iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** XII **Month of publication:** December 2020

DOI: https://doi.org/10.22214/ijraset.2020.23635

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue XII Dec 2020- Available at www.ijraset.com

Parametric Study of Responses of RCC Building on Sloping Ground Using Staad.Pro

Prof. Dushyant A. Zamre[1], Raj S. Yetekar[2], Rahul G. Pawar[3], Shubham P. Sonawane[4], Arshad I. Shaikh[5]
[1]*Assistant Professor, Civil Engineering Department, Savitribai Phule Pune University*
[2, 3, 5, 4]*Civil Engineering Department, Savitribai Phule Pune University*

Abstract: The economic growth and rapid urbanization in a hilly region has accelerated development of infrastructure and construction activities. Because of which, population density in the hilly region has increased. Therefore, there is popular and pressing demand for construction of multi-story building in hilly region. Hill buildings are different from those in plains; they are very irregular in horizontal and vertical plains. Hence, they are susceptible to severe damage when affected by earthquake ground motion. In this paper we analyze using Staad Pro comparison between set back and step set back building with different slopes and plain ground using response spectrum method considering for seismic zone iv and v. The base shear, displacement and time period in step back and step set back buildings are analyzed with different sloping grounds.
Keywords: Hilly Region, Staad Pro, slopes and plain ground, step back, Step Set back, Response Spectrum method.

I. INTRODUCTION

Analysis of buildings in hilly region is somewhat different than the buildings on levelled ground, since the column of the hill building rests at different levels on the slope. The other problems associated with hill buildings are, additional lateral earth pressure at various levels, slope instability, different soil profile yielding unequal settlement of foundation. The scarcity of plain ground in hilly regions leads to construct structure on sloping ground. In plain region to construct high rise structure is predominantly known condition, but in case of hilly region it is very difficult.

In this study the 3D analytical model of G+8 storey building is to be generated of step back building and step setback building for zone iv and zone v case with varying slopes. Building models are analysed by STAAD.Pro software. According to the IS 1893 (part I)-2012, high rise and irregular building must be analysed by response spectrum method using design spectra shown. There is significant computational advantage using response spectrum method of seismic analysis for prediction of displacement and member forces in structure. It is analysis method which measures the contribution from each natural mode of vibration to indicate the likely maximum seismic response of essentially elastic structure. It provides insight into dynamic behaviour by measuring pseudo-spectral acceleration, velocity, or displacement as a function of structural period. For a given time history and level of damping. It is practical to envelop spectra such that a smooth curve represents the peak response for each realization of structural period. Following fig shows the plan of building taken for analysis.

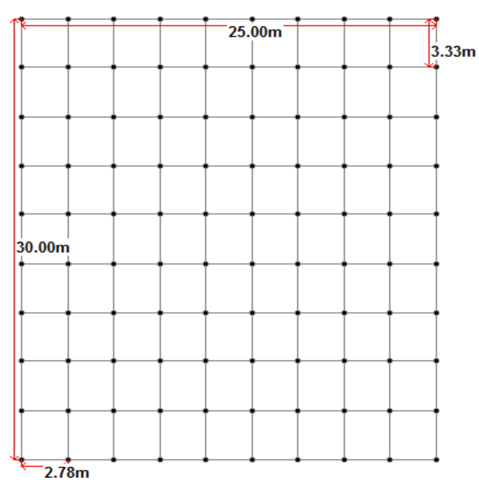


Fig 1. Plan of Building.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue XII Dec 2020- Available at www.ijraset.com

Various models have been prepared by varying ground slopes from 0^0, 2.5^0, 5^0, 7.5^0,10^0, 20^0, 30^0 for both with and without set back configuration as shown with beams tying them at various levels. For effective comparison of ground having less slope we have selected first five angle as stated above, and for steep slope the remaining three slopes.

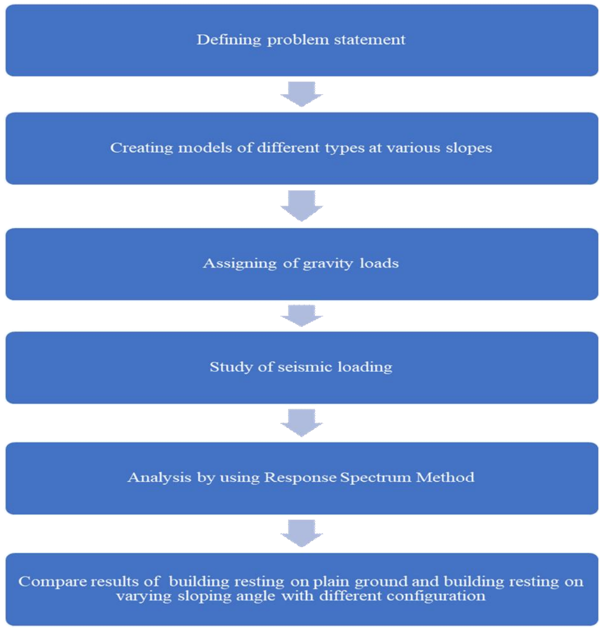


Chart 1. Steps for Analysis.

A. Modeling of The Buildings

The building is modeled using the finite element software STAAD Pro. The analytical models of the building include all components that influence the mass, strength, stiffness and deformability of structure. The building structural system consists of beams, columns, slab, walls, and foundation. The non-structural elements that do not significantly influence the building behavior are not modeled. Slopes of building have been varied from 0 to 30 degrees. Following is the example of model shown in geometry as well as in 3D rendered view.

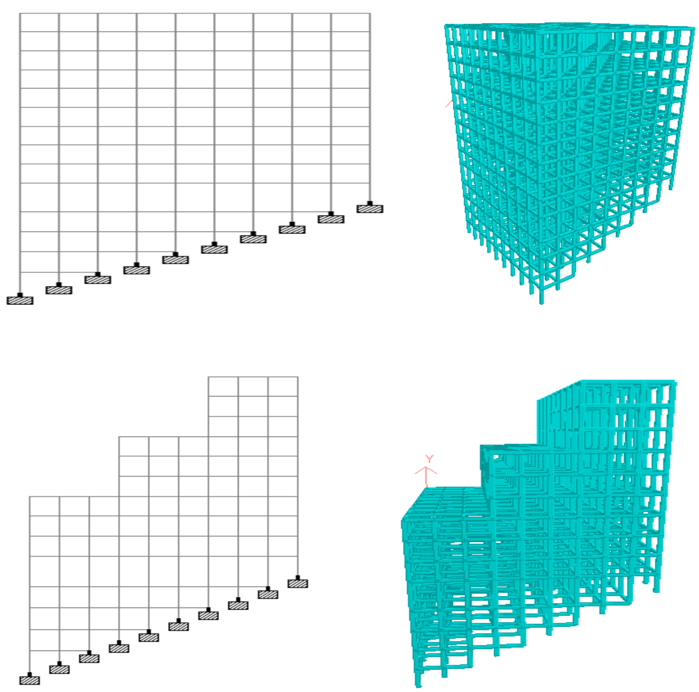


Fig 2. Model of Building Without Setbacks and with Setbacks in STAAD PRO (30^0).

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue XII Dec 2020- Available at www.ijraset.com

II. RESULT ANALYSIS

A. Base Shear

Base shear is an estimate of the maximum accepted lateral force that will occur due to seismic ground motion at the base of the structure.

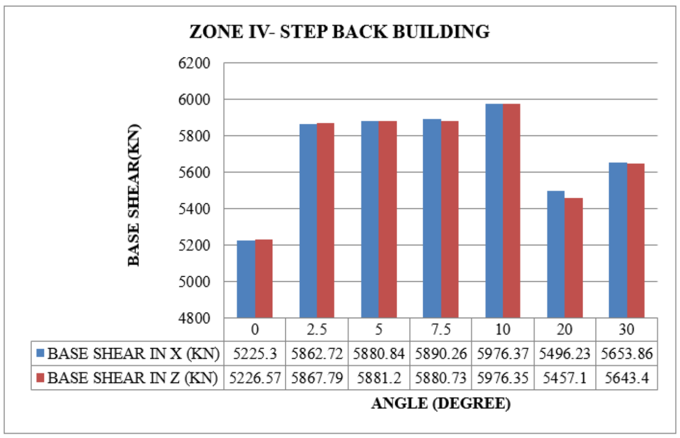
$$Vb = Ah.W$$

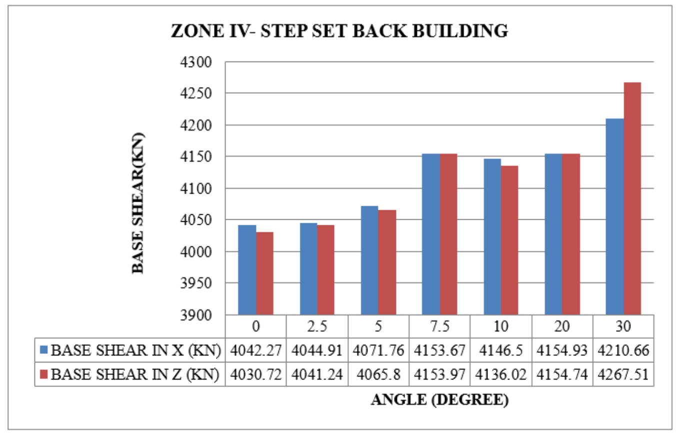
Where,

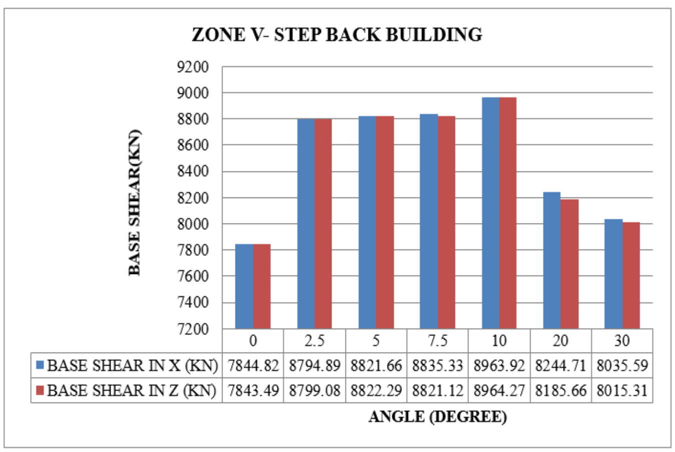
Vb = Base Shear

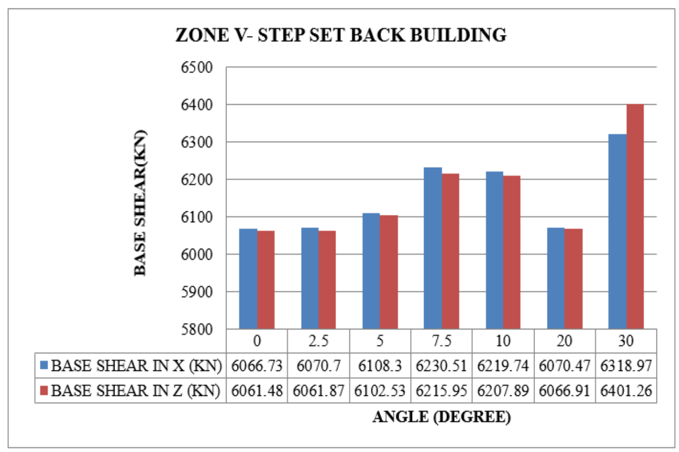
Ah = Design horizontal acceleration.

Ah=ZISa/2Rg





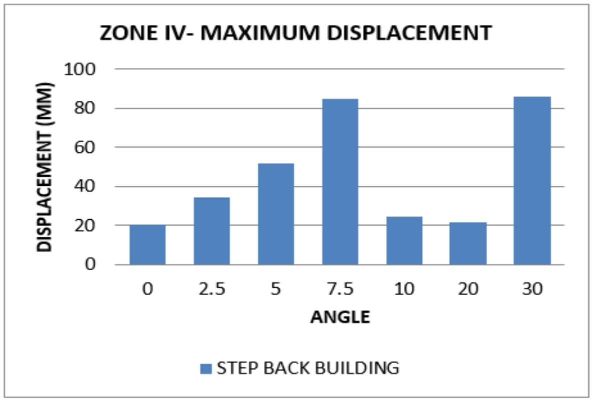


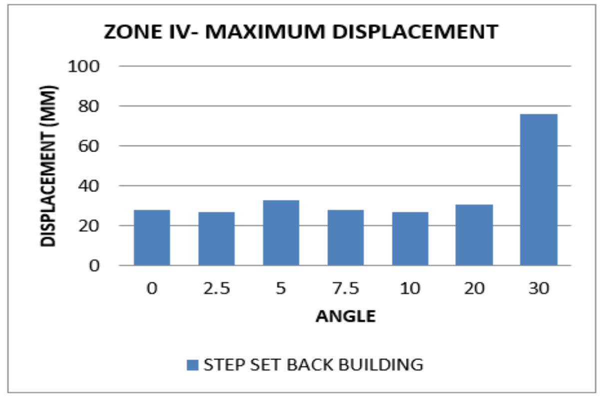


B. Displacement (Storey Drift)

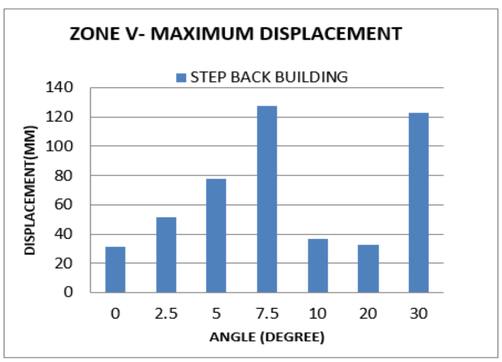
Story drift is difference in a lateral deflection between two adjacent stories. It is the drift of one level of a multistory building relative to the level below

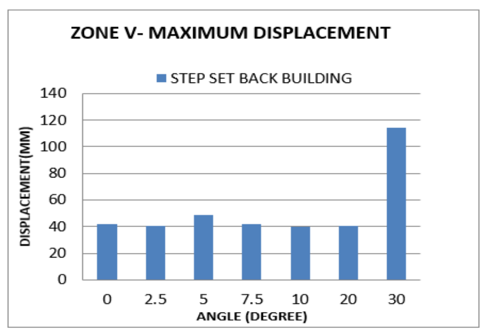
ANGLE	MAX DISPLACEMENT(MM)	
	STEP BACK	STEP SET BACK
0^0	20.672	28.062
2.5^0	34.175	27.118
5^0	51.812	32.664
7.5^0	84.982	27.996
10^0	24.563	26.667
20^0	21.629	30.974
30^0	86.225	76.415





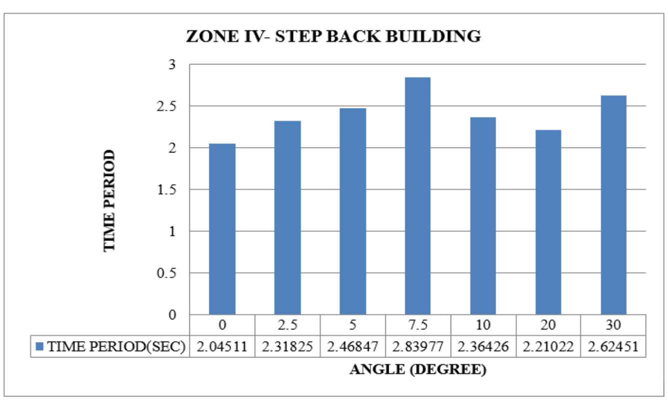
ANGLE	MAX DISPLACEMENT(MM)	
	STEP BACK	STEP SET BACK
0^0	31.008	42.036
2.5^0	51.262	40.677
5^0	77.718	48.986
7.5^0	127.474	41.994
10^0	36.844	39.94
20^0	32.548	40.693
30^0	122.687	114.622

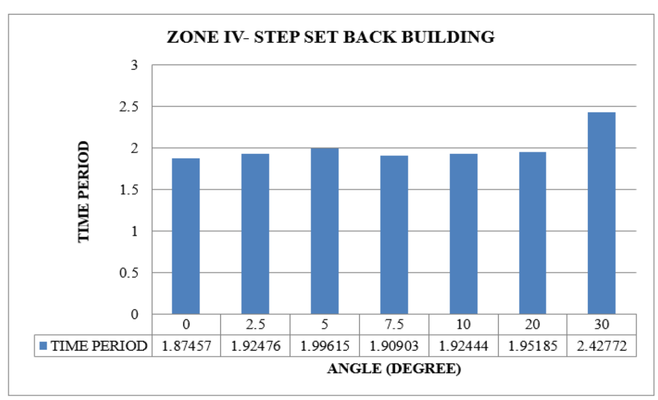




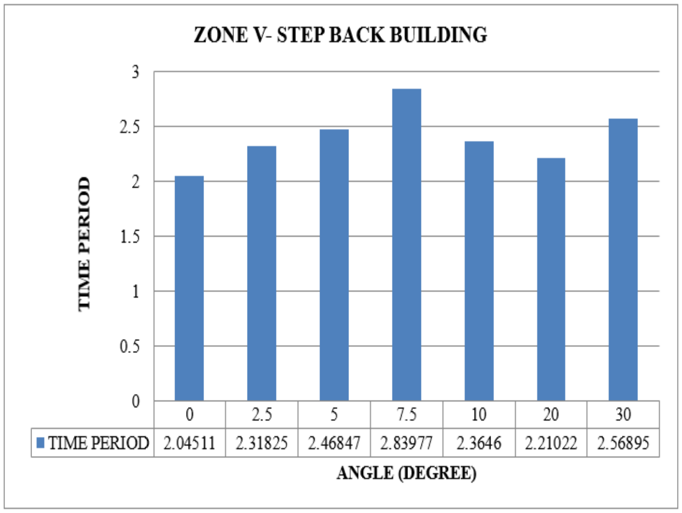
C. Time Period

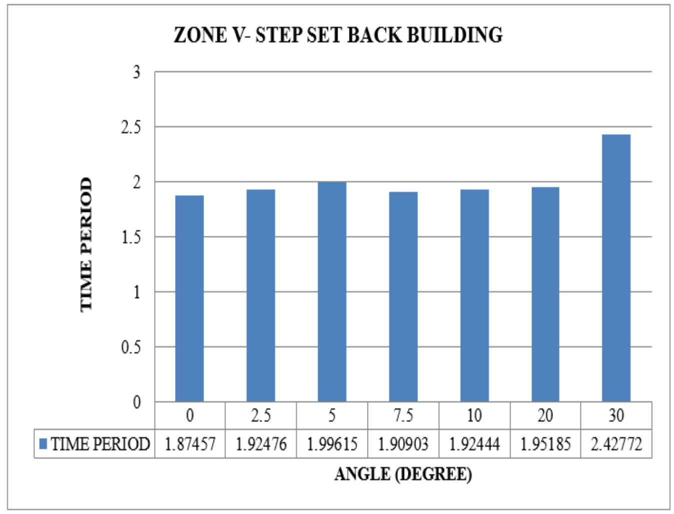
It is the time needed for one complete cycle of vibration to pass a given point. It is a time taken to complete one vibration. Following are the results in each zone.





ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue XII Dec 2020- Available at www.ijraset.com



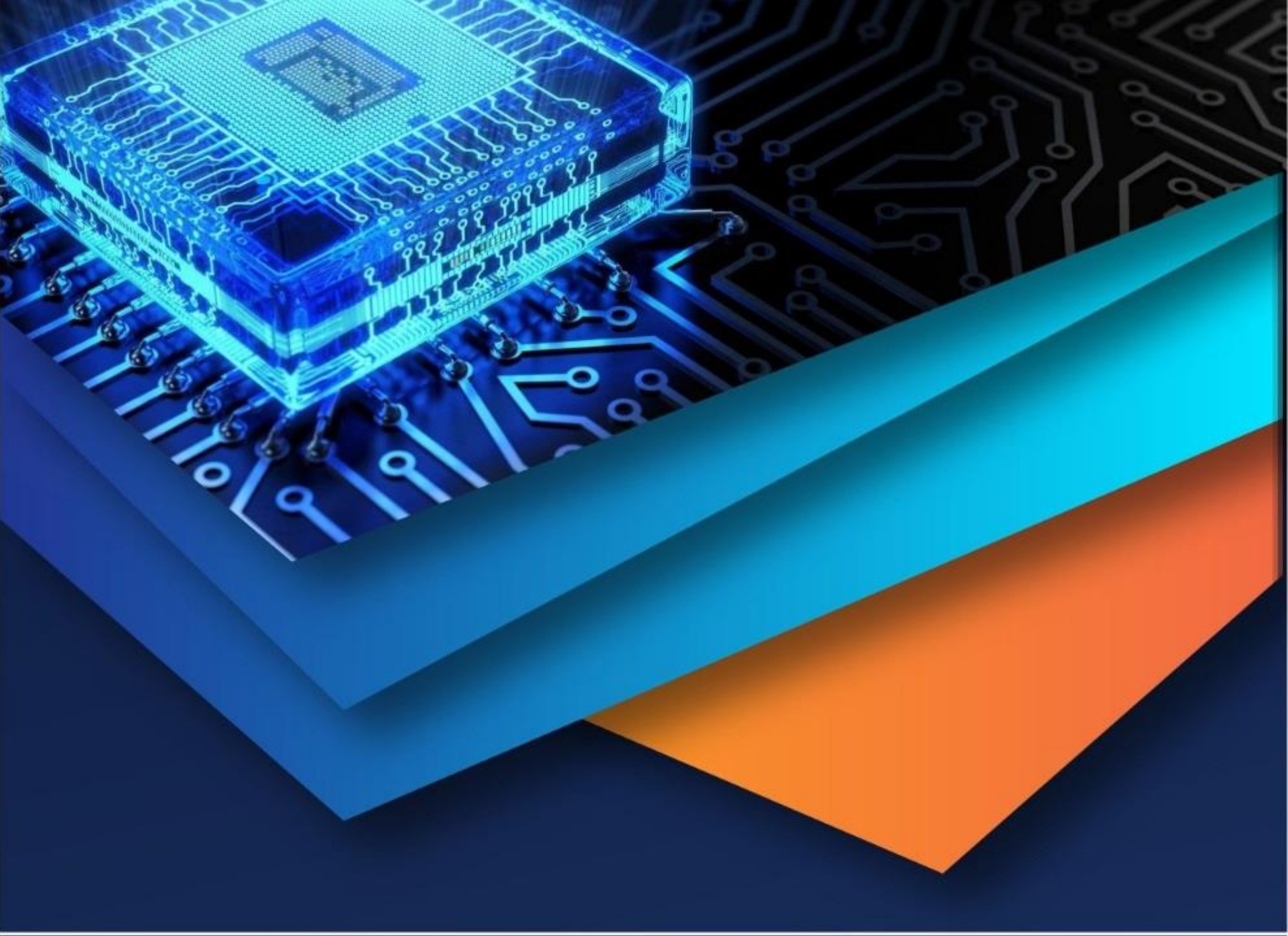


III.CONCLUSIONS

A. Provisions of tie beams prove to be the effective for construction as it reduces the base shear, displacement and counteract the forces.
B. For base shear 0 to 20 Degree slope are effective for construction than the other.
C. For displacement step setback building proves most effective in both zones.
D. For time period step setback type configuration proves effective.
E. Overall for construction of building on sloping ground step setback building proves most effective.

REFERENCES

[1] Ajay Kumar Sreerama, Pradeep Kumar Ramancharla, “Earthquake behavior of reinforced concrete framed buildings on hill slopes”, (USMCA 2013), Report No: IIIT/TR/2013/-1
[2] And Setback Configurations of R.C.C.Frame Building”, ISSN: 2278-0181, Vol. 3 Issue 10.
[3] Dr. R. B. Khadiranaikar and Arif Masali, (Jun 2014), “Seismic performance of buildings resting on sloping ground−A review”, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), ISSN: 2320-334X, Volume 11, Issue 3.
[4] Miss. Chaitrali Arvind Deshpande, (Oct 2014), “Effect of Sloping Ground on Step Back and Set back Configurations of R.C.C. Frame Building”, International journal of engineering research & technology (IJERT), ISSN: 2278-0181, Vol. 3 issue 10.
[5] Miss. Chaitrali Arvind Deshpande, Prof. P. M. Mohite, (Oct- 2014), “Effect of Sloping Ground on Step- Back
[6] Miss. Pratiksha Thombre, Dr. S. G. Makarande, (Jun 2016), “Seismic Analysis of Building Resting on Sloping Ground”, JETIR ISSN 2349-5162, Vol 3 Issue 6.
[7] Mohammed Umar Farooque Patel, A. V. Kulkarni, Nayeemulla Inamdar, (Mar 2012), “A Performance study and seismic evaluation of RC frame buildings on sloping ground”, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), ISSN: 2278-1684, P 51-58.
[8] Mr. A. R. Vijaya Narayanan, Rupen Goswami and C. V. R. Murty, “Performance of RC Buildings along Hill Slopes of Himalayas during 2011 Sikkim Earthquake”, Indian Institute of Technology Madras, Chennai, India.
[9] Mr. B. G. Birajdar, S.S. Nalawade, (Aug 2004), “Seismic Analysis of Buildings Resting on Sloping Ground”, 13th World Conference on Earthquake Engineering Vancouver, B.C, Canada, Paper No. 1472.
[10] Mrs. Vrushali S. Kalsait, (July 2015) “Design of Earthquake Resistant Multistoried Building on A Sloping Ground”, Vol.2 Issue 7.
[11] Narayan Kalsulkar and Satish Rathod, (Jun 2015), “Seismic Analysis of RCC Building Resting on Sloping Ground with varying Number of Bays and Hill Slopes”, International Journal of Current Engineering and Technology, Vol.5, No. 3.
[12] Rajkumar Vishwakarma, Anubhav Rai, (Mar 2017) “Analysis of a RCC frame Tall Structure using Staad Pro on Different Seismic Zones Considering Ground Slopes”, ISSN: 2395-0072, 04 Issue: 03.
[13] Rayyan-Ul-Hasan Siddiqui, H. S. Vidyadhara, (Oct 2013), “Seismic Analysis of Earthquake Resistant Multi Bay Multi Storeyed 3D - RC Frame”, International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 2 Issue 10.
[14] Sujit Kumar, Dr. Vivek Garg, Dr. Abhay Sharma, (August 2014) “Worked on Effect of sloping ground on structural performance of RCC Building under Seismic Load”, ISSN: 2348-4098, Vol. 2 Issue 6.
[15] Umakant Arya, Aslam Hussain, Waseem Khan, (May 2014) “Worked on Wind Analysis of Building on sloping Ground”, International Journal of Scientific and Research Publications, ISSN: 2250-3153, Vol. 4, Issue 5.
[16] Vrushali S. Kalsait, Dr. Valsson Varghese, (July 2015), “Design of Earthquake Resistant Multistoried Building on A Sloping Ground”, (IJISET) International Journal of Innovative Science, Engineering & Technology, Vol. 2 Issue 7.
[17] Y. Raghava Rani, (April 2015) “Seismic Effect on RC Building Resting On Sloping Ground”, Vol.4 Issue 14.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY