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Comparative Study of Effects Of SSI Over Bare And Infill Frame

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ABSTRACT
During earthquake the behavior of any structure is influenced not only by the response of the superstructure, but also by the response of the soil beneath. Structural failures in past have shown the significance of Soil-structure interaction (SSI) effects. The present study focuses on SSI analysis of a symmetric 13 story RC Space frame shear wall building over soft soil and subjected to seismic loading. The transient analysis of structure -soil-foundation system is carried out using ETAB software. Earthquake motion in time domain corresponding to Zone Vof IS 1893:2002 designs. Seismic coefficient method is used to excite the model of soil-structure system. For integrating the SSI effect, one type of soils based on values of elastic modulus of soil, Poisson ratio and shear modulus are considered. Responses in terms of variation in natural period, base shear, deflection, and column forces, obtained from the analysis of the SSI model are compared with that obtained from conventional method assuming rigidity at the base of the structure. The results show that the SSI effects are significant in altering the seismic response full shear wall at central bay and basement wall below plinth in combination is the alternative for minimizing the effects of SSI.

Keywords - Soil-Structure Interaction, natural period, Base Shear, column forces, masonry building, RC building

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I. INTRODUCTION

Soil conditions have a great deal to do with damage to structures during earthquakes. Foundation motions deviate from free-field motions for two principal reasons:

(1) The imposition of stiff foundation systems on (or in) a geologic medium experiencing no uniform shaking will result in foundation motions being reduced relative to those in the free-field and

(2) Inertial forces developed in the structure will cause base shear and moment, which in turn will induce relative foundation/free-field motions due to the foundation compliance.

These phenomena are commonly termed Soil-Structure Interaction (SSI). The general SSI problem is subdivided into kinematic SSI, which is concerned with first factor identified above, and inertial SSI, which is concerned with the second factor. Depending mainly on the relative stiffness of the soil and structure, SSI can have an impact on the response of the structure.

Analyses of soil-structure interaction frequently involve the prediction of deformations and Stresses, both in the surrounding soil mass and over areas of contact with the loading boundaries. Soil-structure interaction is a complex phenomenon which involves mechanism of interaction between various components of a building system.

II. AIM OF THE PRESENT WORK

a. Study of E-Tab software.
b. Analysis of Multi-storeyed frame with fixed base.
c. Analysis of Multi-storeyed frame with different types of soil using soil reaction modulus for various seismic zones.
d. Comparing behavior between fixed base and Flexible base for various seismic zones.

1. PROBLEM FOR ANALYSIS

Type-B II
BARE FRAME AND INFILL FRAME
1. Medium soil
2. Soft soil

It includes following cases.
1. Spacing of beam=4.5 m
2. Floor to floor height =3 m
3. Type of soil-II,III
4. Type of building=Ground and eleven storey
5. 3 bay

Table no – 1
Comparison of period in Second

Sr No	Type of Soil	Type of Model	Bare frame	Infill frame
1	Medium Soil	Model no-1	2.2793	1.2640
2		Model no-2	2.5044	1.6092
3		Model no-3	2.4985	1.6076
4	Soft Soil	Model no-1	2.2793	1.2640
5		Model no-2	2.5205	1.6275
6		Model no-3	2.5139	1.6262

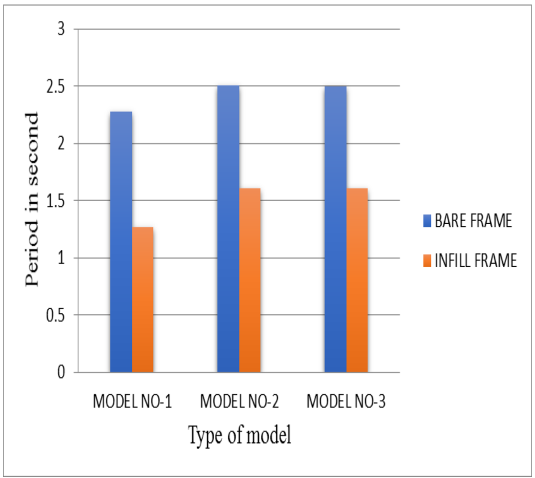

Fig 1. Period v/s type of model for G+11 frame for medium soil

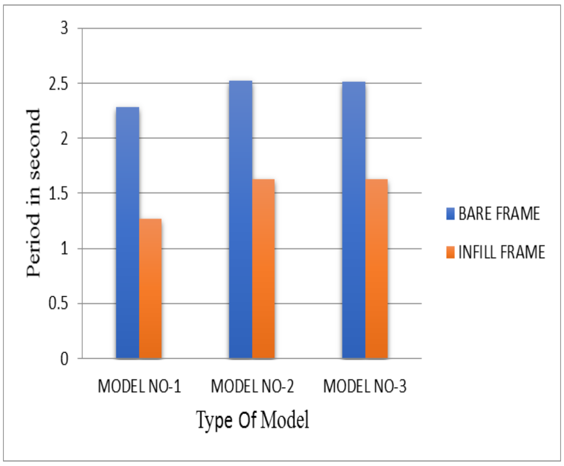

Fig 2. Period v/s type of model for G+11 frame for soft soil

Table no – 2
Comparison of base shear in KN

Sr no	Type of soil	Type of model	Bare frame	Infill frame
1	Medium Soil	Model no.1	108	210
2		Model no.2	98	164
3		Model no.3	99	165
4	Soft Soil	Model no.1	133	258
5		Model no.2	120.32	200
6		Model no.3	120.64	201

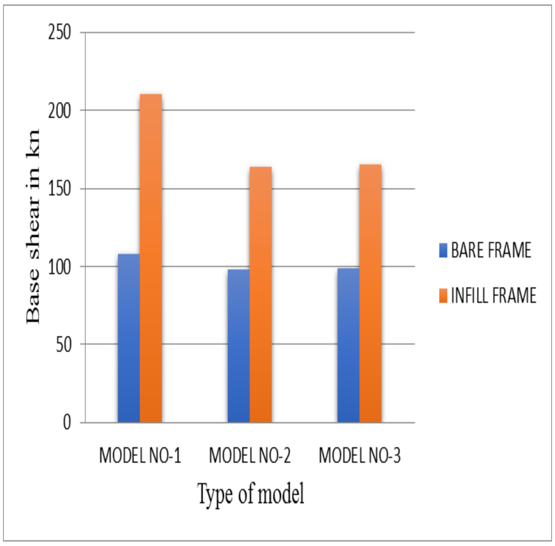

Fig 3. Base shear v/s type of model for G+11 frame for medium soil

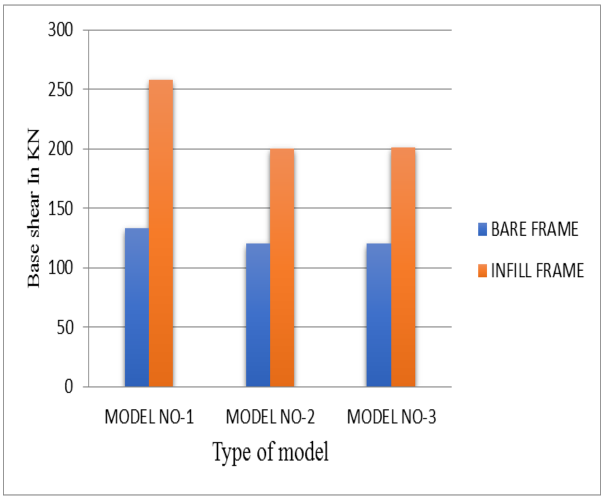

Fig 4. Base shear v/s type of model for G+11 frame for soft soil

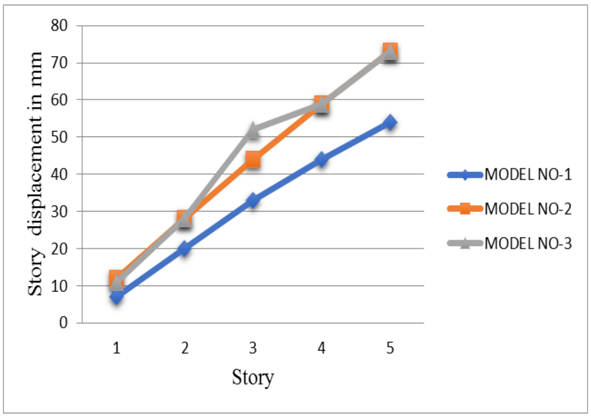

Fig 5. Storey displacement v/s no of bays for G+ 11 bare frame

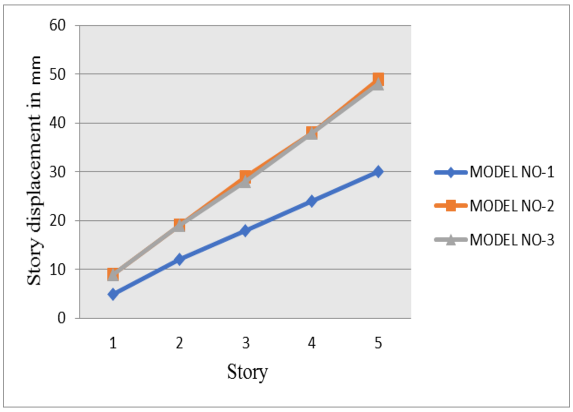

Fig 6. Storey displacement v/s no of bays for G+11 infill frame

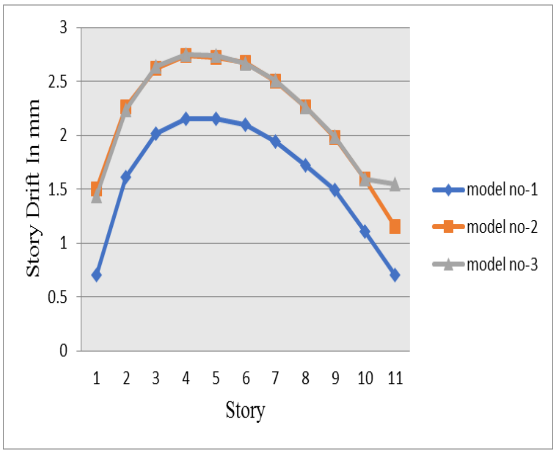

Fig 7. Storey drift v/s no of bays for G+11 bare frame

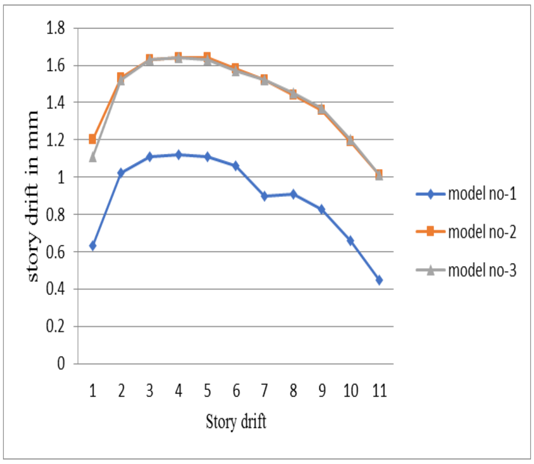

Fig 8. Storey drift v/s no of bays for G+11 infill frame

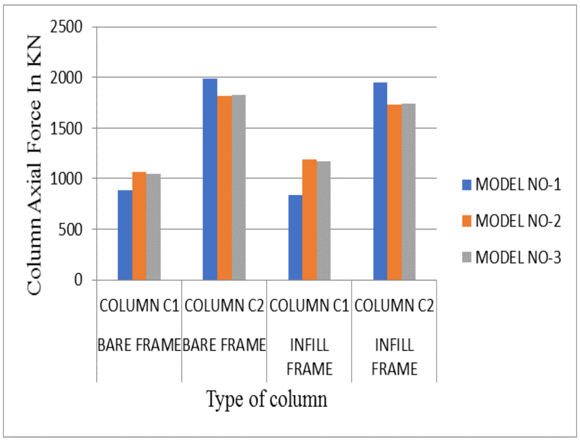

Fig 9. Storey drift v/s no of bays for G+11 infill frame

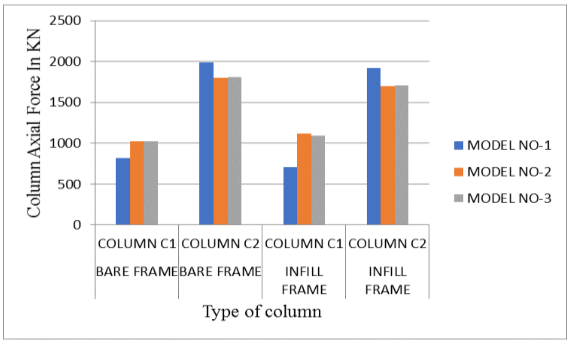

Fig 10. Column axial force v/s type of column for G+11 frame for medium soil

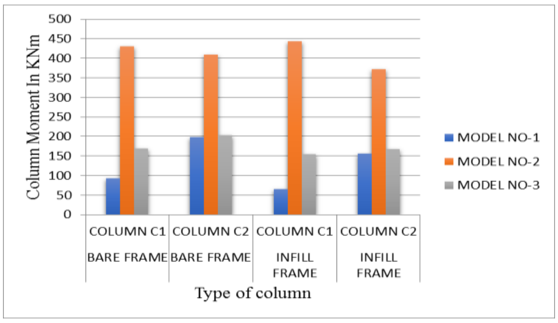

Fig 11. Column moment v/s type of column for G+11 frame for medium soil

Table no – 3						
Comparison of column bending moment 1.5(DL+EQx) in KNm						
Sr No	Type of Soil	Type of Model	bare frame		infill frame	
			Column C1	Column C2	Column C1	Column C2
1	Medium Soil	Model no-1	93(S)	199(S)	65(S)	156(S)
2		Model no-2	430(S)	410(S)	443(S)	372(S)
3		Model no-3	169(H)	204(S)	154(S)	168(S)
4	Soft Soil	Model no-1	101(S)	233(S)	65(S)	184(S)
5		Model no-2	432(S)	442(S)	523(S)	385(S)
6		Model no-3	210(S)	229(S)	209(S)	186(S)

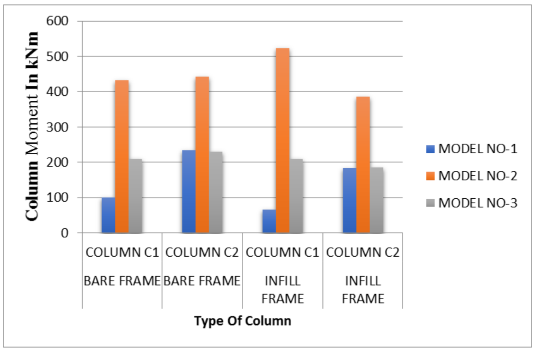

Fig 12. Column moment v/s type of column for G+11 frame for soft soil

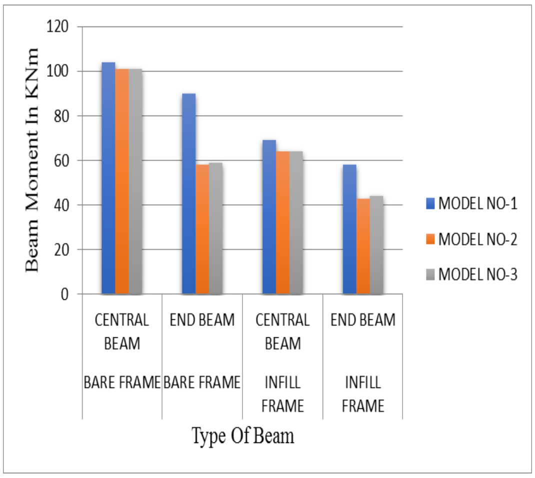

Fig 13. Beam moment v/s type of beam for G+11 frame for medium soil

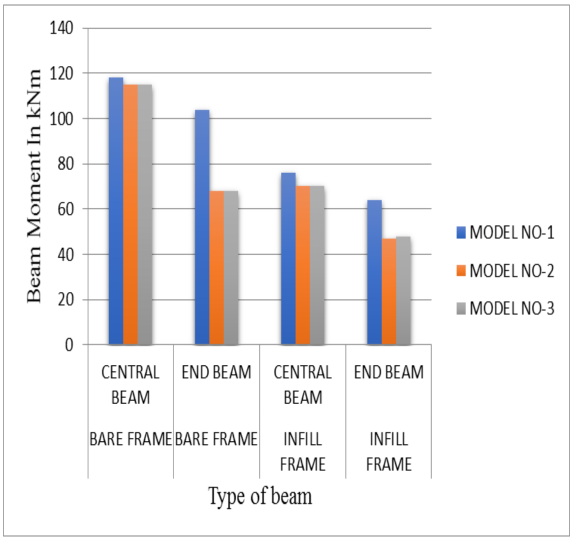

Fig 14. Beam moment v/s type of beam for G+11 frame for soft soil

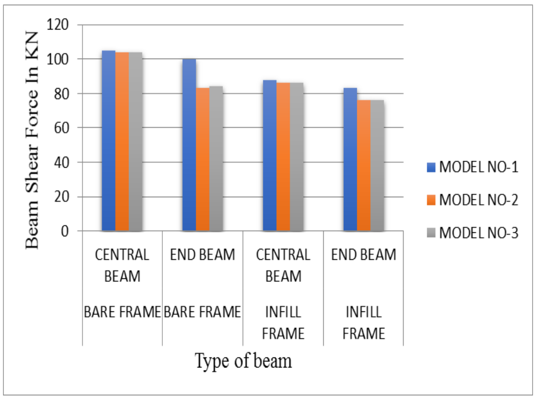

Fig 15. Beam shear force v/s type of beam for G+11 frame for medium soil

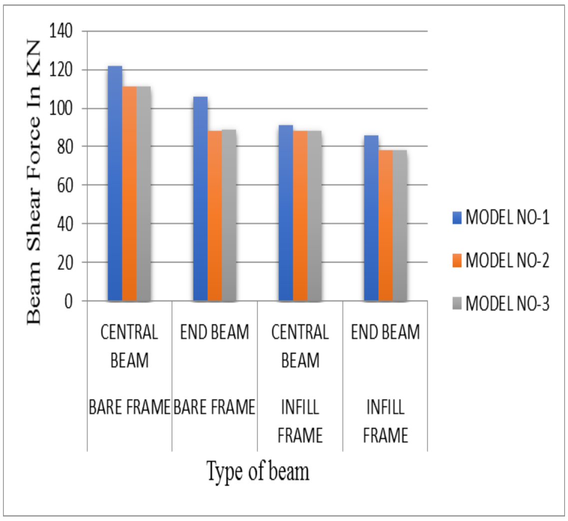

Fig 16. Beam shear force v/s type of beam for G+11 frame for soft soil

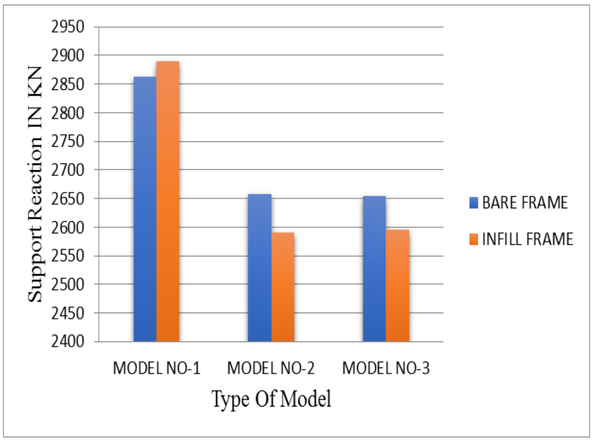

Fig 17. Support reaction v/s type of model for G+11 frame for medium soil

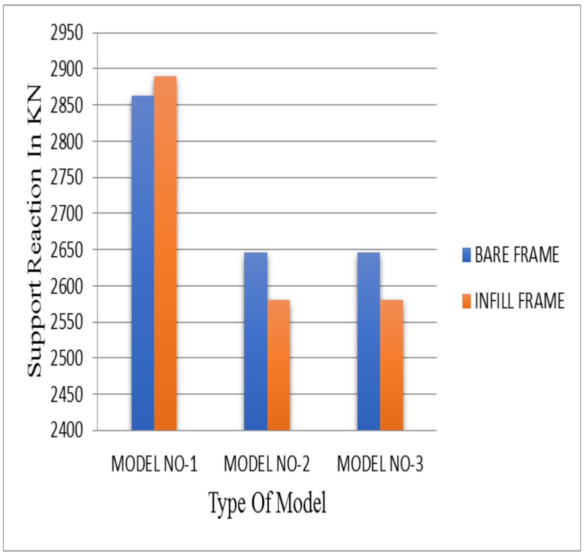

Fig 18. Support reaction v/s type of model for G+11 frame for soft soil

III. OBSERVATION

1. Natural period of the frame increases for flexible base as compared to fixed base but by the introduction of strap beam at the level of footing natural period reduces.
2. Story displacement is increases for flexible base as compared to fixed base but by the introduction of strap beam at the level of footing Story displacement reduces.
3. Column Axial forces at central column are less for fixed base as compared to flexible base, but for end column also the same effect as per central column.
4. Column moment is increases tremendously for flexible base as compared to fixed base but by the introduction of strap beam at the level of footing and shear wall Column moment reduces.
5. Beam moment is again more for fixed base as compared to flexible base.
6. Beam shear forces are again more for fixed base as compared to flexible base.
7. Support reactions are more for fixed base as compared to flexible base and flexible base with strap beam.

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