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ANALYSIS OF A MID RISE STRUCTURE CONSIDERING SEISMIC LOAD UNDER SOIL STRUCTURE INTERACTION TECHNIQUE USING ANALYSIS TOOL

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ABTRACT

Presently a day the human existence and the climate have regularly been imperiled by the normal dangers like seismic tremor, wave, flood, tornado and avalanches. As a result of which the human culture and the country's economy get hampered following the event of a catastrophic event. In emerging nations like India, where the populace is extremely enormous and is expanding step by step, the social and financial variables force individuals to reside in weak regions, because of which the impacts of these cataclysmic events are disastrous.

In this study we are performing seismic assessment using Analytical tool SAP2000 over a mid rise building frame where we will provide lateral load for zone V (0.36) to determine soil structure interaction for lateral loads, for this study a mid rise symmetrical building of G+7 storey is considered.

Keywords: Soil Interaction, Analysis Tool, Mid Rise Building, Support Reaction, Forces.

I. INTRODUCTION

During the last century, it has been assessed that seismic danger accounts around 30% of all out setbacks and 60% of the all out property misfortune. However, soil liquefaction marvels have been perceived since long, it was all the more thoroughly brought to the consideration of designers, seismologists and academic network of the world by a few decimating earthquakes around the globe.

A fixed end underpin is used to support the establishment as it is laid out for the basic evaluation of an RC space casing. In order to conclude the investigation, the base section of the arrangement is treated as fixed, with the impact of soil distortions being ignored. Actually, owing of the interaction between the earth and the structure, any building's shell rests on flexible soil, which causes a redistribution of forces and stresses. This makes traditional examination absurd and maybe harmful. The interaction impact becomes more obvious if multi-story buildings are constructed due to excessive weight, and it may become much more disruptive if seismic weight is applied to such structures.

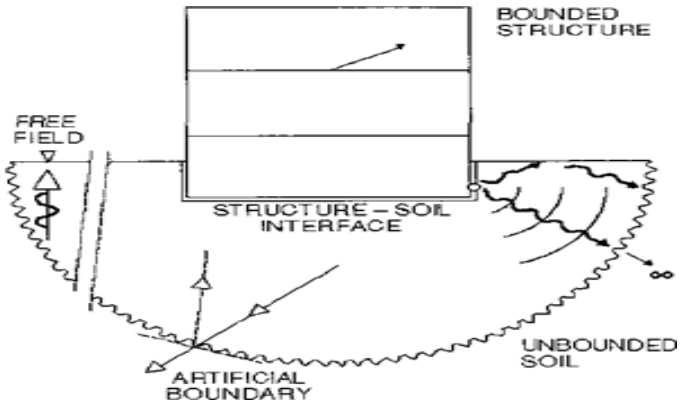

Fig 1: Soil Structure Interaction

Objectives:

The primary objectives of this study is as follows:

1. to assess the stability of the interaction between soil and structure under seismic risk.
2. To ascertain how lateral load affects two different soil types, namely loamy and black cotton soil.

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3. to ascertain the use of the analytical tool SAP2000 in the interaction between the soil and the structure.
4. to identify changes in stresses, stability, displacement, and other crucial standards or safe structures.

II. LITERATURE REVIEW

Supriya and Reddy (2019) [1] this research paper presented the effects of soil interaction on building frame design parameters as change of modulus of sub-grade reaction from 0.010 to 0.050 N/mm3 the analysis was done on parameters namely shear force, bending moment and settlements for different footing sizes of 1mx1m to 4.5mx4.5m the effect of SSI was quantified using finite element analysis. According to the research paper's result, there is minimal to no difference between the shear force and axial force values in the beam and column when calculated using finite element analysis. According to the analysis, there would be a greater percentage difference in the bending moment in the beam, column, and footings at lower EFS values, such as 0.010N/mm3 at smaller footing sizes like 1mX1m, than at higher EFS values, such as 0.050N/mm3 at larger footing sizes like 4.5mX4.5m, which take soil interaction into account.However, when it comes to footings, which experience some settlement, the percentage difference in settlement was 14.41% and 6.72% at lower EFS values, or 0.010N/mm3 at smaller footing sizes, compared to higher EFS values, or 0.050N/mm3 at larger footing sizes, respectively.

Methodology:

Following steps are required in a sequence for proper completion:

Step-1 **Select Geometrical data and modelling of structure using SAP2000.**

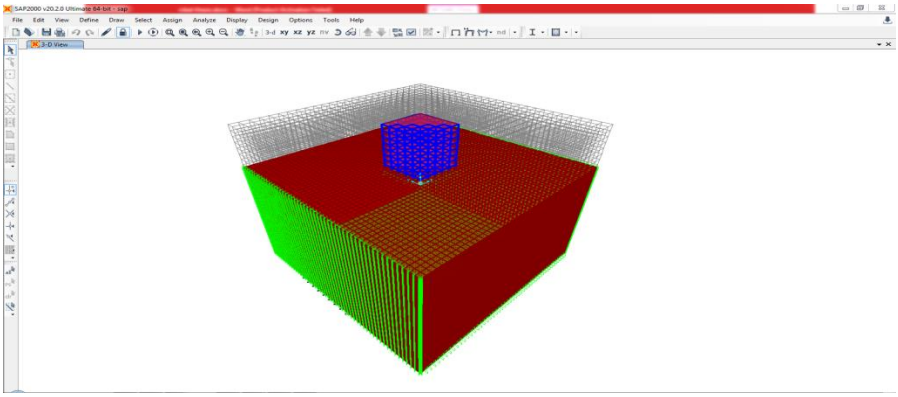

Fig 2: Modelling of the structure

Step-2: Defining material and soil property for study.

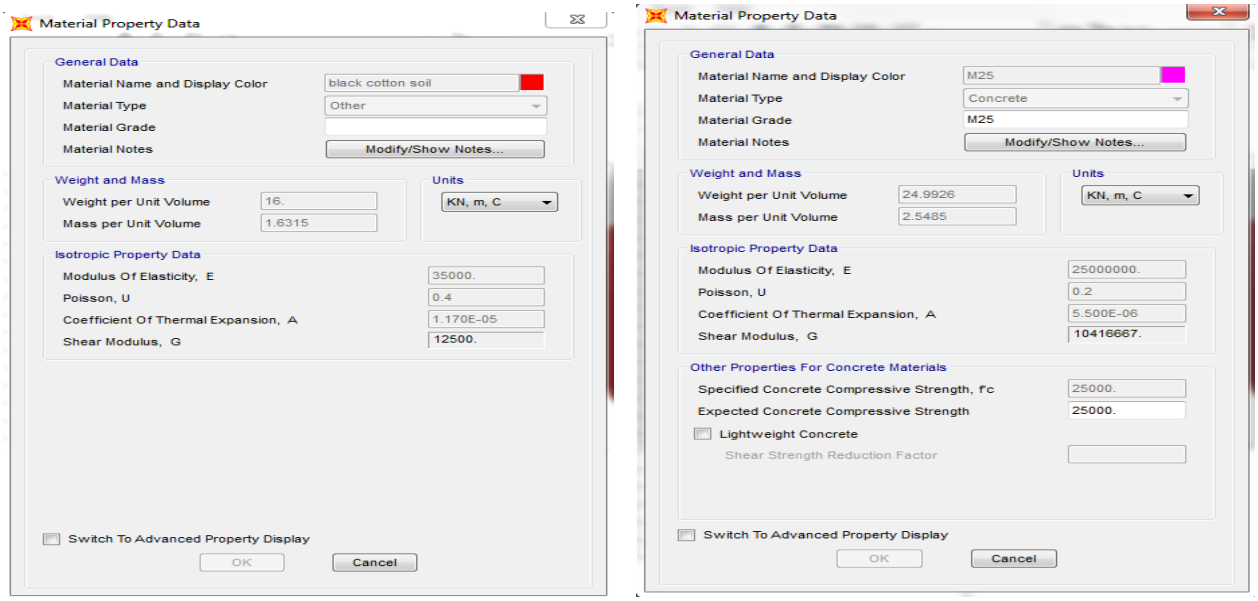

Fig 3: Material & Soil Property

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Step-3: Creating Soil Mass below the structure:

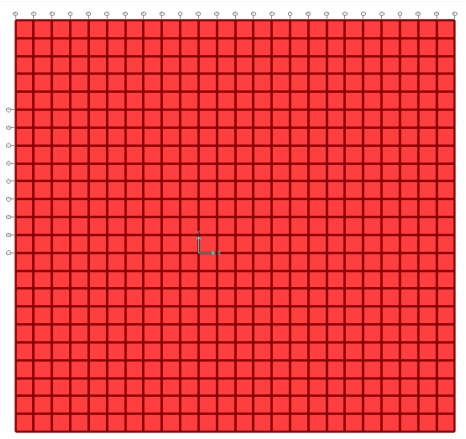

Fig 4: Soil Mass below structure

Step-4: Assigning Boundary Conditions

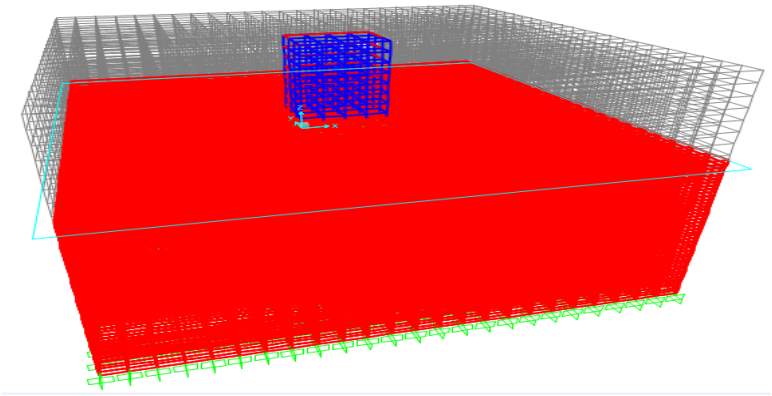

Fig 5: Assigning Support Conditions

Step-5: Interacting RCC Structure over the soil

In order to have interaction and load distribution, we have assigned a G + 7 Structure above soil in this study that is fixed 1.5 m below the soil.

Step-6: Load Combinations

Step-7: Interacting Soil and structure

Interaction of soil mass and structure is done by fixing structure 1.5 meter below the soil for proper distribution of support reaction to the soil mass.which is effected to 18 m beneath the soil as observed after analysis.

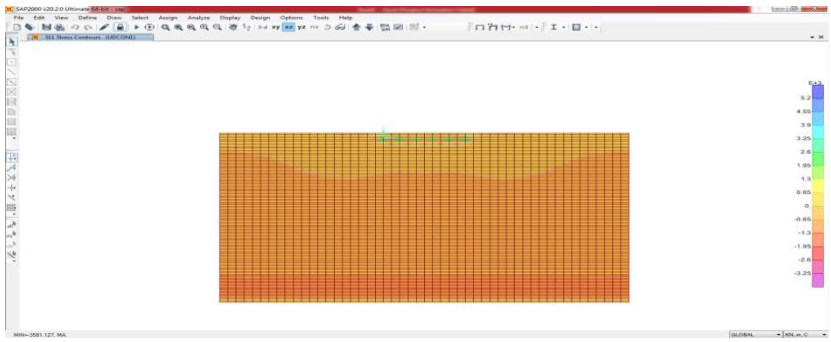

Fig 6: Interaction of Soil mass and structure

Step-7: Analysis of soil structure

Finite element analysis is performed using SAP2000 software, for this analysis soil mass is meshed in elements to determine the minute variation in different elements of the soil.

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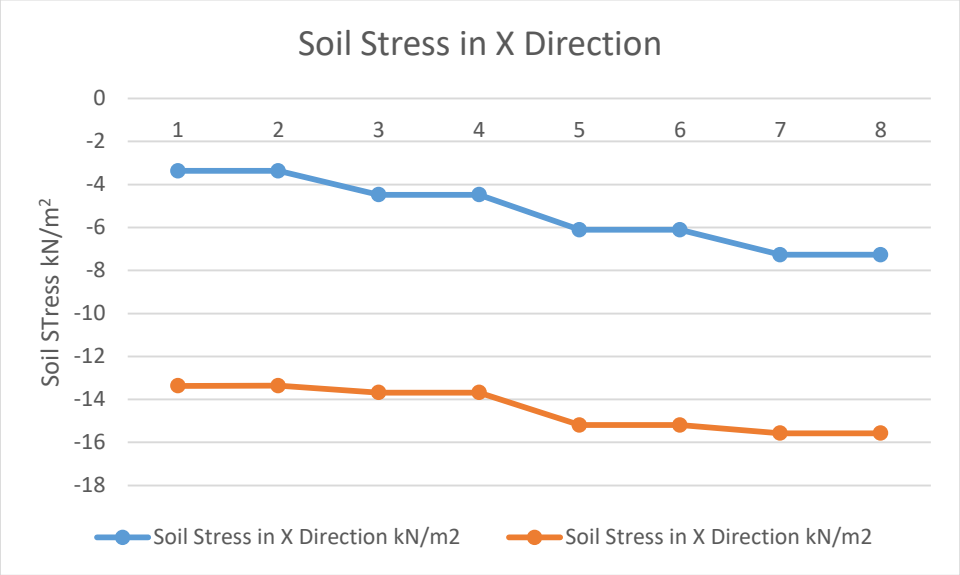
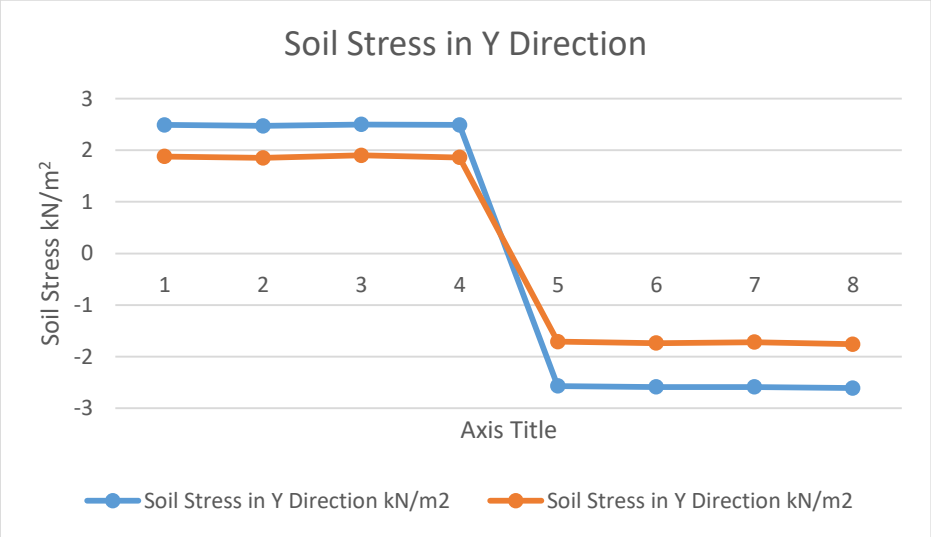
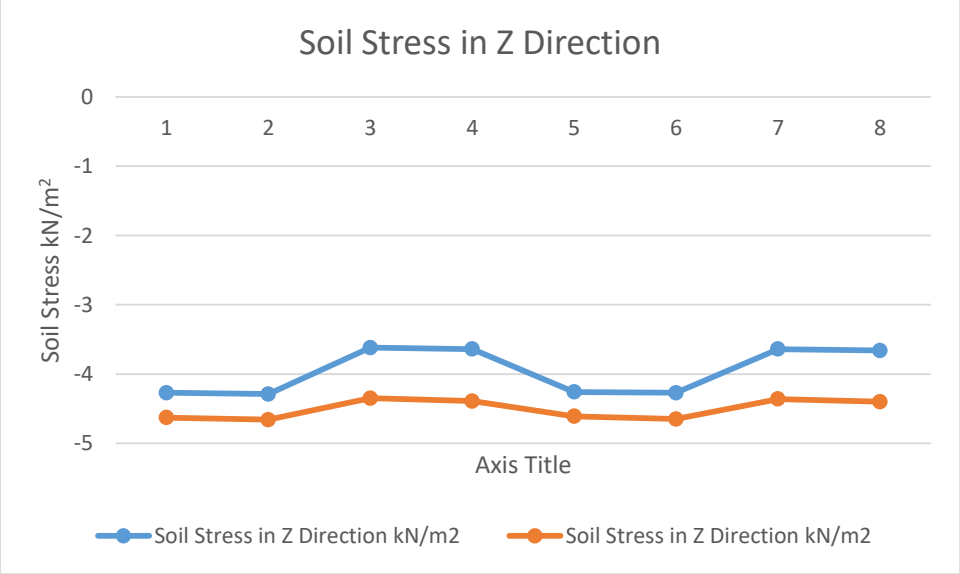
Step-8: Comparative Analysis

In this step we will compare results of both type of soil to determine the variation in reactions, forces and moment.







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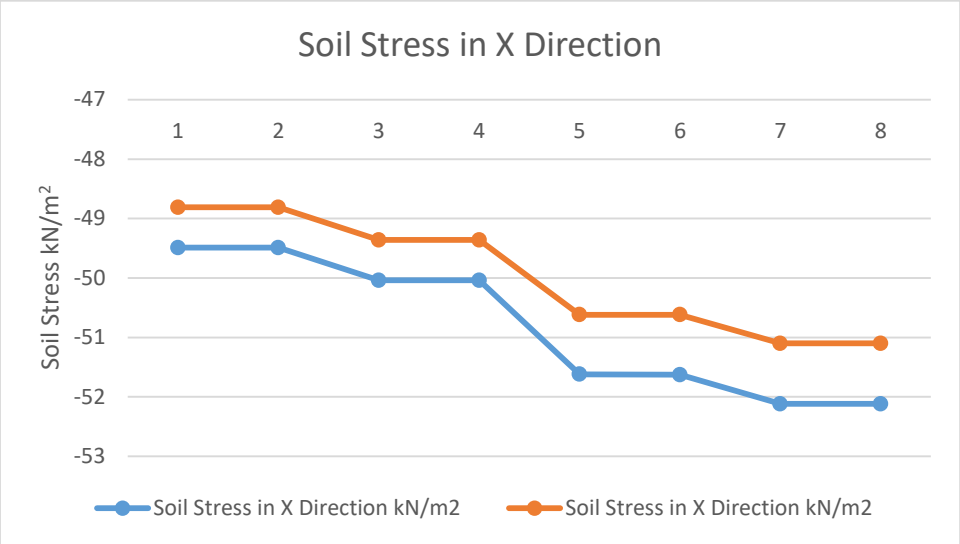
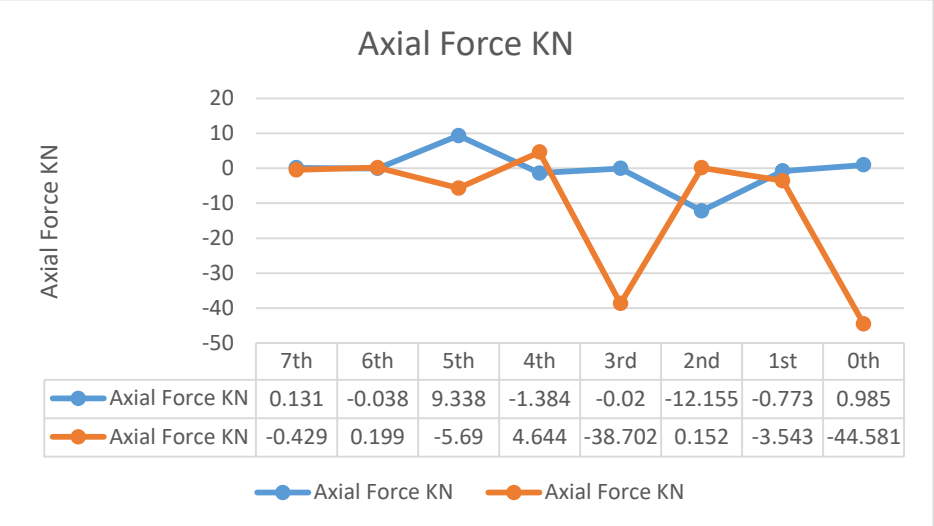
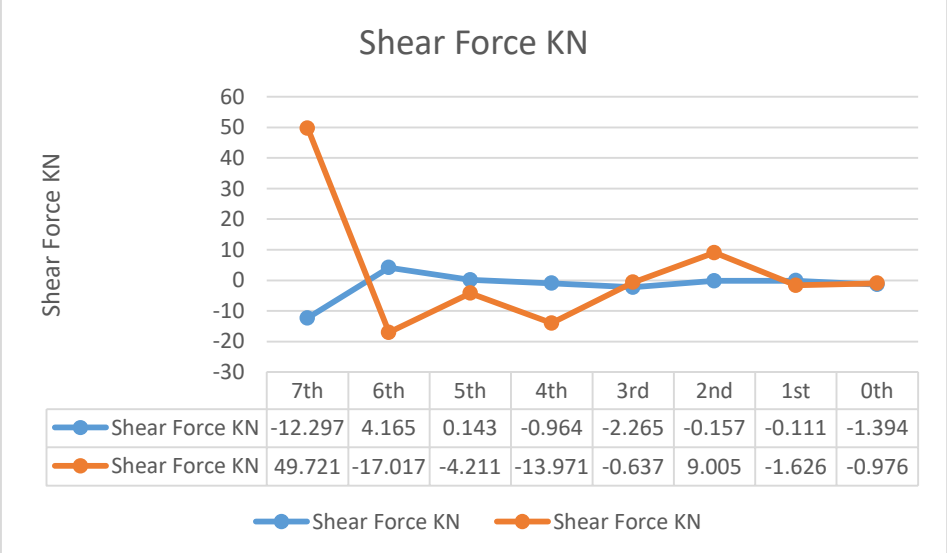
III. DISCUSSION

In the analysis of top region of the soil it is observed that variation in loamy soil is more distributive and linear in X, Y and Z direction which can be said as linear distribution whereas in black cotton soil it can be observe that distribution is uneven.







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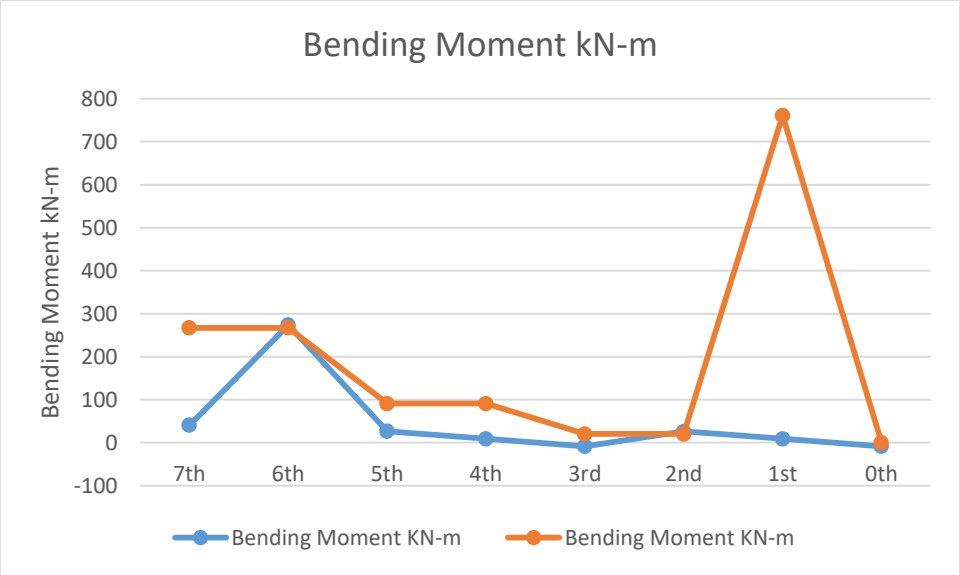

IV. CONCLUSION

This study explores the SSI effect on the overall risk of a mid rise building structure with respect to two failure modes: strength in terms of plate and joint forces, moment, Displacement and Support reaction at the base of the structure:

1 It is observed in the above analysis that loamy soil is 18.50 % more stable in resisting forces.

2 It is observed that effect of lateral forces is more in black cotton soil as compared to loamy soil.

3 It is observed that soil mass is meshed finitely in SAP2000 Which provide accurate and linear results.

4 It can be concluded that there is variation in both the cases i.e. structure under black cotton soil and loamy soil, as forces and moment are varying by 16% and 14 % respectively.

5 The consideration of SSI shows a complete conflicting effect on the seismic fragility and risk depending on the two different soil failure modes. This has a positive effect regarding the strength failure mode, but this brings a negative effect regarding the displacement failure mode.

V. SUMMARY

Here it can be concluded that the soil properties effect the overall stability of the structure and it is justify that for designing lateral forces soil type have major role in analysis.

In this study it has been observed that effect of structure forces is distributed to 18 m beneath the soil mass.

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