COMPARISON OF SOIL STRUCTURE INTERACTION FOR REGULAR AND IRREGULAR BUILDINGS WITH DIFFERING FLOOR LEVELS AND SOIL STRATUM

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Abstract - *In the current work, an effort is done to study these soil structure interactions when the structure is built on different soil stratums for regular and irregular buildings with various floor levels. In this project, chosen two different soil layers for the analysis and the building is resting on isolated footing with Ground floor, (G+2) and (G+4) regular and irregular building is considered. Equivalent static analysis is carried out in order to study the displacement, Von Mises stress and stresses in X, Y and Z directions developed in the structure.*

Key Words: **ANSYS MECHANICAL APDL, SOIL STRUCTURE INTERACTION, REGULAR AND IRREGULAR BUILDING, EQUIVALENT STATIC ANALYSIS**

1. INTRODUCTION

The greater part of the civil engineering structure includes some kind of structural component with direct contact with ground. At the point when these exterior forces, for example, seismic effects, act on these systems, neither the structural displacements nor the ground displacements are independent of each other. The method in which the reaction of the earth influences the action of the structure and the action of the structure influence the reaction of the soil is expressed as soil- structure interaction.

It has normally considered that soil-structure interaction beneficially affects on the reaction of structure. Taking into account soil structure interaction makes the structure more flexible and accordingly rising the normal period of the structure compared to the inflexibly supported structure. The conventional overview is suitable only for certain class of structures and soil conditions, for example, light structures in moderately rigid soil. This statement does not constantly hold true. The soil structure interaction can enclose a damaging effect on the structural reaction and neglecting soil structure interaction in the study may direct to dangerous design for both superstructure and groundwork.

The contact between the building, groundwork and soil layer underneath the footing modify the genuine performance of the building significantly acquired by considering the structure alone. Flexibility of soil layer beneath footing reduces generally, hardness of the structure. In the conservative investigation of a building, the base loads are computed without considering soil settlement. The structure is assumed as completely flexible structure in this kind of study. The stress- strain features of soil layers are accountable for differential settlement. The forces of the structural members may change because of differential settlement. It is essential to consider building frame, base and soil as single important structural unit.

2. BUILDING DESCRIPTION

Table -1: Description of RC framed structure

Description	Model-1	Model-2	Model-3	Model-4	Model-5	Model-6
No. of stories	Ground floor	Ground floor	(G+2)	(G+2)	(G+4)	(G+4)
Total floor height	3.2m	3.2m	9.6m	9.6m	16m	16m
Dimension of structure	16m x 20m	16m x 20m	16m x 20m	16m x 20m	16m x 20m	16m x 20m

Table -2: Material Properties of Concrete and Steel

Property	Value
Grade of steel (N/mm²)	Fe 415
Grade of concrete for all structural members (N/mm²)	M-25
Modulus of elasticity of concrete (kN/m²)	$E_c = 5000\sqrt{fck}$ $= 5000\sqrt{25}$ $= 25\text{x}10^6$
Poisson's ratio for concrete	0.15
Concrete density	25 kN/m³

Table -3: Material Properties of soil

Soil Type	Modulus of elasticity (kN/m²)	Poisson's ratio
Hard Soil	$65\text{x}10^3$	0.3
Soft Soil	$15\text{x}10^3$	0.4

Table -4: Geometric Parameters

Parameter	Value
Slab thickness	0.15m
Beam	0.23m x 0.45m
Column	0.23m x 0.45m
Height of each storey	3.2m
Depth of soil layer	4m
No. of bays in X direction	4
Spacing of bay in X direction	4m
No. of bays in Z direction	4
Spacing of bay in Z direction	5m
Footing size	2.7m x 2.5m x 0.6m

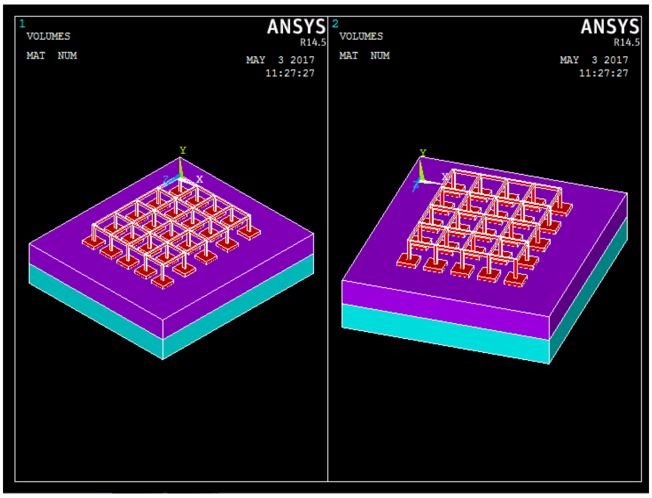


Fig -1: Isometric and oblique view of Model-1

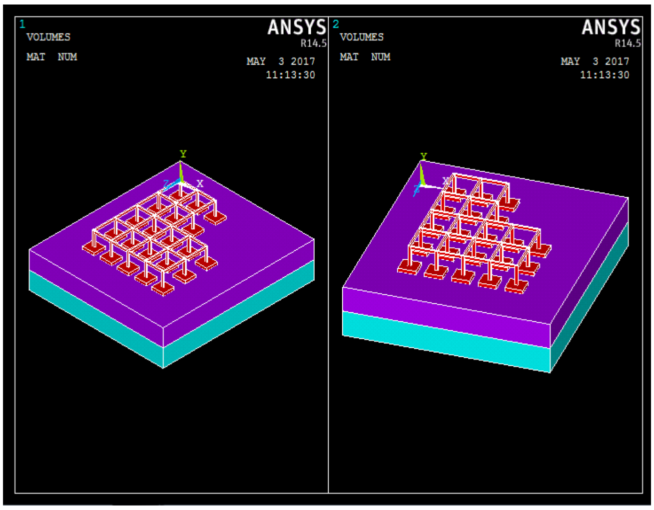


Fig – 2: Isometric and oblique view of Model-2

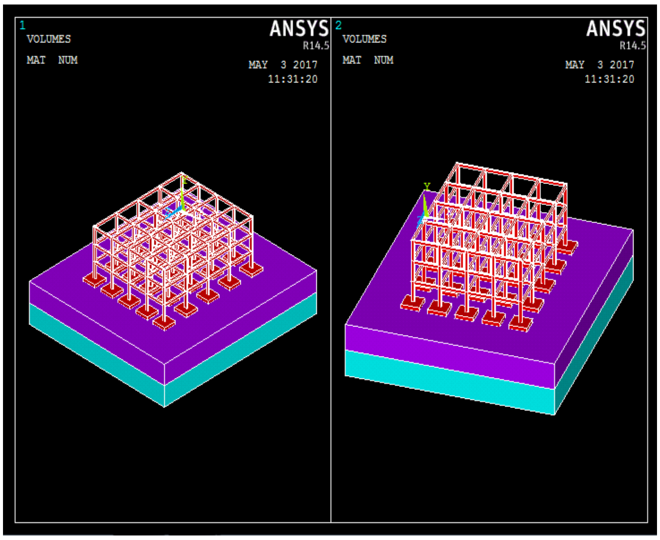


Fig – 3: Isometric and oblique view of Model-3

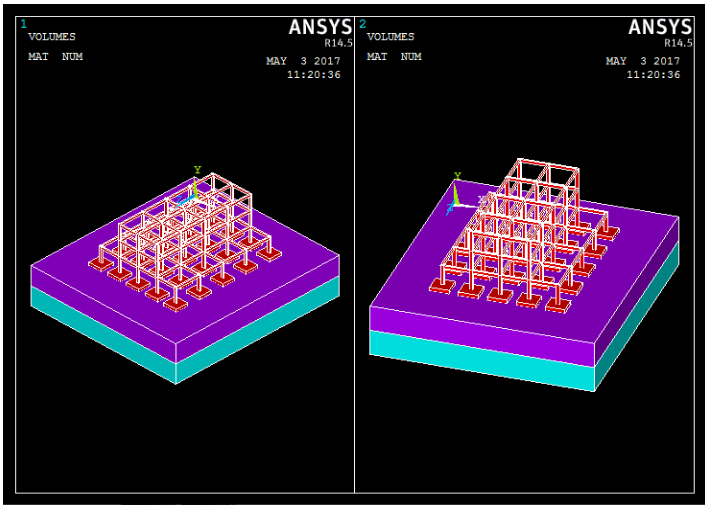


Fig -4: Isometric and oblique view of Model-4

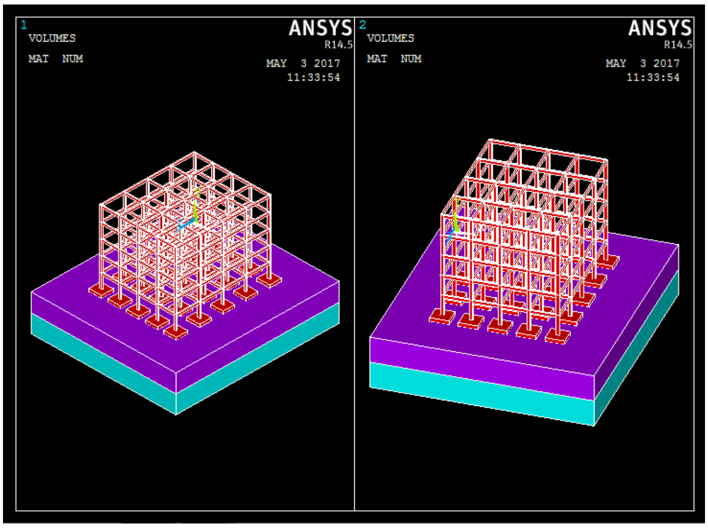


Fig -5: Isometric and oblique view of Model-5

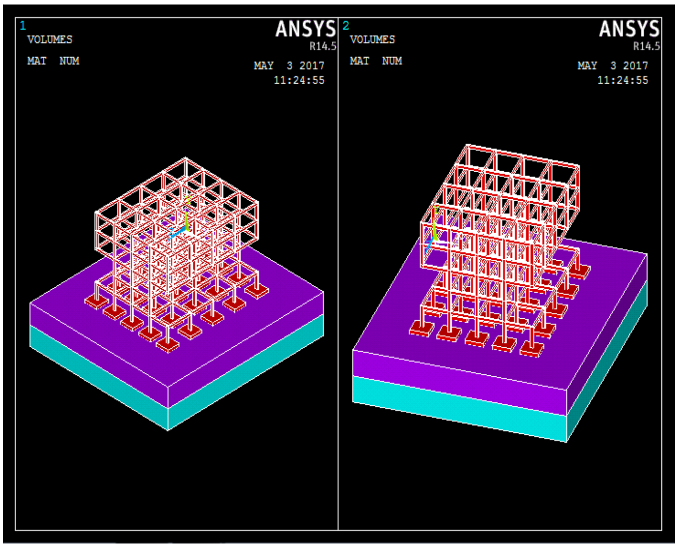


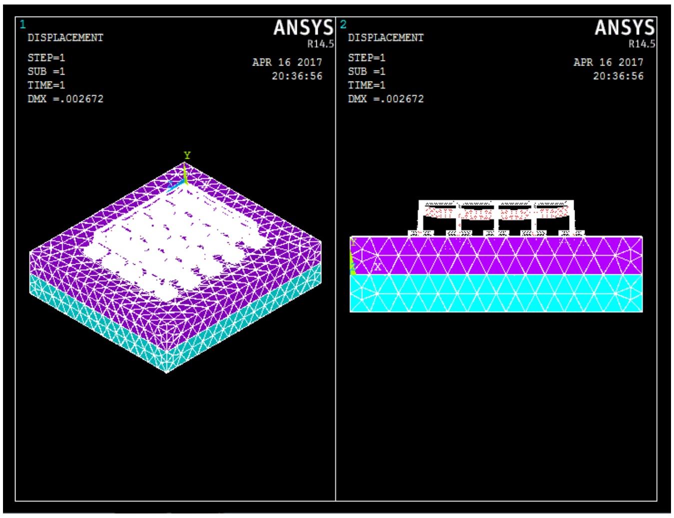
Fig -6: Isometric and oblique view of Model-6

3. RESULTS AND DISCUSSIONS

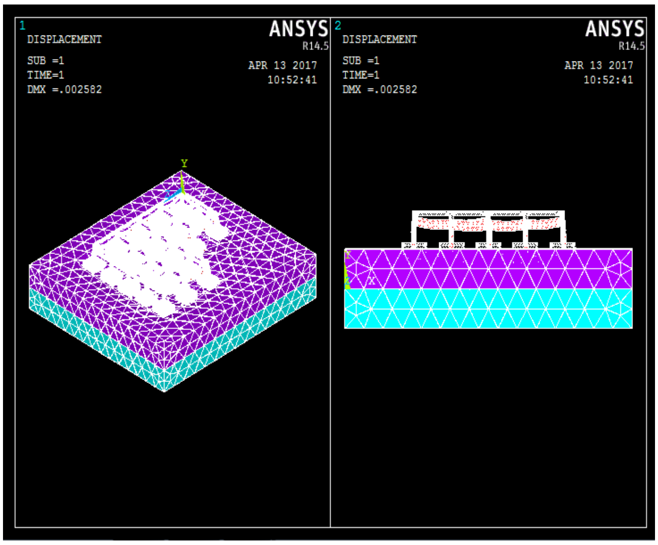
Equivalent static analysis is carried out for Ground, (G+2), (G+4) for different soil stratum of depth 4m each and four bays in both X and Z direction. The results obtained are listed below.

3.1 COMPARISON OF DISPLACEMENT VALUES FOR DIFFERENT MODELS

3.1.1 MODEL-1

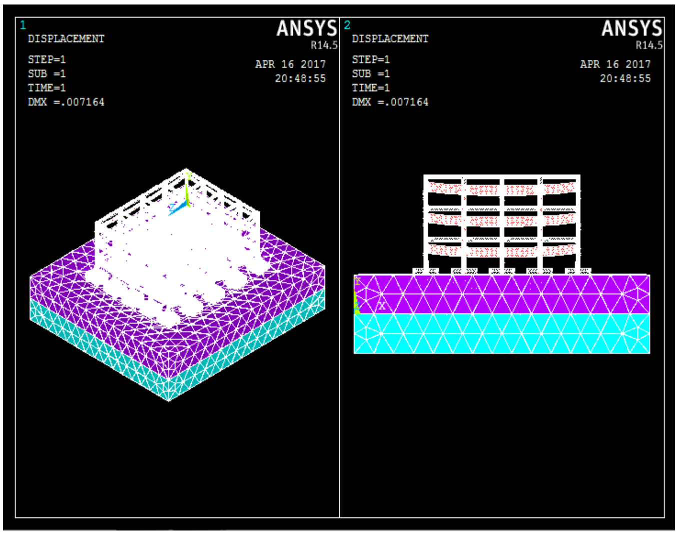


3.1.2 MODEL-2

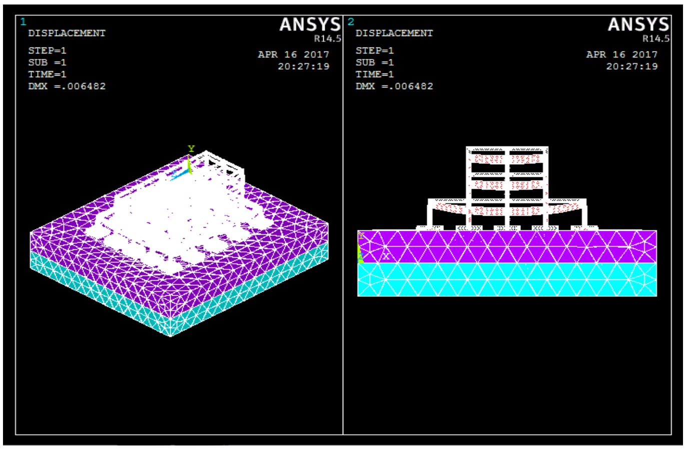


Description	Model-1 Regular Ground Floor	Model-2 Irregular Ground Floor
Displacement	2.672mm	2.582mm

3.1.3 MODEL-3

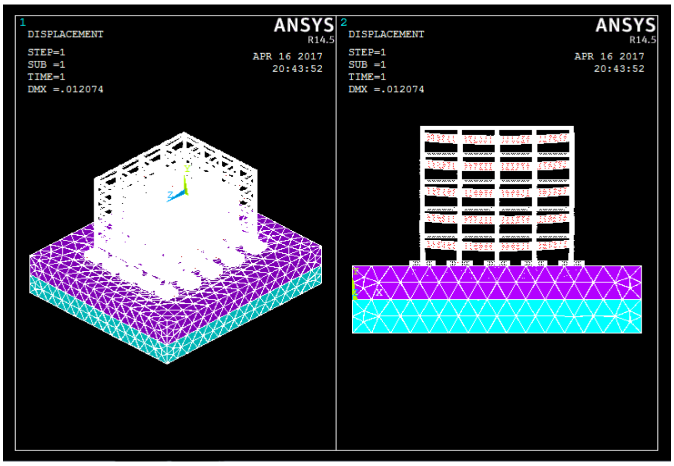


3.1.4 MODEL-4

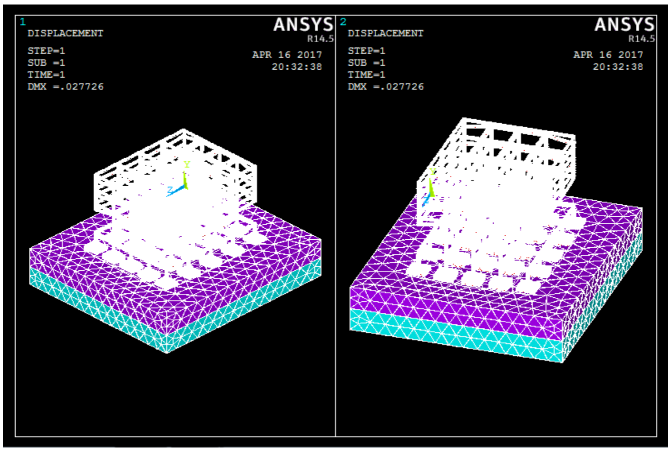


Description	Model-3 Regular (G+2)	Model-4 Irregular (G+2)
Displacement	7.164mm	6.482mm

3.1.5 MODEL-5



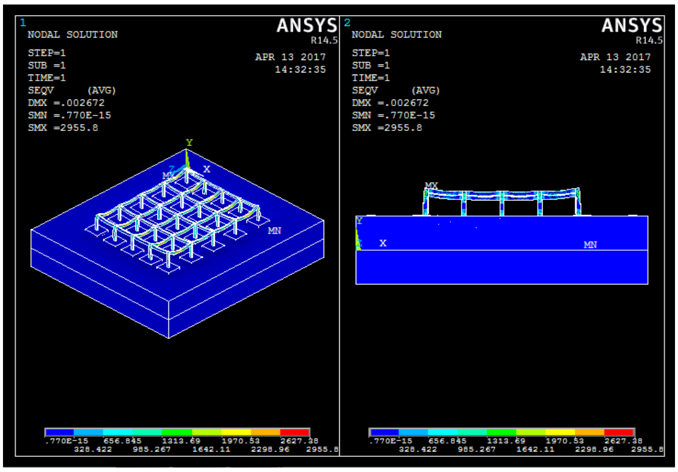
3.1.6 MODEL-6



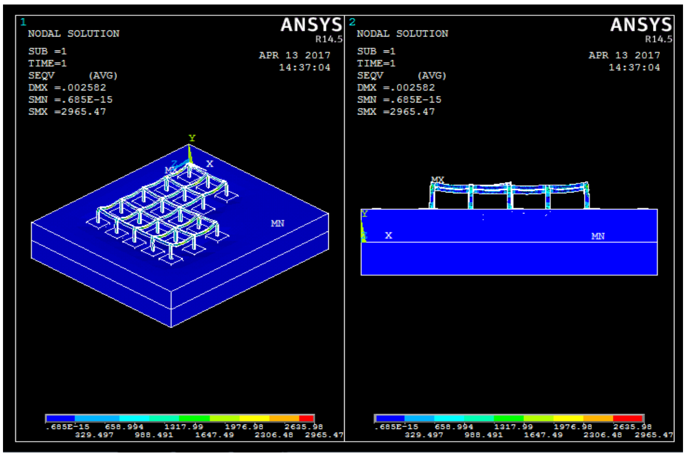
Description	Model-5 Regular (G+4)	Model-6 Irregular (G+4)
Displacement	12.074mm	27.726mm

3.2 COMPARISON OF VON MISES STRESS FOR DIFFERENT MODELS

3.2.1 MODEL-1

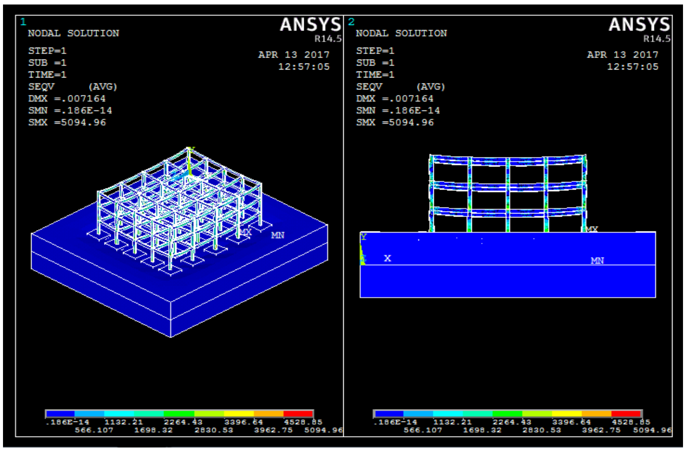


3.2.2 MODEL-2

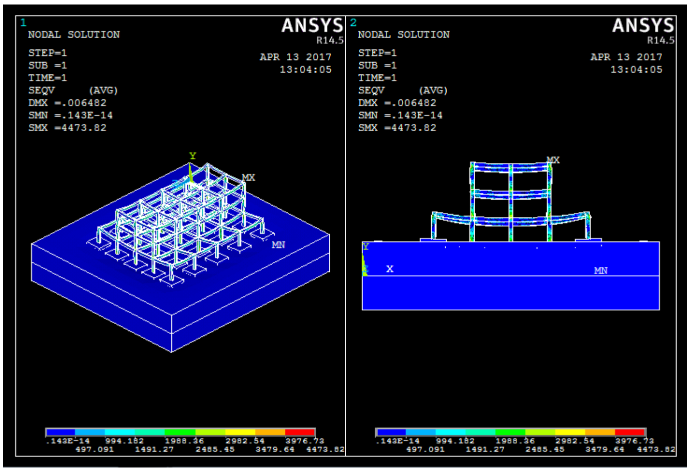


Description	Model-1 Regular Ground Floor	Model-2 Irregular Ground Floor
Von Mises Stress	2955.8 kN/m^2	2965.47 kN/m^2

3.2.3 MODEL-3

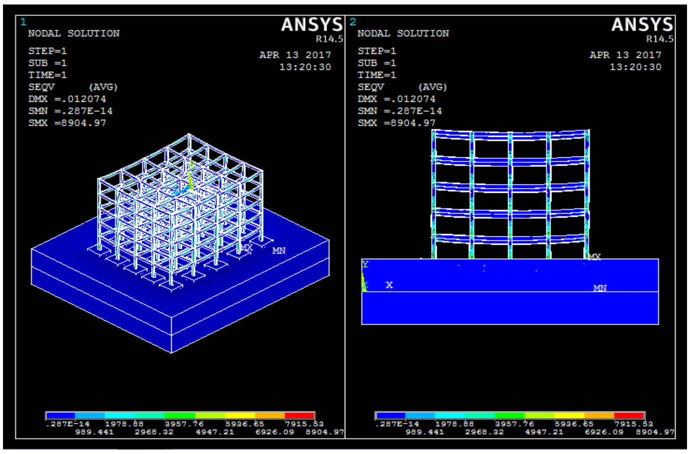


3.2.4 MODEL-4

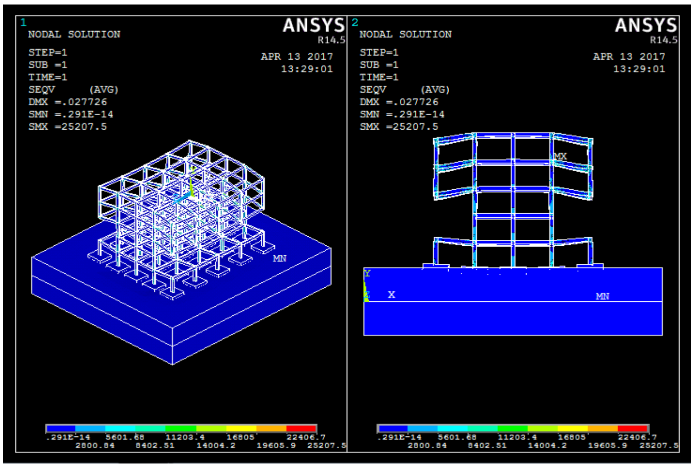


Description	Model-3 Regular (G+2)	Model-4 Irregular (G+2)
Von Mises Stress	5094.96 kN/m²	4473.82 kN/m²

3.2.5 MODEL-5



3.2.6 MODEL-6



Description	Model-5 Regular (G+4)	Model-6 Irregular (G+4)
Von Mises Stress	8904.97 kN/m²	25207.5 kN/m²

4. CONCLUSIONS

In the investigation of regular and irregular reinforced concrete framed multi-storied structure, following conclusions were listed.

1. It is important to consider the outcome of soil structure interface before construction of any type of structure. The results show that soil structure interface plays a main part in response of structure.
2. Displacement value is more in irregular (G+4) building when compared to regular (G+4) building. But the displacement value is slightly more in regular Ground and (G+2) building when compared with irregular Ground and (G+2) building.
3. Stress values obtained from the analysis is more for irregular buildings when compared to regular buildings.
4. Von Mises stress values is more than regular buildings when compared with irregular buildings.
5. Elastic properties of soil influence the performance of the structure.
6. It is observed that the displacement value enhance as the elevation of the building rises.
7. Change in deformation is observed due to different soil layers. Different soil stratum gives different values of deformation.

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