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# Seismic Analysis of Multi-Storey Building in Zone Ii and Zone V by Consedering Different Angles of Slope Ground

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**ABSTRACT:** Generally the buildings are situated in flat landscape but nowadays due to scarity of flat landscape the buildings are constructed on slope grounds. in this project we are considering 4 models of building having different angles of slope ground like 0°,5°,10° & 15° in this project R.C.C structure(G+12) multi-storey building is studied for earthquake loads like (response spectrum & time history method ) using ETABS software. This is carried out by considering 2 siesmic zones (zone-II & zone-V) by taking all these conditions we get different response of building like base shear, bending movement. storey displacement.

**KEYWORDS:** Slope ground, Earthquake, Response spectrum and time history, Base shear, Storey displacement.

## I. INTRODUCTION

In hilly area as there is less availability of flat land in most of the cases the building or the structures will be constructed on sloppy ground only. This helps in reducing the cut and fill of soil. This is done with the regular or common structures where the levels under structure will be at different levels on the basis of ground profile. Such constructions will be a challenging one as the foundation will be located at disparate levels as per the soil profile and extra caution has to be taken during such executions. The dissimilarity in the stiffness as well as in the mass in vertical and lateral axis results in center of mass (CM) &center of stiffness of a all the stories may not coincide with each other & not be in a vertical line for the different floors. A majority part of our India is liable to high level of damage due to seismic hazards. India consists of great arc of mountains & Himalayas in northern part which was formed by on-going tectonic-collision of plates. Earthquakes are one of the significant aspects which may effect on the high rise building especially on hilly areas and must be considered during design.

In India quake zones are sorted into four zones (zone II, zone III, zone IV, and zone V). Due to the insufficiency of flat topography in this section there is a requirement of the creation of the constructions on the sloppy land. Hence there is need of study of seismic safety & the design of the structures on slopes. The report of a sloped construction is depending on the frequency quake as it may influence its routine when it will be faced to land motion.

In this research work study is prepared by changing slope angle to will determine the rate of changes of seismic responses for building between two zones (zone II, and zone V). Earthquake is the most disastrous and unpredictable phenomenon of nature. When the structure is subjected to seismic forces it does not cause loss to human lives directly but due to the damage causes to the structures that leads to the collapse of the building and hence to the occupants and the property In this section there is requirement of construction of multi-floored RC buildings doe to the rapid urbanization and increase in fiscal growth and therefore increase in population thickness. Owing to the insufficiency of the flat ground in this section there is an compulsion of the erection of the constructions on the sloppy land.

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Figure 1 Actual Building located on sloppy land

Figure 2 Sectional view of Fig 1

## II. LITRATURE REVIEW

Likhitharadhya Y R et al (2016)Studied on “Seismic "Analysis of Multi-Storey BuildingResting On Sloping Ground and Flat Ground". They taken One building configuration is taken into consideration, including structures on level ground. Ten stories are taken into consideration for each sort of layout. The plan's structure is kept same for all configurations of building frame. The columns are taken to be square to avoid the issues like orientation. The response spectrum analysisis carried out using the spectra for medium soil as per IS1893 (Part 1) 2002 for seismic zone V, medium soil and 5% damping. They noticed that compared to flat ground, sloping ground structures had considerably higher maximum displacement and shear forces that may result in dangerous circumstances.

Khadiranaikar and ArifMasali (2014)In this paper, the research on "seismic response of buildings on hill slopes" is compiled. It has been explored how dynamically the structure responds to a hillside. A review of studies on the seismic behavior of structures supported by sloped ground has been made. Buildings on sloping land are known to behave differently during earthquakes than other types of buildings. Such structures may also have setbacks as the different floors slant backwards toward the hillside. According to the majority of research, structures sitting on sloping ground experience more displacement and base shear than structures resting on flat ground, and shorter columns are more susceptible to damage from earthquakes because they attract more pressures. Buildings set back from the ground may be more susceptible to seismic stimulation.

Nagargoje and. Salbe et al (2012) The researchers conducted a study on the "earthquake resistance of buildings on slopes. To investigate dynamic reaction of these buildings, they performed a 3D space frame analysis. The analysis focused on parameters such as base shear, which measures the lateral force exerted on the foundation of the building, and top floor displacement, which quantifies the movement experienced at the highest level of the structure. By studying these dynamic responses, the researchers aimed to gain insights into the seismic behavior and performance of buildings that are situated on a hill.The study involved a parametric analysis of thirty-six buildings the location is in seismic zone III These buildings were categorized into three configurations: step back, step back set back, and set back buildings. The purpose of the study was to explore and compare the seismic output of these different configurations.

Phanigade and Y. Singh (2011) The researchers presented a paper titled "Seismic act of Buildings Located on Slopes," which focused on studying various building configurations on sloping ground. Additionally, they examined response dynamic of buildings by comparing those situated on sloping ground with regular structures on a level surface. The study involved analyzing fundamental periods of seismic behavior, storey drift, column shear, and vibration of the two typical building configurations.

Biradar and S.S. Nalawade (2004) In contrast to the previous study that focused on performance of the seismic wavehill buildings with story levels up to 11, the research presented in this paper extends the investigation to include a wider range of story levels. Specifically, the study encompasses buildings with story levels buildings that are situated on a hill., corresponding to heights ranging from 15.2 meters to 52.6 meters. This expanded scope allows for an expanded comprehension of the earthquake behavior and performance of hill buildings across a broader range of heights. The researchers discovered that step back buildings exhibited higher story displacements compared to step back-set back buildings. Additionally, they noticed that base shear caused in back-set back buildings was significantly higher, ranging from 60% to 260%, than in set back buildings. Based on these findings, the researchers suggested that step back-set back buildings.

## III. OBJECTIVES

1. To learn the reaction of a regular RC building resting on diverse of slopped land under linear-dynamic analysis (response-spectrum).
2. To ascertain the response of building under time history method relative learning of the tower by bearing in mind two seismic sectors Zone II & V & unlike of slopped land.
3. To Recognize the effectiveness and behaviour of a step-back framed building
4. To study a range of reactions such as Base-shear, Shear-force, storey-displacement, storey-drift, of constructions & then comparing these responses between Zone II & V to know the rate of change in responses b/w these two zones.

## IV. PROBLEM STATEMENT

In our description, 8 models were developed.out of these blocks first one is believed to be positioned on a flat topography 2nd one is believed to be positioned on a 5 degree sloping topography, 3rd one to be on 10 degree sloping topography and the last one believed to be positioned on a 15 degree sloping topography. The study for blocks will be performed out by using Equivalent lateral load and response spectrum types of investigation& at the finish of the report,a various consequences are compared & presented in the tabular outline along with graphs. Then the wrapping up is done.

| Model No | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Slope | 0° | 5° | 10° | 15° |

Table 1: Models & corresponding Ground Slope

LOADS CONSIDERED

1. Self wt. Of members (DeadL) - IS 875-1st part –year 1987
2. Imposed Load (IL) – IS-875: 2nd part –year 1987
3. Wind Load (WindL)– IS-875 3rd part –year 1987
4. Quake Loads - IS-1893 1st part – year 200

| Sl.No | Particular | Value |
|---|---|---|
| 1. | Zone Factor-Z | 0.1 |
| 2. | Building Length in X | 45.4 m |
| 3. | Building Length in Y | 15.6 m |
| 4. | Building Height | 48.9 m |
| 5. | Tx | 0.58 |
| 6. | Ty | 0.19 |
| 7. | Response Redcution Factor | 3.0 |
| 8. | Importance Factor | 1.0 |

Table 2 Quake Parameters

Natural Vibration Period (T) = 0.09 H / √ d
In X Direction= 0.09X48.9/√ 45.4 = 0.58
In Y Direction = 0.09X48.9/√ 14.4 = 0.19
LOAD COMBINATIONS

| Sl.No | Factored Load Sets |
|---|---|
| 1. | 0.9DeadL +1.5WndX |
| 2. | 0.9DeadL -1.5WndX |
| 3. | 0.9DeadL +1.5WndY |
| 4. | 0.9DeadL - 1.5WindY |
| 5. | 0.9DeadL + 1.5RespX |
| 6. | 0.9DeadL + 1.5RespY |

| Sl.No | Factored Load Sets |
|---|---|
| 7. | 0.9DeadL - 1.5RespX |

Table 3 Factored Load combinations

SECTIONAL VIEWS OF Slope = 0°, 5°,10°& 15° BUILDINGS

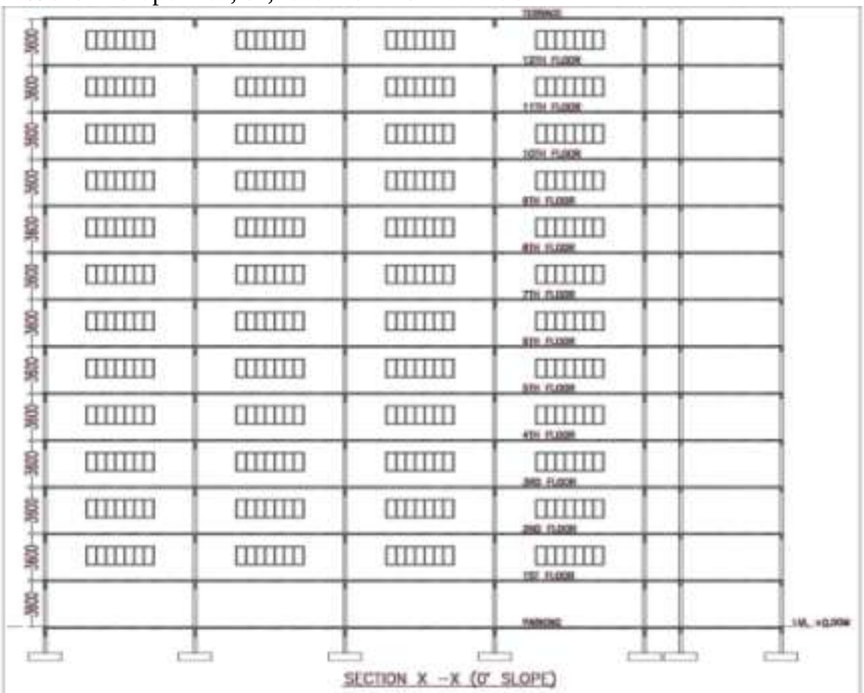


Figure 3 Section X-X with Slope = 0°

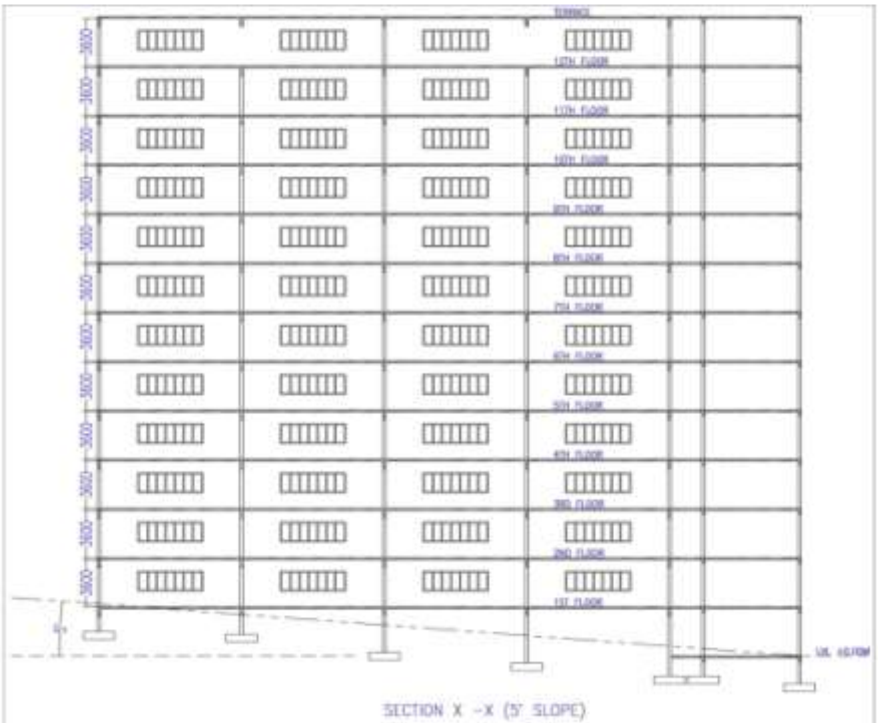


Figure 4 Section X-X with Slope = 5°

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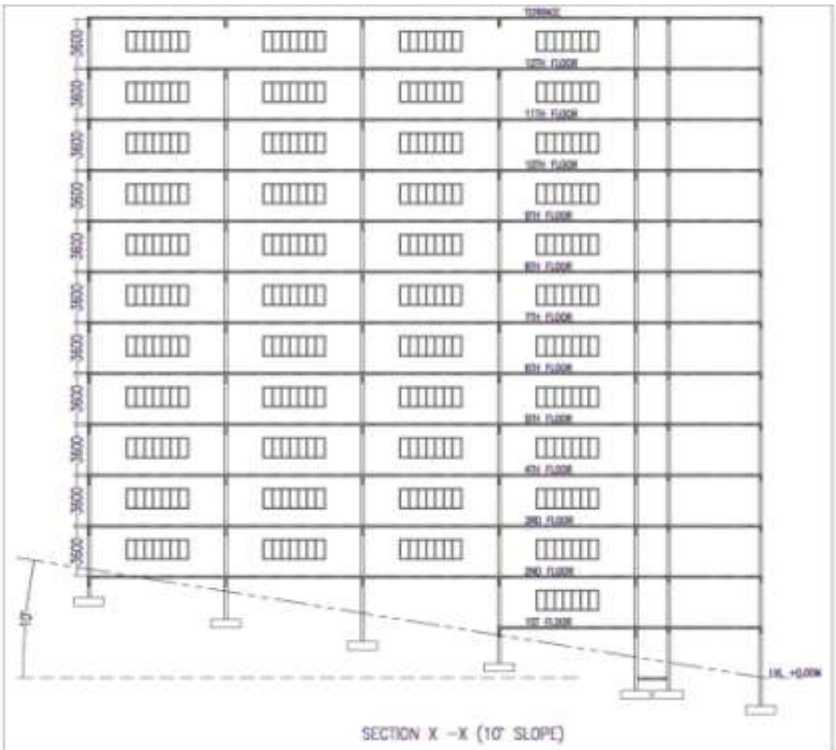


Figure 5 Section X-X with Slope = 10°

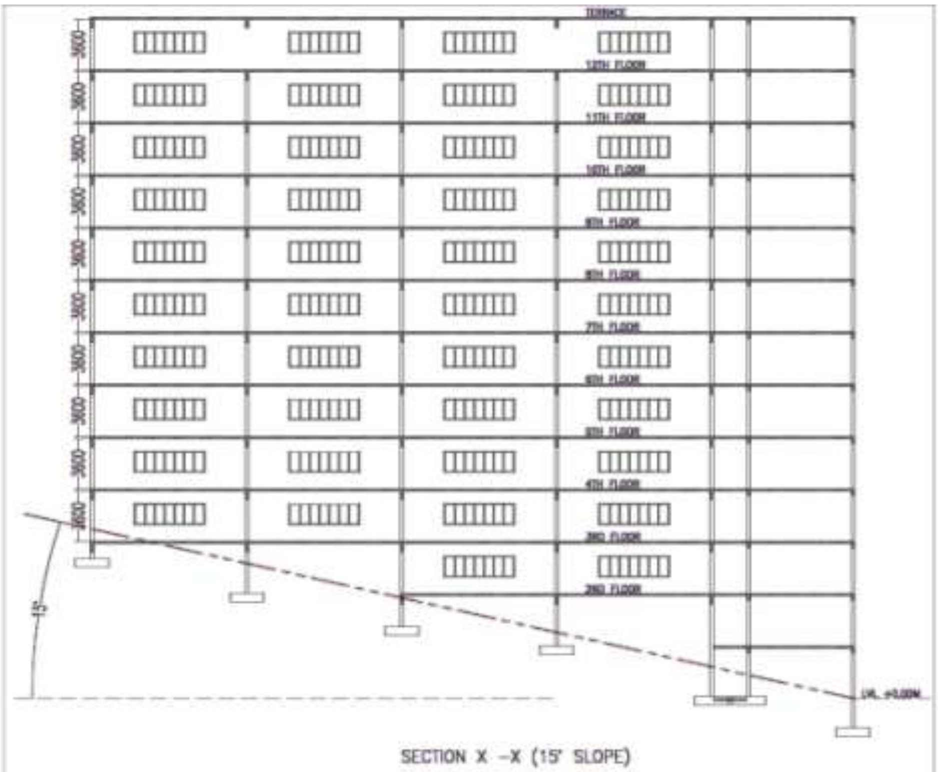


Figure 6 Section X-X with Slope = 15°

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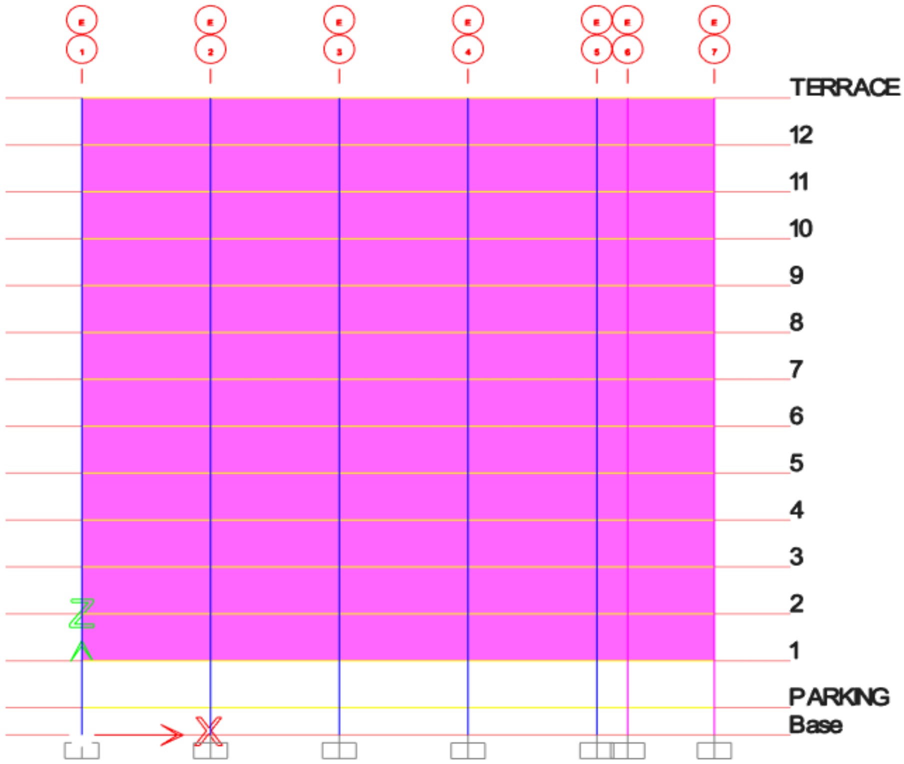
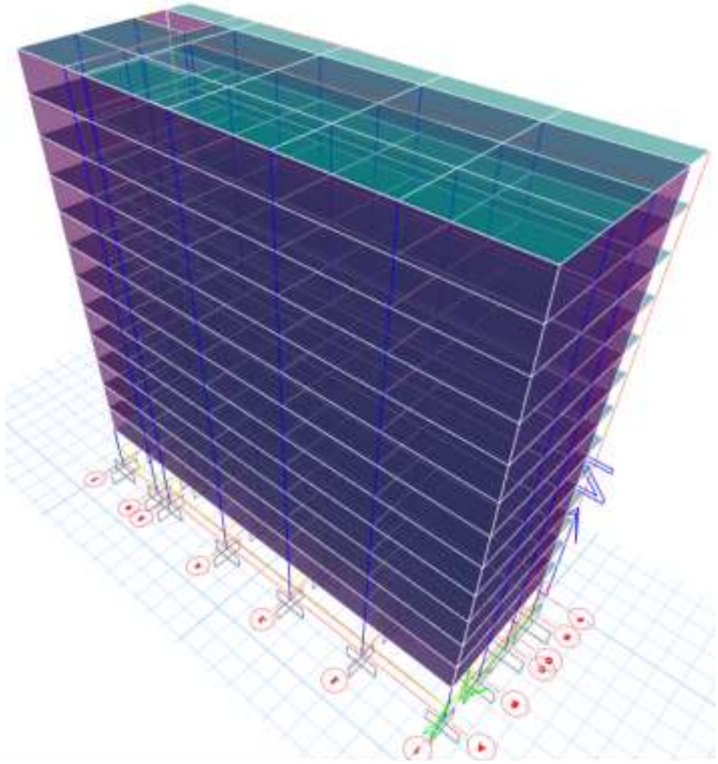
ELEVATION AT GRID E




ISOMETRIC-VIEW OF THE BUILDING



## V.RESULTS

BASE SHEARZONEII
1.2DeadL + 1.2L + 1.2RespX

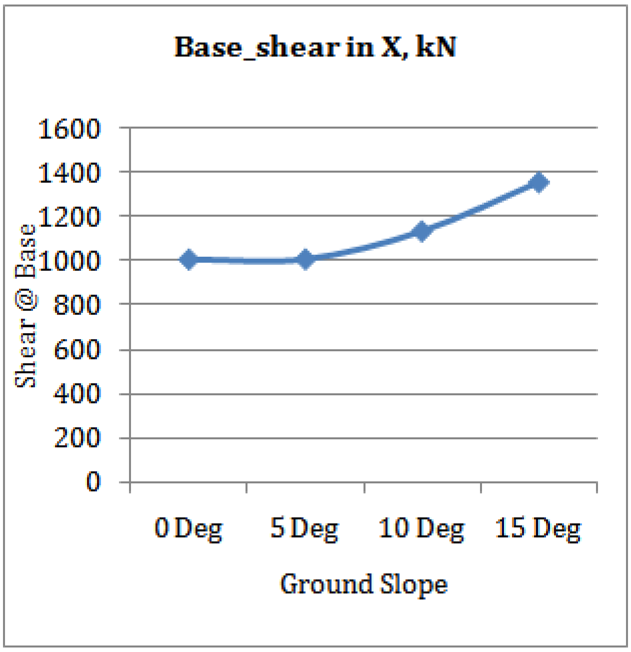



Figure 7 Base-Shear for 1.2DeadL + IMPOL+ 1.2RespX in Zone II

1.2DeadL + 1.2L + 1.2RespY

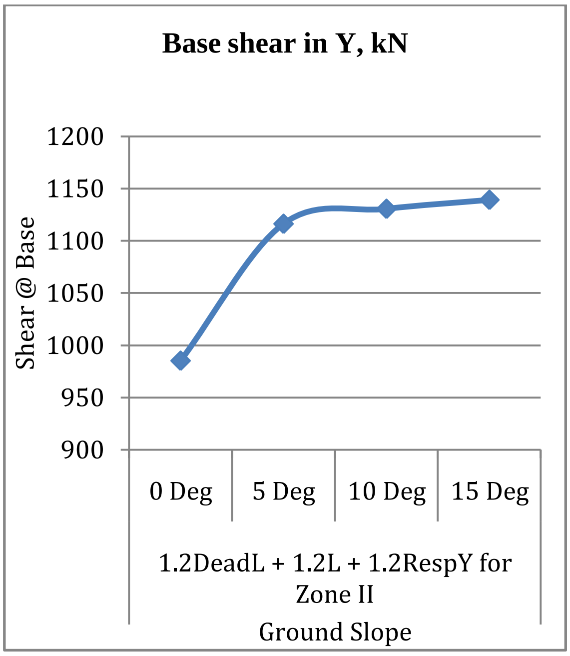



Figure 8 Base Shear for 1.2DeadL +IMPOL+ 1.2RespY in Zone II

1.2DeadL + 1.2L + 1.2TimeHX

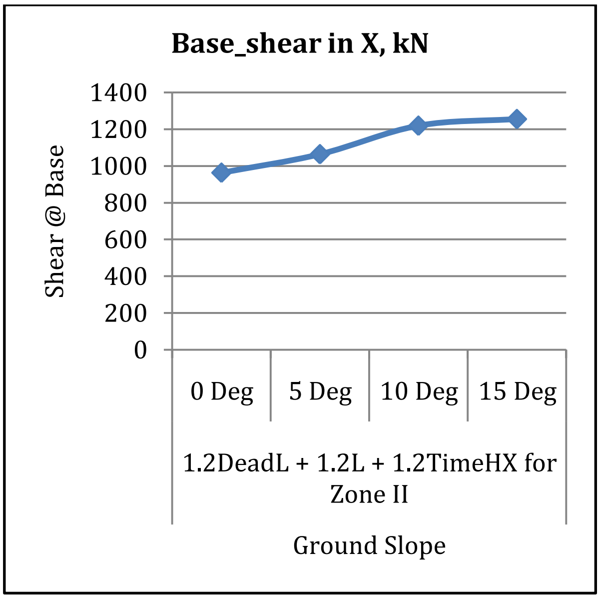



Figure 9 Base Shear for 1.2DeadL + IMPOL+ 1.2TimeHX in Zone II

1.2DeadL + 1.2L + 1.2TimeHY

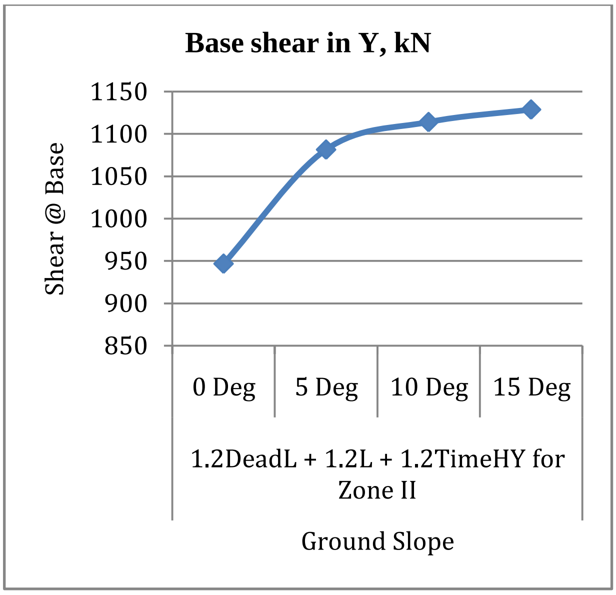



Figure 10 Base Shear for 1.2DeadL + IMPOL+ 1.2TimeHY in Zone-II

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BASESHEARZONEV
1.2DeadL + 1.2L + 1.2RespX

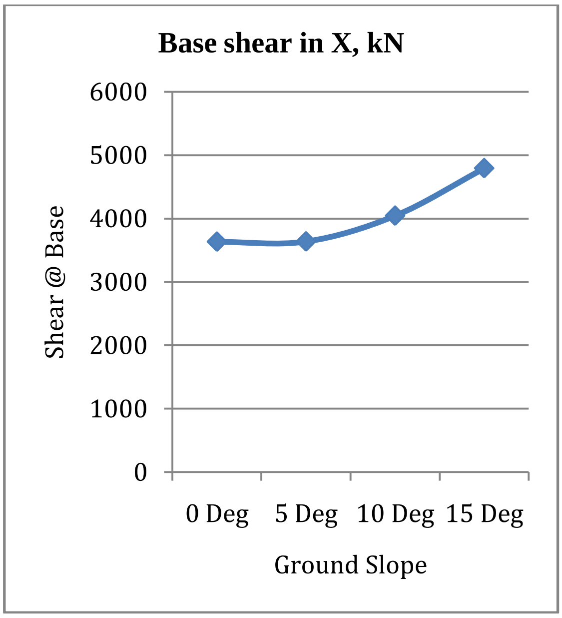


Figure 11 Base-Shear for 1.2DeadL + IMPOL+ 1.2RespX in Zone V

1.2DeadL + 1.2L + 1.2RespY

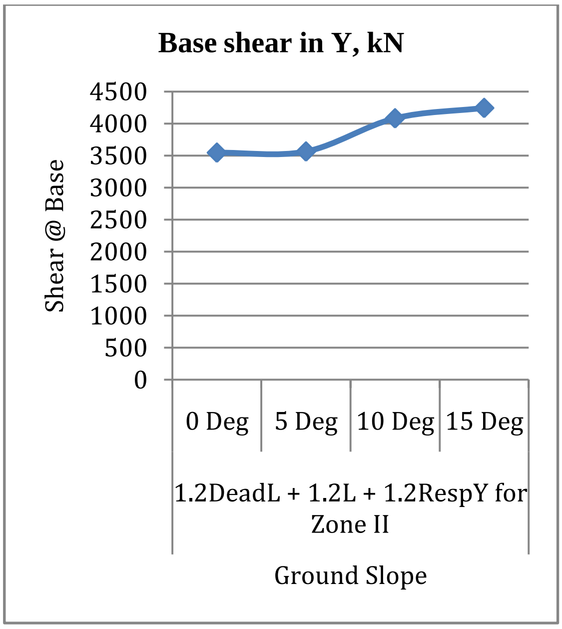


Figure 13 Base-Shear for 1.2DeadL + IMPOL+ 1.2RespY in Zone V

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1.2DeadL + 1.2L + 1.2TimeHX

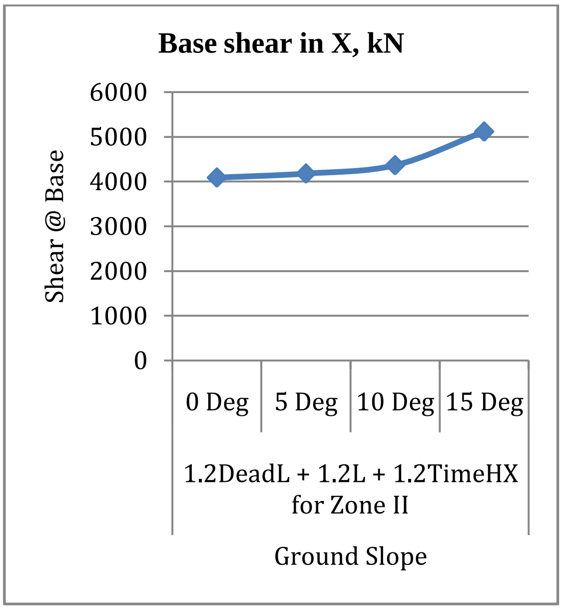


Figure 12 Base-Shear for 1.2DeadL + IMPOL+ 1.2TimeHX in Zone II

1.2DeadL + 1.2L + 1.2TimeHY

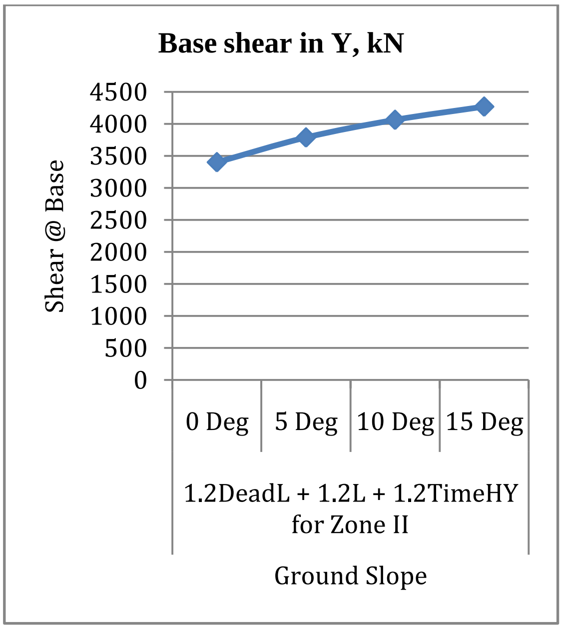


Figure 14 Base-Shear for 1.2DeadL + IMPOL+ 1.2TimeHY in Zone II

STORY DISPLACEMENTZONEII

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1.2DeadL + 1.2L + 1.2RespX

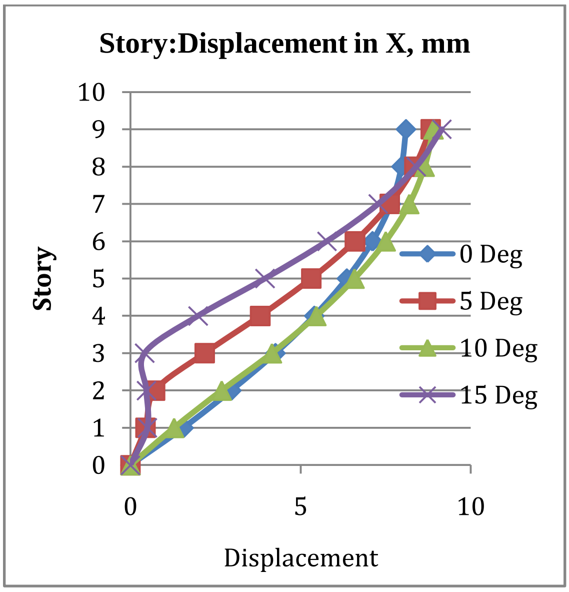


Figure 15 Story Displacement for 1.2DeadL + IMPOL+ 1.2RespX in Zone-II

1.2DeadL + 1.2L + 1.2RespY

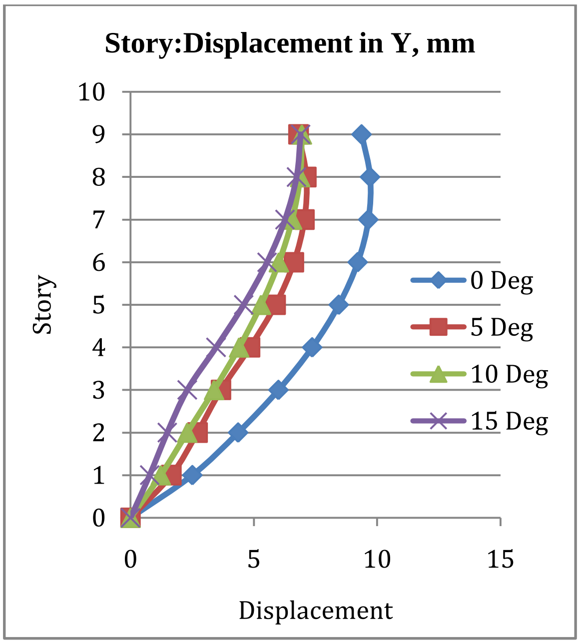


Figure 16 Story Displacement for 1.2DeadL + IMPOL+ 1.2RespY in Zone-II

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1.2DeadL + 1.2L + 1.2TimeHX

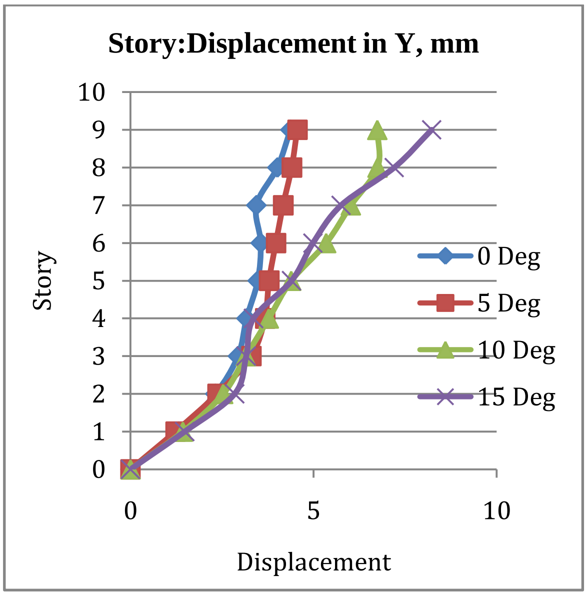


Figure 17 Story Displacement for 1.2DeadL + IMPOL+ 1.2TimeHX in Zone-II

1.2DeadL + 1.2L + 1.2TimeHY

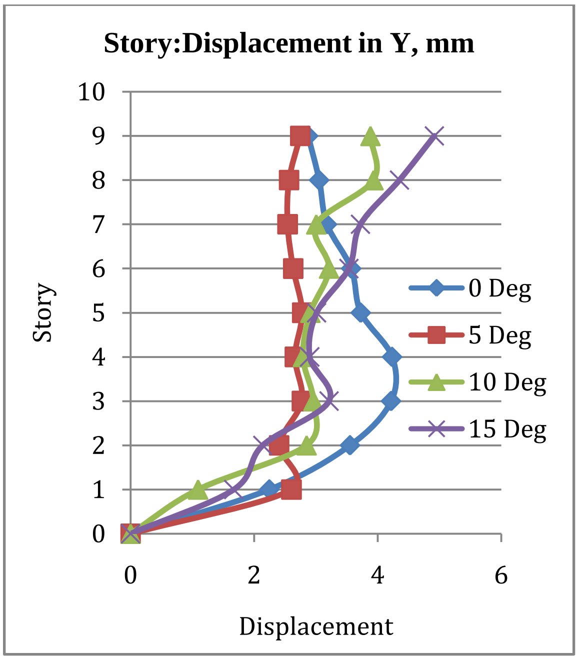


Figure 18 Story Displacement for 1.2DeadL + IMPOL+ 1.2TimeHY in Zone-II

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**S**TORYDISPLACEMENTZONEV
1.2DeadL + 1.2L + 1.2RespX

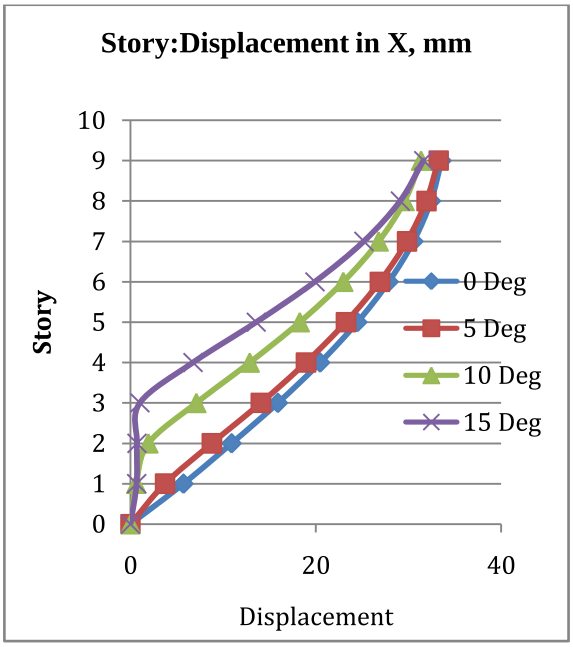


Figure 19 Story Displacement for 1.2DeadL + IMPOL+ 1.2RespX in Zone-V
1.2DeadL + 1.2L + 1.2RespY

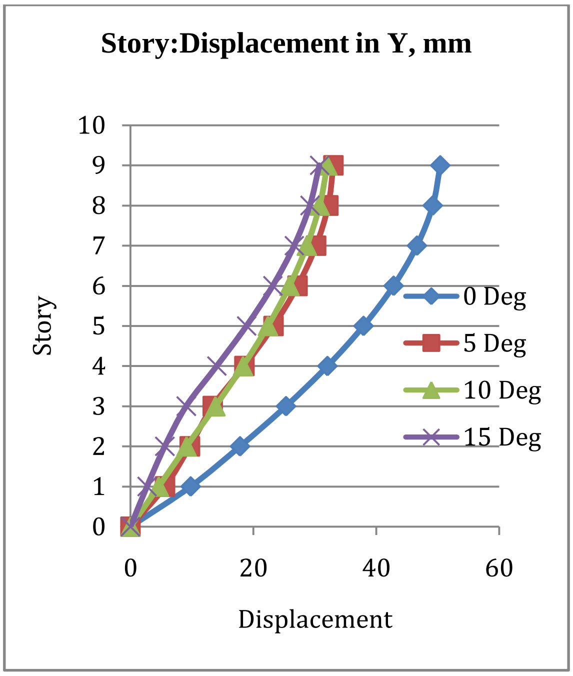


Figure 20 Story Displacement for 1.2DeadL + IMPOL+ 1.2RespY in Zone-V

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1.2DeadL + 1.2L + 1.2TimeHX

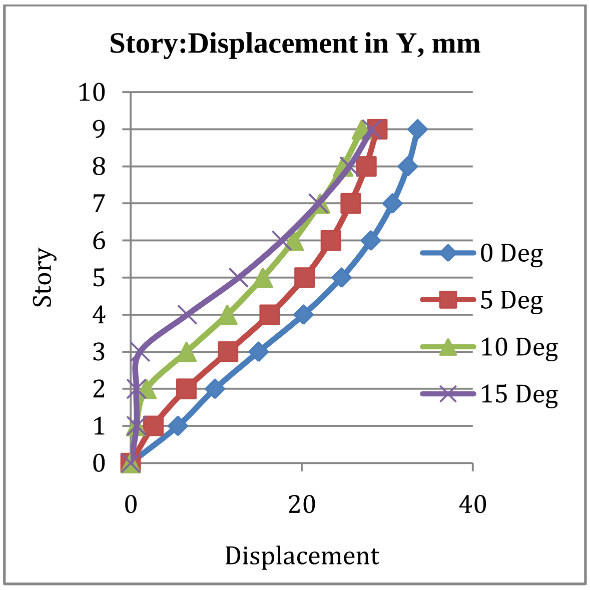


Figure 21 Story Displacement for 1.2DeadL + IMPOL+ 1.2TimeHX in Zone-V

1.2DeadL + 1.2L + 1.2TimeHY

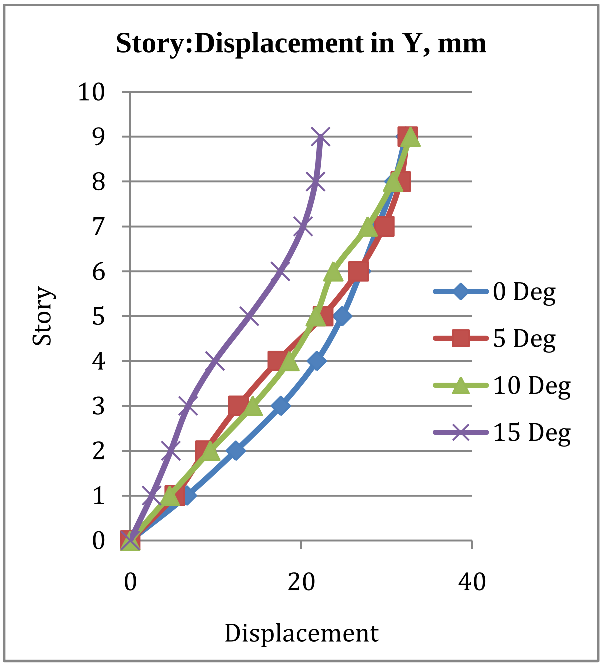


Figure 22 Story Displacement for 1.2DeadL + IMPOL+ 1.2TimeHY in Zone-V

## VI.CONCLUSION

1. When comes to base-shear for zone II the model which is resting on 3 deg slope shows higher base shear compared to the model sitting on plane-ground by 0.08% along X &it is 11.74% along Y. This is 10.95% along X and 1.27% along Y between 10 deg and 5 deg. Further this is increased by 16.13% & 0.75 % in X & Y direction for 15 deg from 10 deg. Finally, between 15 deg and 0 deg models this value is the highest. I.e. it is 25.37 % and 13.51 % along X & Y direction respectively.
2. When comes to base shear for zone V the model which is resting on 3 deg slope shows higher base shear compared to the model sitting on flat-ground by 0.11% along X and it's 0.51% along Y. This is 10.03% along X and 12.69% along Y between 10 deg and 5 deg. Further this is increased by 15.61% & 3.81 % in

X & Y direction for 15 deg from 10 deg. Finally between 15 deg and 0 deg models this value is the highest. I.e. it is 24.16 % and 16.44 % along X&Y direction respectively.

3. It can be watched from the above tables and graphs that the base shears value are rising as the gradient is rising.
4. So when it comes to displacement part we notice that storey displacement is more in 0 deg model & less in 15 deg model in zone-II
5. Similarly in zone-V 0 deg model exhibit higher-storey displacement compared to 15 deg model
6. From the displacement outcomes we can accomplish as slope increases storey displacement decreses in both zone-II and zone-V

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