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Comparative Seismic Analysis of Regular & Irregular Building with Time History Method

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***Abstract:** Over the decades, researchers have pre assumed in practice of structure design, that the structure is fixed at its base, As the structures are supported on soil but many structural designers do not consider the soil structure interaction (SSI) effects at the time of earthquake. The major goal of the current study is to ascertain how the interaction of soil and structure affects both regular and irregular structures with irregular stiffness in areas of high damage risk. In the current study, an effort is made to determine how soil structure interacts with buildings using E-TABS2016. In seismic zone IV, distinct soil conditions—hard (type-I), medium (type-II), and soft (type III)—are being compared using time history analysis.*
***Key Words:** soil structure interaction, stiffness irregularity, time history analysis.*

I. INTRODUCTION

One of the most crucial fields of structural engineering research today is soil structure interaction. In the process known as "soil structure interaction," the response of the soil is influenced by the motion of the structure and the motion of the structure is influenced by the response of the soil. By using SSI, designers can obtain the inertial force and actual soil foundation displacement caused by free field motion, which could result in a reduction in the cost of the project. Finite element analysis and computer-added technology have made it easier to tackle and observe problems like these throughout time in this field.

Structures fail as a result of earthquakes, and it usually starts at a weak point. Additionally, irregular constructions fall into the category of weak points due to discontinuity in mass (seismic weight greater than 150 percent of adjacent floor), stiffness irregularity, and geometry irregularity (lateral load resisting dimension greater than 200 percent of adjacent story).

During an earthquake, ground get accelerated & dynamic behavior get reflected on the superstructure Vertical irregularity is the main cause of structural failure. When these structures are built in high seismic prone zones, such as zone IV or zone V, the analysis and designing portion of the construction becomes more challenging and complicated.

II. METHODOLOGY

In the current study, ETABS 2016 has been used to analyse a nine-story structure. Finite element analysis will be done with time history data input. The indicated characteristics of the created model are mentioned below

Table-1 :- Structural Property

1.	Plan dimension	16 X 15 m^2
2.	No. of stories	9
3.	Floor to floor height	3000 mm
4.	Beam size	250X500
5.	Column size	450X450
6.	Thickness of slab	150 mm
7.	Zone	IV
8.	Zone factor	0.24
9.	Importance factor	1
10.	Response reduction factor	5
11.	Grade of concrete	M30
12.	Grade of steel	Fe415
13.	Density of concrete	25kN/m^3

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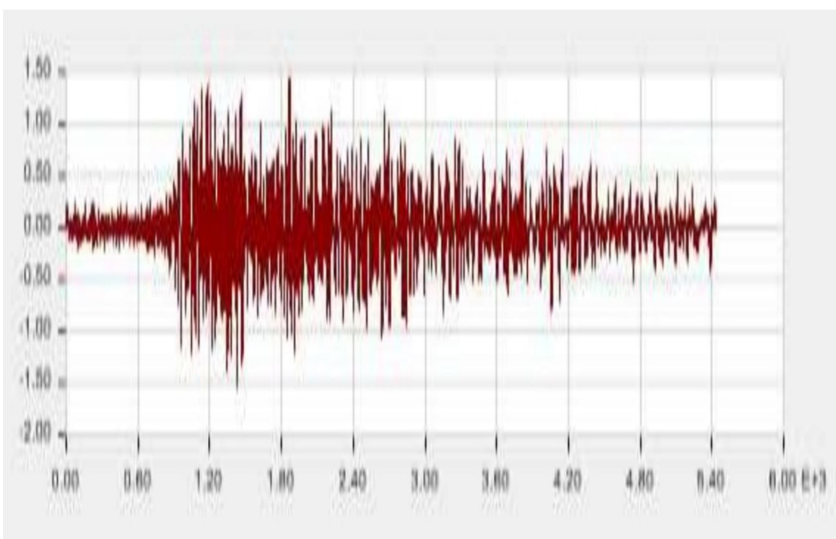
Table-2:- Wind Load Property

	Loadings	Values
1.	Slab load	3.75 kN/m^2
2.	Floor finish	1.0 kN/m^2
3.	Roof finish	1.0 kN/m^2
4.	Live Load	3.0 KN/m^2

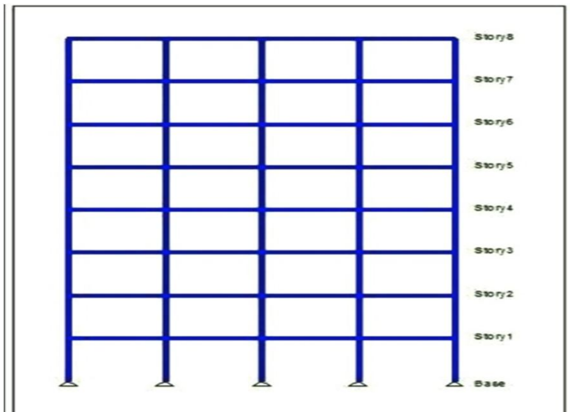
A comparison between a conventional building (model I), an irregular building without a slab on story 1 (model II), and an irregular building with a slab that is twice as thick on story 1 (model III) was done in the current study. Different soil conditions, such as soil types I, II, and III, which stand for hard, medium, and soft soil, respectively, as advised by the IS code 1893:2002 part I, were taken into consideration. Different metrics, including tale displacement and drift index for various soil types, have been estimated and compared while maintaining a fixed support condition.

A. *Time History Data*

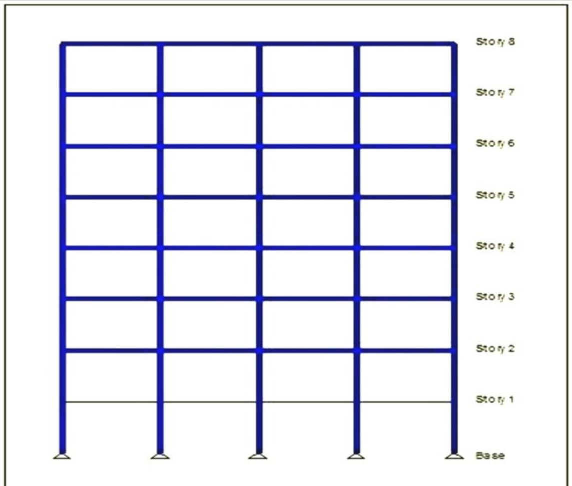
Depth (Km) 46.0
Magnitude 7.8
Region Iran-Pakistan-Border-Region
Above details taken from IMD
Station Code DCE
Station Lat. 28.795N
Station Long. 77.118E
Station Height (m) 208.0
Site Class CVs30 between200m/secto375m/sec
Record Time 16.04.201310:49:13.829
Sampling Rate 200Hz
Record Duration 169.970Sec.
Direction E-W(Epositive)
Max. Acceleration 1.521cm/sec^2



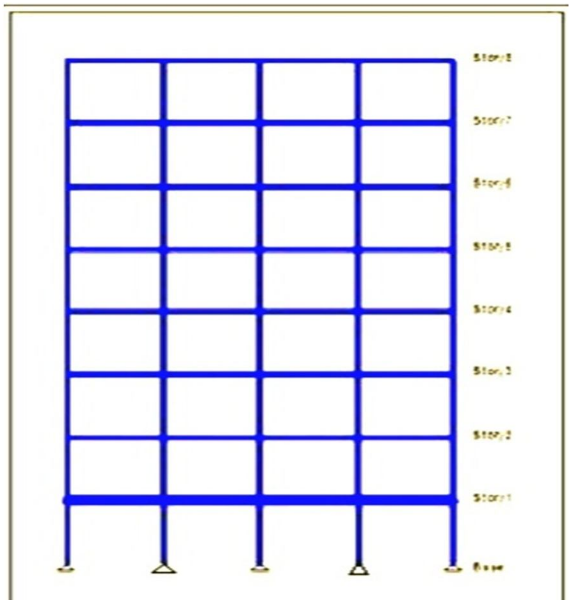
Time History Graph



Model -1 Regular



Model -2 Irregular

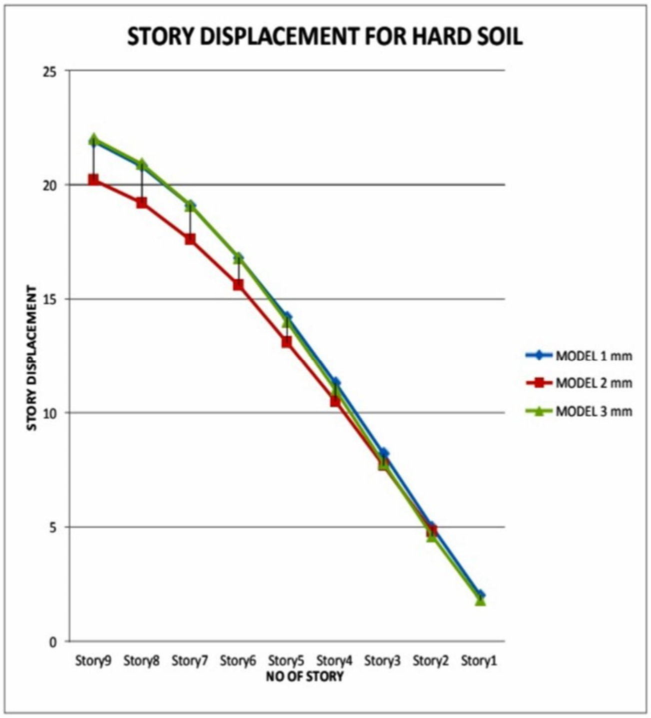


Model -3 Irregular

III. OBSERVATIONS AND RESULTS

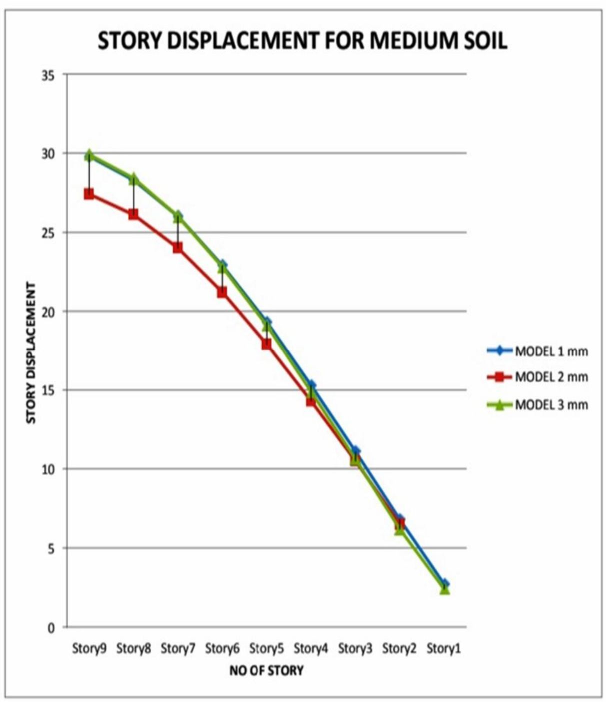
A. Story Displacement For Hard Soil

The graph displays the story displacement for hard soil for Models I, II, and III. For hard soil, Models I and 3 exhibit almost the same values, whereas Model 2 shows a lower and different value clearly shows that displacement decreases with increasing stiffness



B. Story Displacement For Medium Soil

The graph narrate the story displacement for medium soil for Model I , Model II , Model III where as modeI 1 and 3 behavior show approximate same values instead model 2 shows lower & different value for medium soil i.e. type 2



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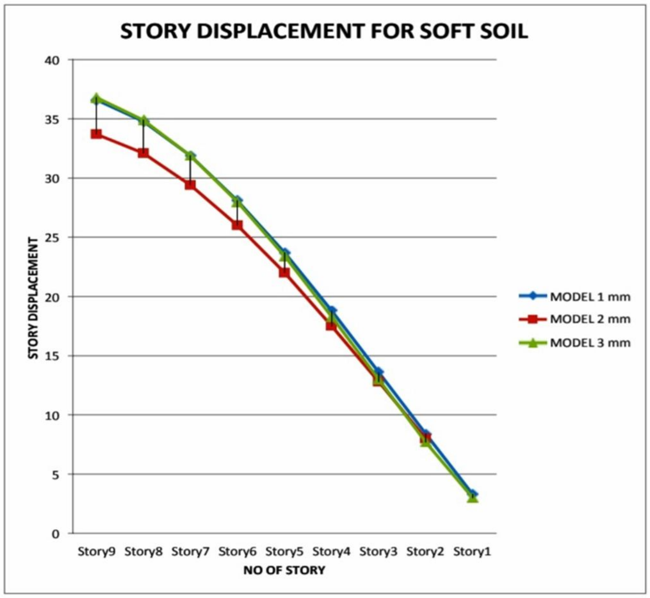
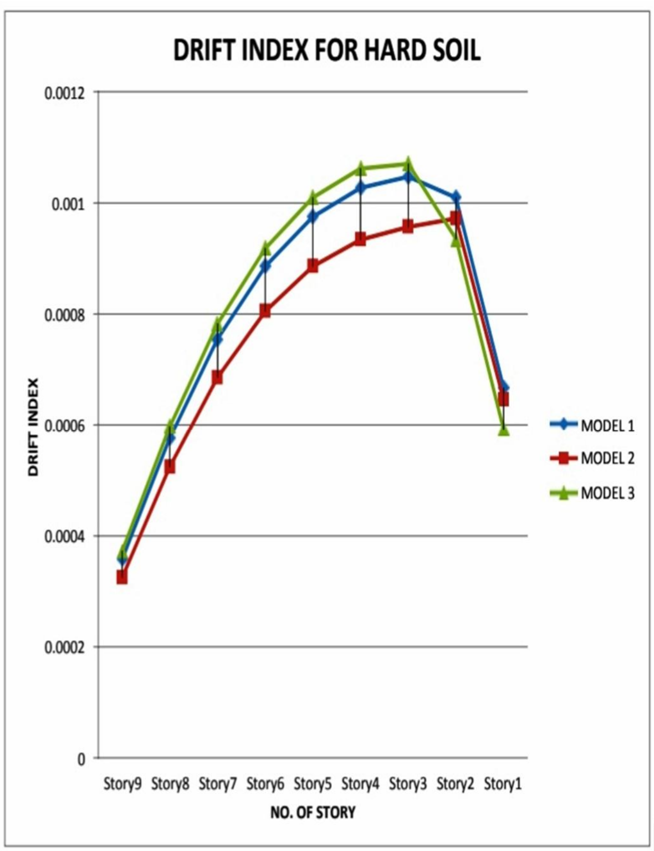
C. Story Displacement For Soft Soil

The graph shows change in the story displacement for loose or soft soil for Model I , Model II , Model III where as modeI 1 and model 3 show approximate same values as well as model 2 shows lower & different value for loose/ softsoil



D. Index For Hard/Rocky Soil

The graph indicate the drift index of stiff soil for Model I , Model II , Model III as per results modeI 1 and model 3 behavior is almost same as well as model 2 shows lower & different value for hard soil model III shows the minimum value for ground floor of drift index



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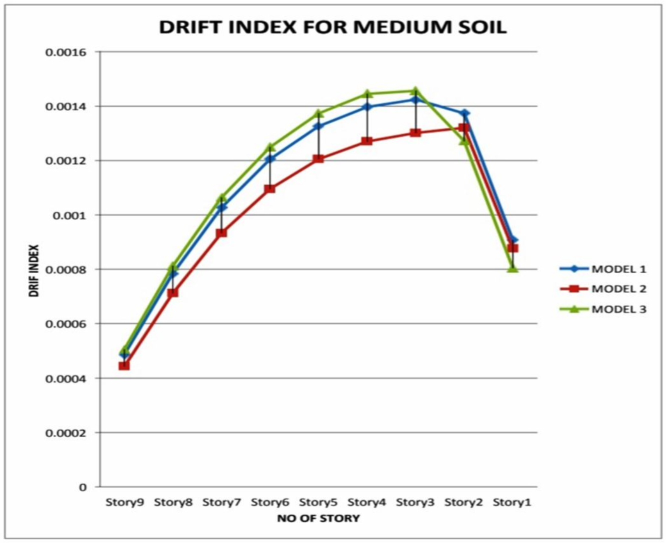
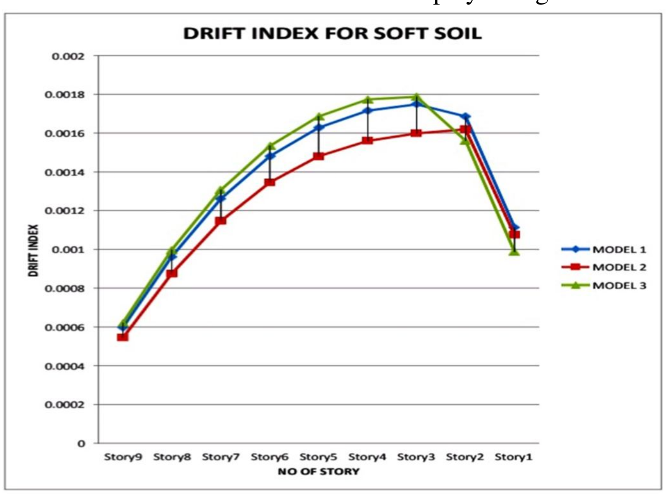
E. Drift Index For Medium/Stiff Soil

The graph displays the drift index for medium soil for Model I, Model II, and Model III, where Model I, Model I, and Model III exhibit almost the same values while Model I, Model II, and Model III, show lower and different values for medium soil, respectively.



F. Drift Index For Soft Soil

The graph displays the soft soil drift index for Models I, II, and III, with Model I showing roughly the same values as Model III and Model 2 showing a lower and different value for soft soil. Model III displays the ground floor's minimum drift index value.



IV. CONCLUSION

1) The results demonstrate that the behavior of models I and III, which represent a regular building and a building with a double depth of slab, behave nearly identically, but model II, which represents a building without a slab on story 1, exhibits the best results for soil displacement across all type earth
2) The results reveal that model I and model III, which represent regular and irregular buildings with double slab depths, behave almost identically, whereas model II, which represents a building without a slab on the first floor, exhibits a different behavior and provides the best drift index results for all types of earth soil
3) As per results, Analysis of the all type of the buildings i.e. regular and irregular building, Story Displacement increased as the stiffness of the soil decreases
4) Drift value of the buildings get increases as the stiffness of the soil decreases according to the places and conditions

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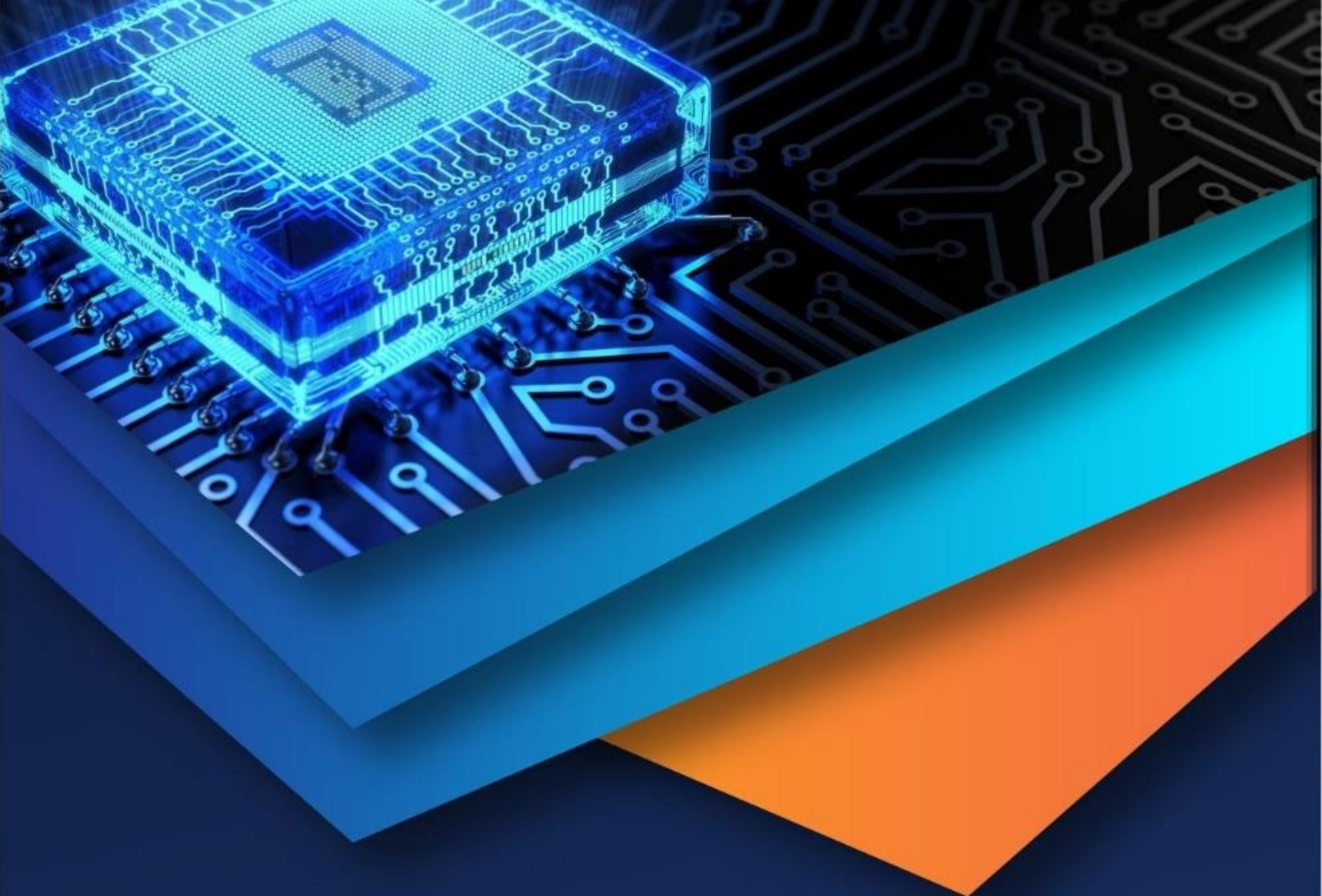

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