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Analysis of a Structure on Sloping Ground under Seismic Effects

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Abstract*: The aim of this work is to make a study on seismic behaviour of reinforced concrete framed buildings with columns of unsymmetric plan within on storey. For this study an MS Excel sheet was developed in which 26 cases of varying slope by small increments which can formulate the mode shapes, bending moment, shear force, storey drift, base shear, etc.here we considered 0º,4.5º and 9º sloping ground. Considering different seismic zones II, III, IV and V with different soil types soft, medium and hard type. The results were compared. Using STAAD Pro v8i, 4 reinforced concrete frames on plane ground were modelled. Then the analysis was carried out for gravity as well as seismic loading. Models were created for the above cases when placed on sloped terrain. Comparison for various results like Axial force, shear force, moment stress in columns were done. The reinforcement detailing of all the above 8 models were done using STAAD Pro v8i. All the above mentioned models were modelled with element material. The volume ratio and orientation angles were entered as obtained from STAAD Pro v8i concrete design results. Monotonic loading was applied to the models and results like load displacement hysteresis curve, stress on members, deflected shapes, etc. were extracted. The results show that when a reinforced concrete framed structure is built on a sloping terrain, the short columns tend to fail easily. Shear cracking pattern appeared at the beam column joint of short columns. Long column being more ductile takes up lesser lateral force when compared to the short columns.
***Keywords:* staad.pro, moment, deflection. Shear force,analysis. Sloping ground, short column**

I. INTRODUCTION

Earthquake is the most disastrous due to its unpredictability and huge power of devastation. Earthquakes themselves do not kill people, rather the colossal loss of human lives and properties occur due to the destruction of structures. Building structures collapse during severe earthquakes, and cause direct loss of human lives. Numerous research works have been directed worldwide in last few decades to investigate the cause of failure of different types of buildings under severe seismic excitations. Massive destruction of high-rise as well as low- rise buildings in recent devastating earthquake proves that in developing counties like India, such investigation is the need of the hour. Hence, seismic behavior of asymmetric building structures has become a topic of worldwide active research. Many Investigations have been conducted on elastic and inelastic seismic behavior of asymmetric systems to find out the cause of seismic vulnerability of such structures. The purpose of the paper is to perform linear static analysis of medium height RC buildings and investigate the changes in structural behavior due to consideration of sloping ground. Slope structures are not the same as those in fields; they are exceptionally sporadic and unsymmetrical in level and vertical planes, and torsionally coupled. Consequently, they are defenseless to extreme harm at the point when influenced by earthquake ground movement. Seismic powers acts more separate in sloping areas because of the auxiliary anomaly. Likewise it has been contemplated that the earthquake activities are inclined in sloping ranges. In India

for instance, the north-east states. The shortage of plain ground in sloping ranges forces development movement on slanting ground bringing about different vital structures, for example, strengthened cement surrounded doctor's facilities, universities, inns and workplaces laying on uneven slants. The conduct of structures amid earthquake relies on the dissemination of mass and firmness in both even and vertical planes of the structures. In sloping locale both these properties differs with inconsistency and asymmetry. Such developments in seismically inclined territories make them presented to more prominent shears and torsion.

In our study we have taken 36 cases in sloping ground at 0^0, 4.5^0 and 9^0in all the four seismic zones in soft , medium and hard soil types and analyze the G+14 unsymmetrical structure using STAAD . Pro V8i software and study the variations in Bending Moment, Shear Force, maximum Displacement in X and Z Direction and Storey Displacement in all the floors in both X and Z direction.

II. OBJECTIVES

Many irregular configured buildings with different foundation levels are constructed with locally available traditional material in

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hilly slopes due to lack of flat land in hilly regions. Because of population density,demand of such type of building in hilly slopes is increased.The study of earthquake resistant building on slopes with different type of soils is required to prevent the loss of life,property during earthquake ground motion.

Main objectives of this study are:

A. To determine the effect of seismic zones on sloping ground.

B. To determine the effect of different type of soils on the structure.

To determine the variation due to sloping angels.

C. Some of the research work done before are as follows

1) *Vrushali et. al.* (2015) Studied the effect of earthquake on high rise building (G+15) resting on sloping ground using STAAD.Pro software for structural analysis and design, same loading conditions are considered in each case and comparative study is done considering different sloping angels as (0º, 7.5º, 15º& 22º) and observed that Buildings resting on sloping ground have more lateral displacement compared to buildings on plain ground, the critical bending moments is increased on 22° slope than 7.5° slope and 15° slope ground and after designing, it is concluded that steel quantity on sloping ground is more than on plain ground for same cross section of column and beam.
2) *Sujit kumar et. al. (2014)* observed the behavior of sloping ground structures considering inclinations of (7.5º, 15º) under seismic forces. Considering seismic zones comparison has been done on sloping ground and plane ground building. Here G+ 4 storeys are taken with same properties and loadings for its conduct and comparison. Observed that bending moment in column increases with increase in sloping angle of the ground whereas axial force in columns remains almost same.

III. METHODOLOGY

A. firstly create different modelling is staad pro with different sloping plane.

B. provide property and material as per Indian standards.

C. provide fixed support at the bottom of columns.

D. define seismic zones as per 1893-part1 with different soil type.

E. provide loadings earthquake in X & Z dircetion, dead and live load as per875 part 1and 2 respectively.

F. provide load combinations as per 875 part-5.

G. now analyze and compare the results in post processing.

H. prepare comparative graphs in M.S. Excel.

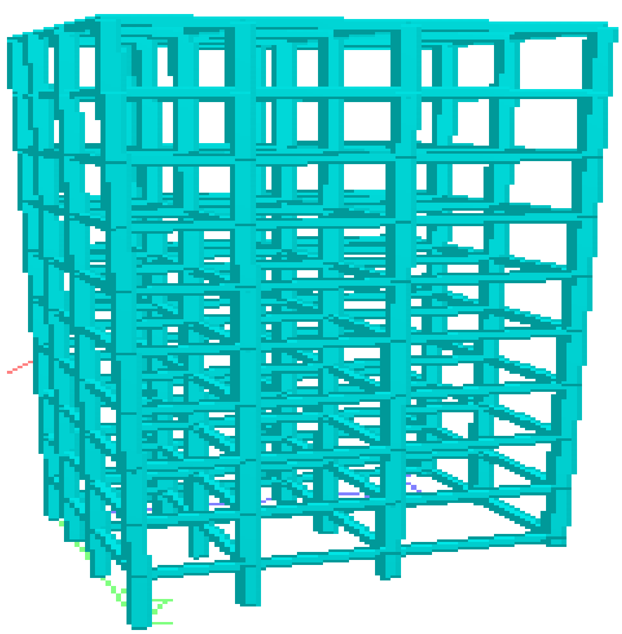

fig 1.1 3d view of models with sloping ground.

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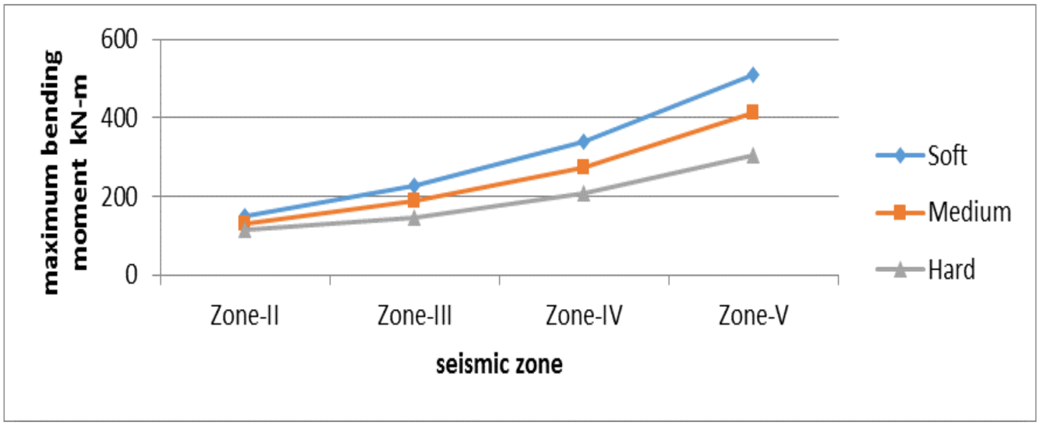
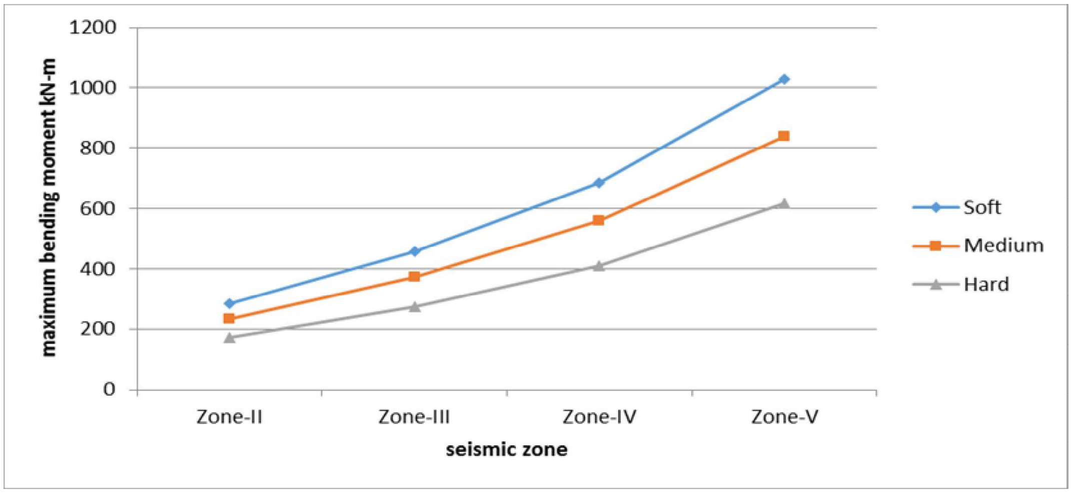
IV. RESULT & ANALYSIS

A. Bending Moment

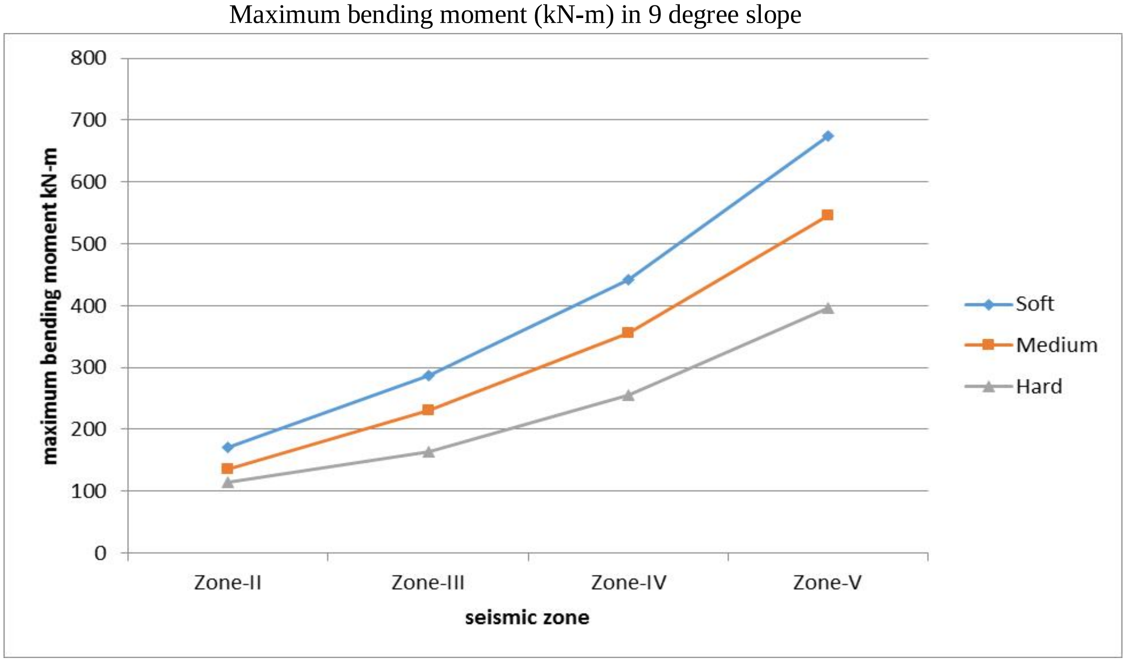
Maximum bending moment (kN-m) in 0º slope.



Maximum bending moment (kN-m) in 4.5 degree slope



Maximum bending moment (kN-m) in 9 degree slope



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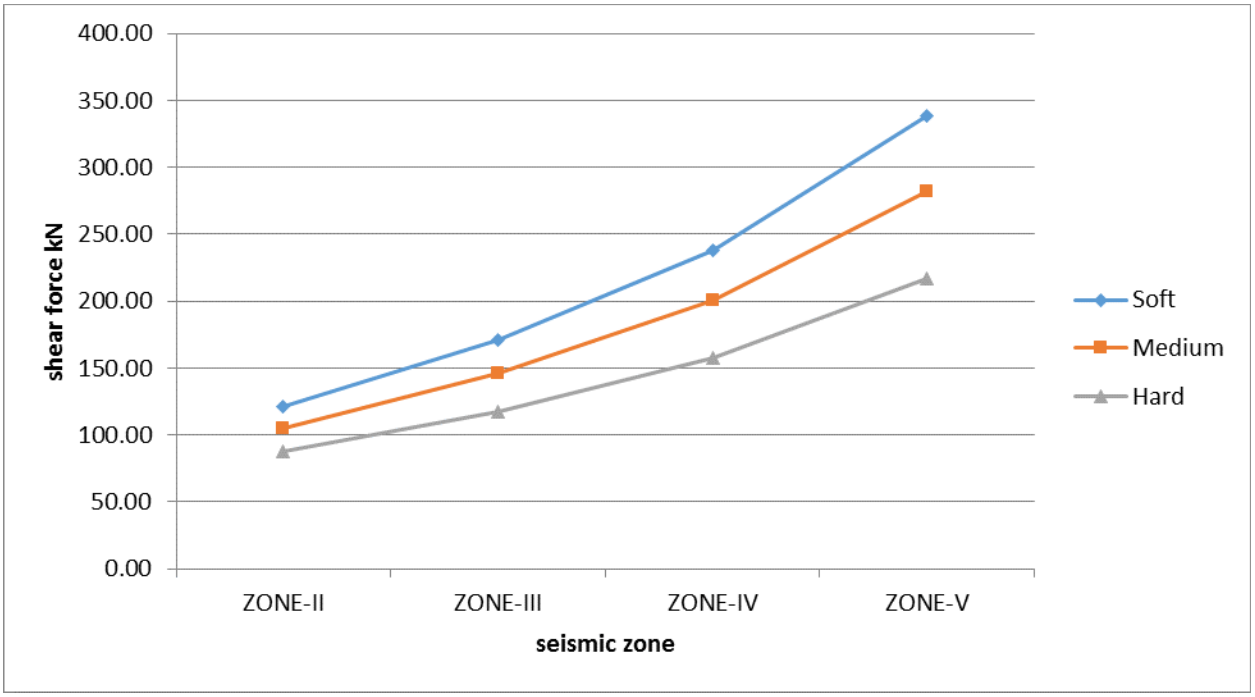
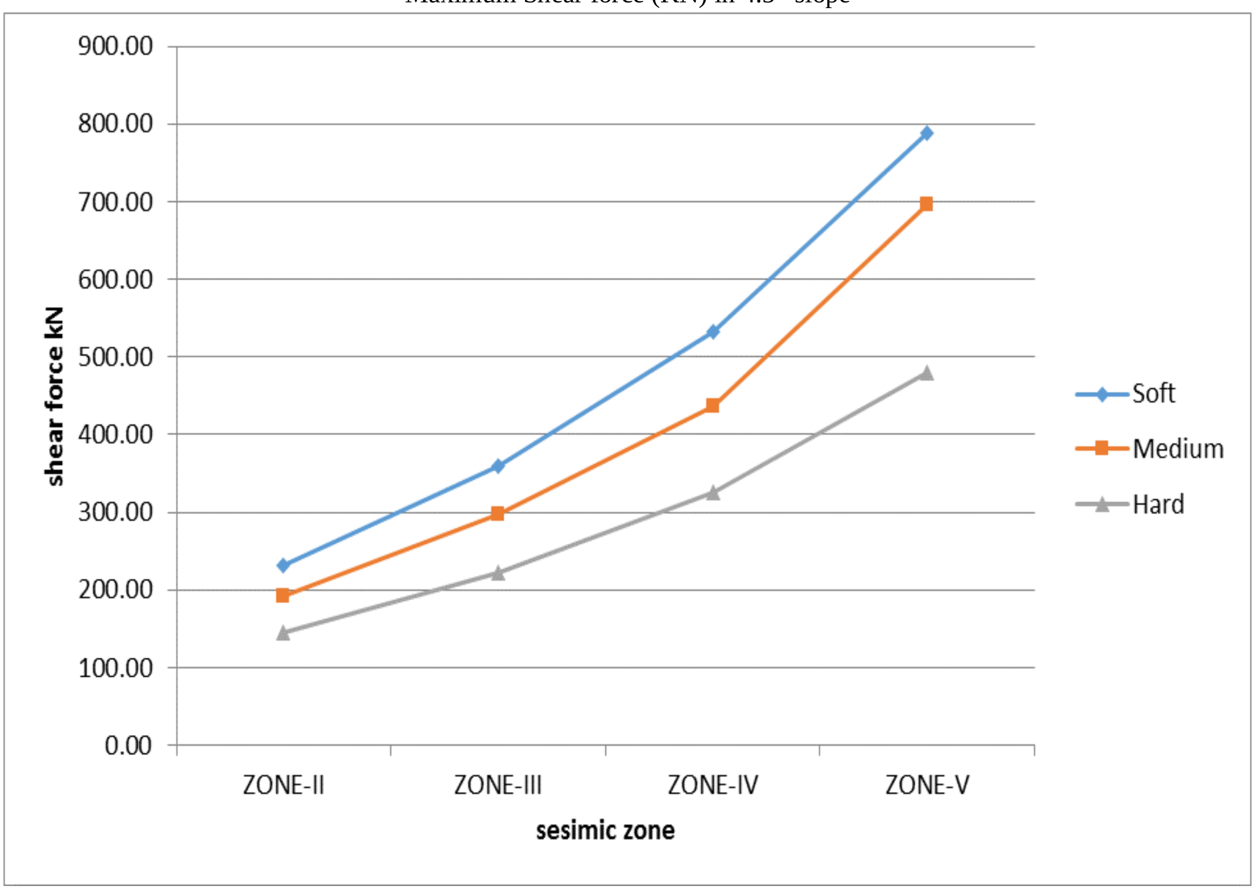
B. Shear Force

Maximum shear force (KN) in 0º slant



Maximum Shear force (KN) in 4.5^{O} slope



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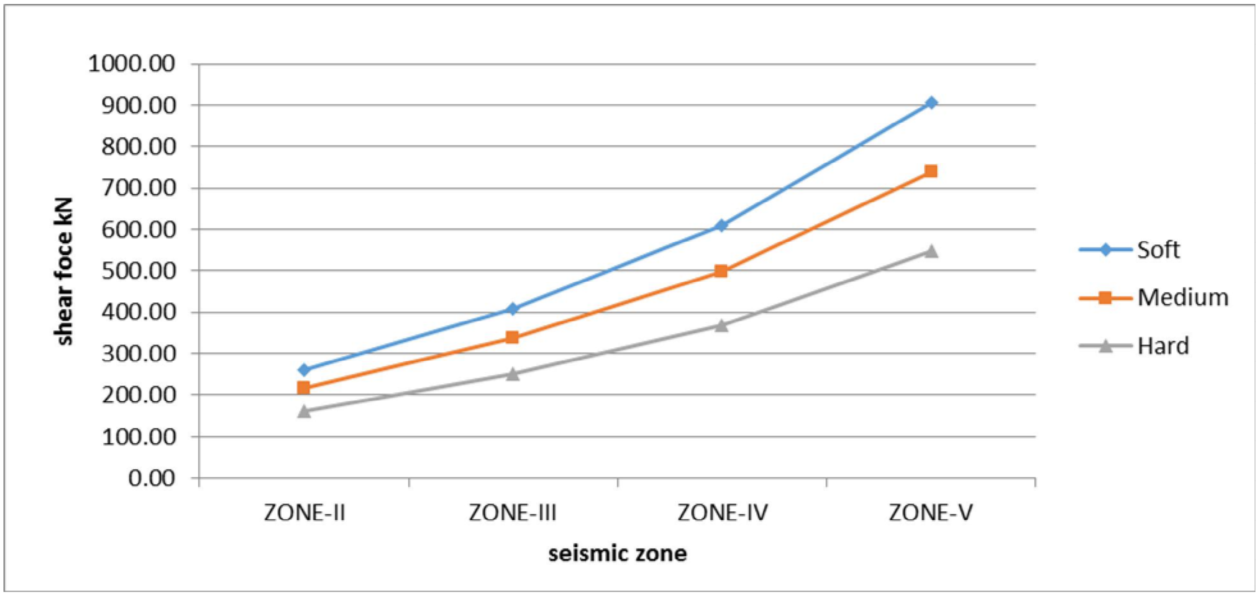
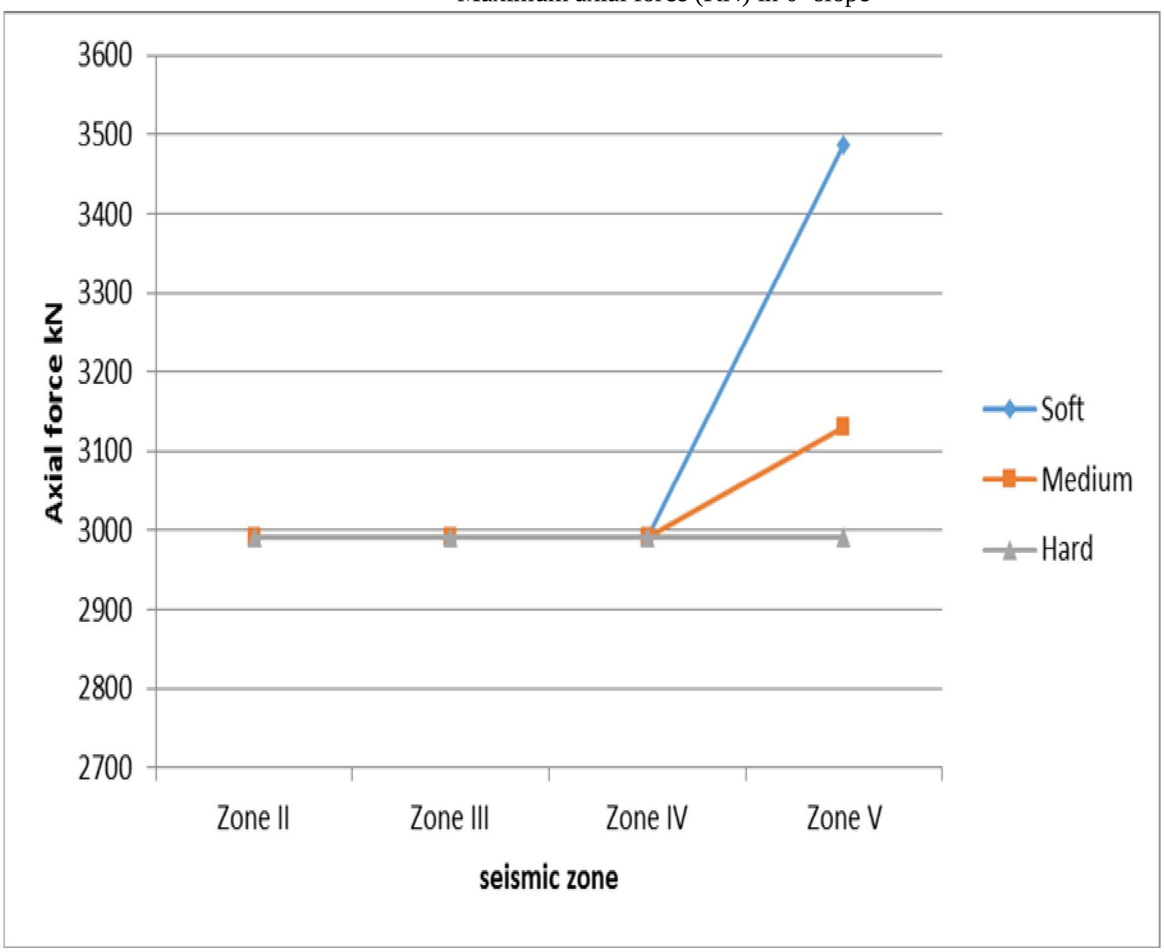
Maximum Shear force (KN) in 9 slope



C. Axial Force

Maximum axial force (KN) in 0° slope



Maximum axial force (KN) in 4.5° slope

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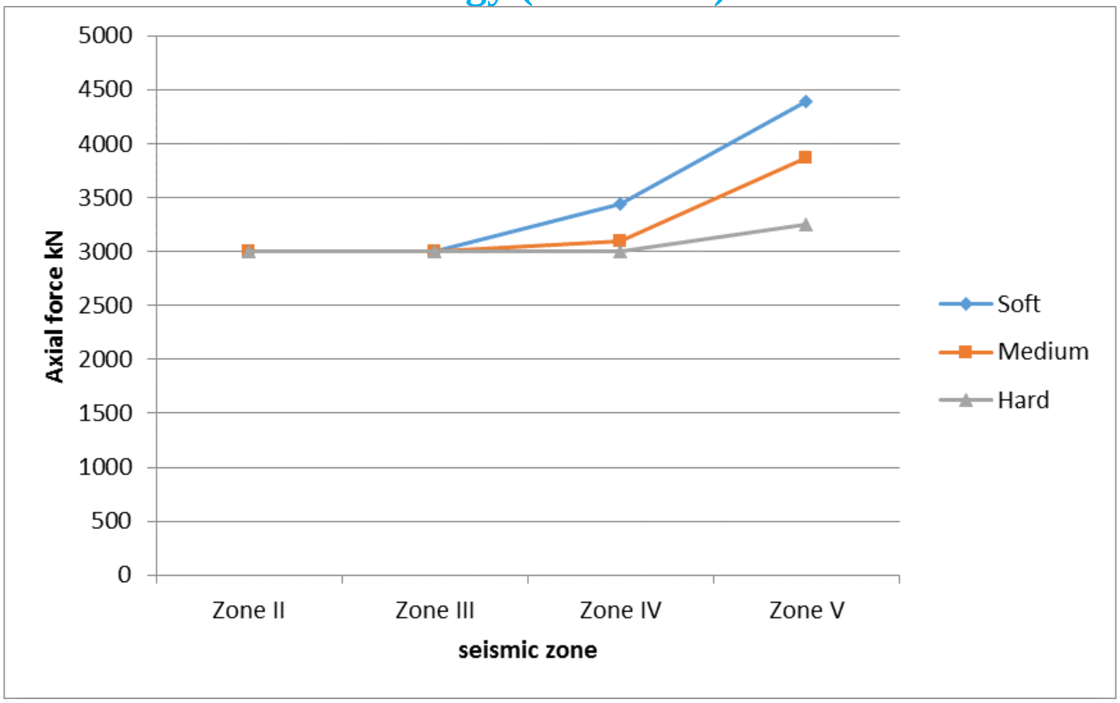
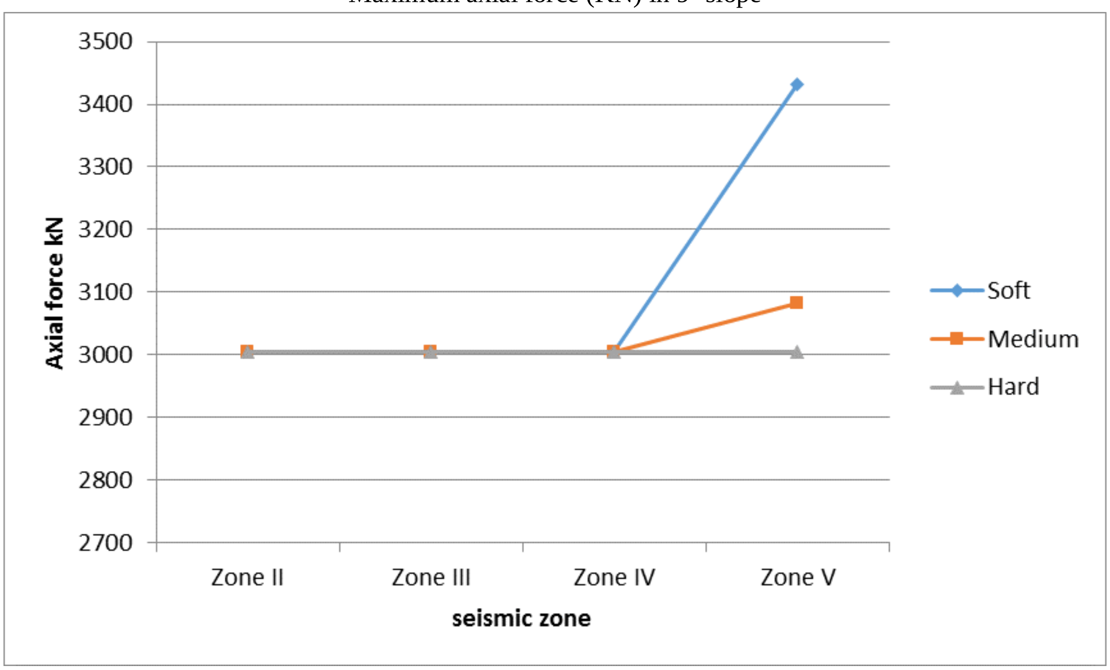


Maximum axial force (KN) in 9^{o} slope



V. CONCLUSION

A. Shear Force

1) Maximum shear force is seen in soft soil and minimal in hard soil therefore hard soil is stable whereas soft soil is severe.
2) In seismic zones, maximum shear forceis observed in zone-V and minimal in zone-II means zone-II provide superior stability.

B. Bending Moment

1) Maximum bending moment is observed in soft soil and minimal in hard soil therefore hard soil is stable.
2) In earthquake zones, bending moment maximumis observed in zone-V and minimal in zone-II means zone-II provide better

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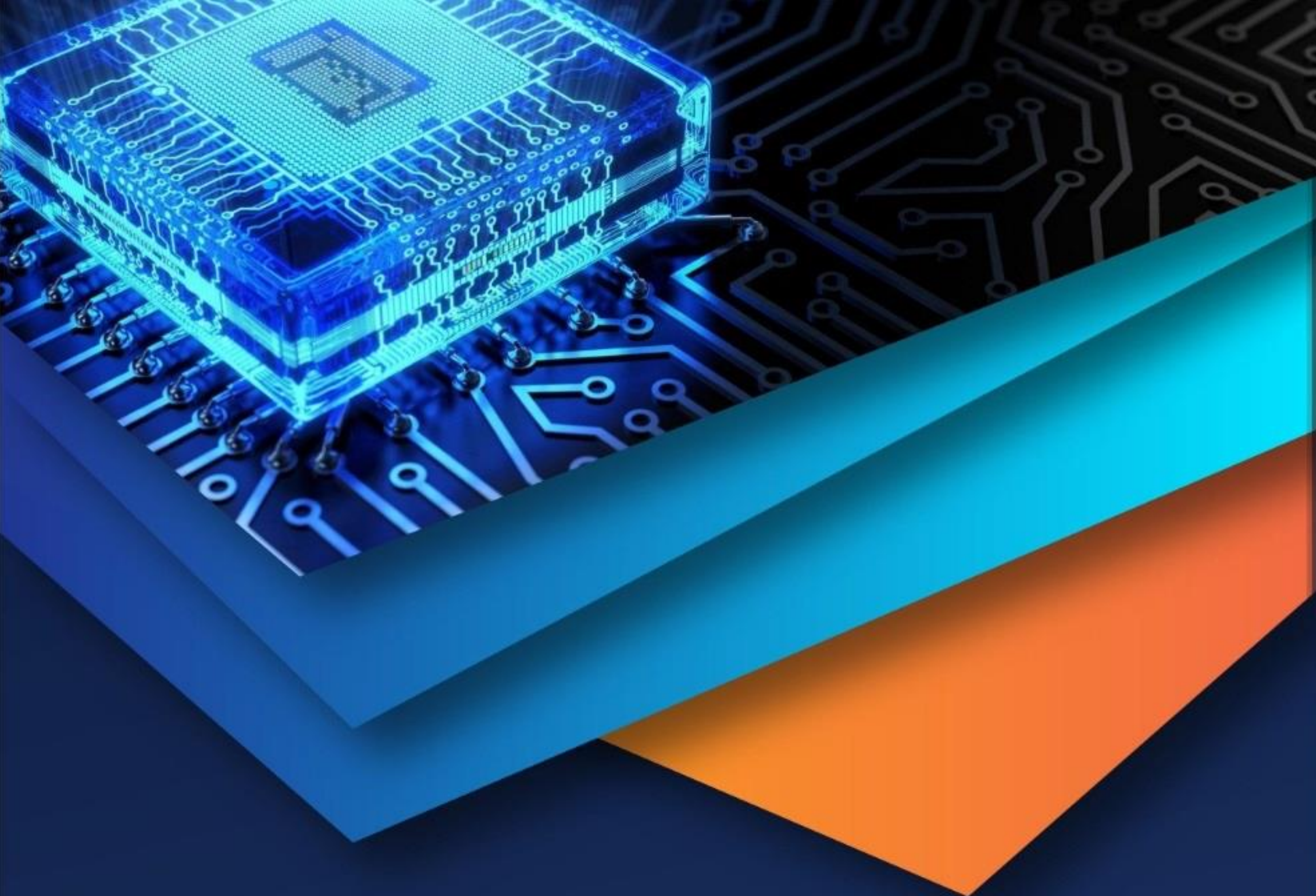
strength.

C. Maximum axial force

1) Maximum axial force is observed in soft soil, moderate is medium soil and minimal in hard soil therefore hard soil is stable whereas soft soil is severe.
2) In seismic zones, maximum axial forceis observed in zone-V and minimal in zone-II therefore zone-II provide better stability.

REFERENCES

[1] Sujit kumar, vivek garg, and abhay sharma. "Effect of Sloping Ground on Structural Performance of RCC Building under Seismic Load", International journal of sciences, engineering and technology, ISSN: 2348-4098, Volume 2, Issue 6, 2014.
[2] Umakant Arya, Aslam Hussain, and Waseem Khan, "Wind Analysis of Building Frames on Sloping Ground". International Journal of Scientific and Research Publications,ISSN 2250-3153,Volume 4, Issue 5, May 2014.
[3] Vrushali S. Kalsait,and Dr.Valsson Varghese, "Design of Earthquake Resistant Multistoried Building on A Sloping Ground". IJISET - International Journal of Innovative Science, Engineering & Technology,ISSN 2348 – 7968. Vol. 2 Issue 7, July 2015.
[4] Paul D.K. and Kumar S. "Stability Analysis of Slope with Building Loads",Soil Dynamics and Earthquake Engineering, 16, 395-405, (1997).
[5] Vijaya Narayanan, "Performance of RC Buildings along Hill Slope of Himalaya during 2011 Sikkim Earthquake", EERI Newsletter, EERI Special Earthquake Report,1-14, February 2012.
[6] Dr. S. A. Halkude, Mr. M. G. Kalyanshetti, and Mr. V. D. Ingle "Seismic Analysis of Buildings resting on sloping grounds with varying Number of bays and hill Slopes", International Journal of Engineering Research and Technology, ISSN: 2278-0181, VOL 2, ISSUE 12, December 2013.



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