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Research Paper

Soil Structure Interaction of Framed Structure Supported On Different Types of Foundation

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Abstract-
In the analysis of framed structure the base is considered to be fixed neglecting the effect of soil and foundation flexibility.Flexibility of the soil causes the decrease in stiffness resulting increase in the natural period of thestru cture.Such increase in the natural periods, changes the seismic response of structure hence it be an important is sue for design consideration The present study providessystematic guidelines for determining the natural period s of frame buildings due to the effect of soilflexibility and identification of spring stiffness for different regular a nd irregular story buildings and various influential parameters have identified and the effect of the same on cha nge in natural periods has to be studied. The study has carried out for building with Isolated, mat and pile found ations for different soil conditions like soft, medium and hard strata, and a comparison between the regular and irregular buildings and natures of change in the natural periods has to present. And response spectrum analysis this study may useful for seismic design.

Keywords *– Soil structure interaction, pile foundation, raft foundation, isolated footing, time period.*

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I. Introduction

The soil structure interaction is a special field of analysis in earthquake engineering, this soil structure i nteraction is defined as "The dynamic interrelationship between the response of the structure is influenced by th e motion of the soil and the soil response is influenced by the motion of structure is called a soil structure inte raction." However engineering community discussed about SSI only when the basement motion by interaction f orce as compared to the ground motion of free field. The stress and deformation in the supporting soil cause vibr ation of structure generates base shear, moment, displacement and alter the natural period, since in reality it is n ot fixed base structure, the deformation of soil further modify the response of the structure. The structure with ir regularity have to be designed at most care by understanding determined effects of irregularities to full fill the re quirements. The research finding the effect of irregularities have discussed mainly on plan irregularities because of its mass distribution, non-
uniform stiffness and strength in the horizontal direction. Even though the structures are of the same region, sam e configuration and same earthquake magnitude, but the damages that occur during the earthquake are not of the same pattern. This means that there are some factors that affects the damage pattern like earthquake characterist ics, structural system of plan, mass, stiffness, and vertical irregularities.

II. Literature Review

Bhojegowda V T[1]**, Mr. K GSubramanya(2015)[2**], -
In the analysis of framed structure the base is considered to be fixed neglecting the effect of soil and foundation flexibility. The study has carried out for building with Isolated, mat and pile foundations for different soil condi tions like soft, medium and hard strata, and a comparison between the regular and irregular buildings and nature s of change in the natural periods has to be present. And response spectrum analysis this study may useful for sei smic design
Suman[1]**, Dr.Sunil Kumar Tengali(2017)**[2], Conventional structural design methods neglect the Soil Structu re Interaction (henceforth SSI) effects. The importance of soil structure interaction in the analysis. To study this effect, a G+7 storeyed building with vertical irregularities located in zone IV is analyzed using SAP2000 by con sidering different soil properties and different types of foundations. Conclusions will be drawn for the selection of suitable foundation to avoid failure of the structure.

Kaushlesh Dangi[1]**, Dr. Vivek Garg(2018)**[2] In conventional analysis and design of structure, the structural engineer considers the base of R.C. building as fixed and avoids the effect of soil structure interaction (SSI). The soil structure interaction causes non-
uniform settlement of raft foundation which in turn modifies the forces and displacements in structure-foundation-soil system.
Byresh A[1]**, Umadevi R(2016)**[2]**,** Soil Structure0Interaction (SSI) is the process where the soil response parti cles to earthquake ground motion affect the structure motion and the response of structure affects the motion of soil mass. The study has used the finite element tools ETABS ver15 for modelling and for SSI analysis. se shear , Modal time period, Storey displacement and storey drift are compared for seismic effect. The linear static anal ysis and nonlinear static analysis i.e. "Pushover analysis" are done for G+20 storey structure. Analyzing for "No n-
linear static analysis the performance point for the (Fully Encased Composite is significantly much more as com pared to the RCC model.

Methodology - BUILDING DETAILS
A symmetrical G+5, G+10 & G+15 building of plan dimensions 10.5m x 10.5m has been taken for Isolated Foot ing, Pile & Raft foundation on the ETAB's Software.
CODES USED FOR ANALYSIS AND DESIGN FOR BUIDLING
i. IS 1893:2002
ii. IS 456:2000
iii.IS 875 (part 1,2 &3)

Structure Type	Ordinary RC moment resisting frame
No. of storey	G+5,G+10,G+15
Typical storey height	3 m
Plinth height	1.5m
Type of building use	Commercial building
Seismic zone	V (Z=0.36as per IS 1893-2002)

Material Properties -

Grade of concrete(fck)	M25
Grade of steel (fy)	Fe 500
Young's modulus of concrete, Ec	25x 106kN/m2
Poisson's Ratio of reinforced concrete	0.20
Thickness of slab	150 mm
Specific weight of infill	14.6 kN/m3
Dead Load Intensities	
Roof finishes	2.0 kN/m2(as per IS 875-1987 (Part I)
Floor finishes	0.5kN/m2
Live Load Intensities	
Roof	2kN/m2(as per IS 875-1987 part II)
Floor	1.5kN/m2

Details of soil parameters considered

Type of Soil	N value Considered	Mass density (ρ) kN/m³	Shear wave velocity (m/sec)	Poisson ratio (ν)
Hard	40	21	111.2697	0.25
Medium	20	18.5	84.3349	0.33
Soft	9	17	54.5978	0.48

III. DISCUSSION ON RESULTS

The present work makes an effort to evaluate the effect of Soil Structure Interaction on dynamic characteristic of building frame on isolated footing, raft foundations and pile foundations. The results of the study presiding to th e following Conclusions.

The pile foundation of RC frame structure with consideration of SSI as per above discussion we observed that th e time period is increases and also it gives the more flexibility for the building and frequency is decreases. In cas e of raft foundation time period is decreases with consideration of SSI due to presence of medium soil to soft soi l. And In case of pile foundation of RC frame structure with consideration of SSI, displacement is more in above the ground story level .Very negligible displacement below ground story due to presence of consideration of SS I in case of raft foundation RC frame structure with consideration of SSI, displacement is minimum and without consideration of soil layer model shows the maximum displacement at above the ground story but it doesn't exc eeded the as per IS 1893-

2002 part I so it is feasible to improve the stiffness in elements by providing infill or bracings.

IV. CONCLUSIONS

The present work make an effort to evaluate the effect of Soil Structure Interaction on dynamic characteristic of building frame on isolated footing, raft foundations and pile foundations. The results of the study presiding to th e following Conclusions.

- Time period elongation takes place in soil structure interaction compared to fixed base condition.
- The base shear is decreased due to increase in time period due to flexibility in soil condition.
- There is no much variation in time period for frame model with pile foundation of flexible base in comparis on with the fixed base model.
- The story displacement and inter story drift decreases in 5, 10 & 15 story for time history analysis, hence th e time history is well performed for tall structures. Story drift is increased in both the cases in middle story s howing maximum drift, When SSI is considered, there is a magnification of story drift in the middle story.

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- Response of the structure increases with change in soil type from hard to medium and soft irrespective of he ight of structure and type of foundation.
- As the height of the structure increases, proportionally the base shear, time period and response also increas e. Hence the tall structure supported on soft soil will have more displacement and it needs to be more flexibl e.
- Hence SSI is also important parameter while designing the tall structures under the different soil.

FUTURE SCOPES

1.To include the non-linear behavior of the soil by using non-linear springs.
2.The analysis can be carried out with Three-Dimensional modeling of soil.
3. Study may further be extended for different seismic zones.
4. Study may further be extended for layered soil.

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