant Arya1, Aslam Hussain2, Waseem Khan3 Wind Analysis of Building Frames on Sloping Ground Max

Gayake Prasad R.1 Prof. Nikam P. A.2 "Comparative Study of with & Without Shear Wall for Drift & Displacement"

Nehal A. Bhavsar, Noopur A. Shah, 3Satyen D. Raman "Study on Effectiveness of Shear Wall on Different Building Aspect Ratio"

B. G. Birajdar and S. S. Nalawade (August 1-6, 2004) Seismic analysis of building resting on sloping ground 13th World Conference on Earthquake Engineering Vancouver, B.C., Canada, Paper No. 1472

S. M. Nagargoje and Mr. K. S. Sable Seismic Performance of Multi-storeyed Building on Sloping Ground Nagargoje et al. Elixir Elec. Engg. 53 (2012) 11980 11982

Photo Gallery: Commercial Softwear