A Review on “Soil - Structure Interaction of Multistorey R.C.C. Frames”

1Mrs. Gitadevi B. Bhaskar1, Mr. Mayank Banwale2
1Assistant Professor, Department of Civil Engineering, GHRAET, Nagpur, Maharashtra, India
2M-Tech Student (SE), Department of Civil Engineering, GHRAET, Nagpur, Maharashtra, India

Abstract: Comprehensive experimental and analytical studies have been carried out to understand the behaviour of existing frame buildings constructed before the introduction of seismic design codes in different aspects of the response have been done assuming a fixed-base structure while ignoring the flexibility of soil and foundation. In this paper, the interaction between the super-structure and sub-structure is analysed by modelling the soil as simple as possible to capture the overall response of the system. As new analytical hysteretic rules and more advanced tools of analysis have been developed in recent years. The analysis can lead to reduction in the structural response and damage consequences in joints and infills.

Keywords- Soil structure interaction, Linear analysis, Shear wall, Soft soil.

I. Introduction:

A common design practice for dynamic loading assumes the building to be fixed at their bases. In reality the supporting soil medium allows movement to some extent due to its property to deform. This may decrease the overall stiffness of the structural system and hence may increase the natural periods of the system, such influence of partial fixity of structures at foundation level due to soil flexibility intern alters the response. On the other hand, the extent of fixity offered by soil at the base of the structure depends on the load transferred from the structure to the soil as the same decides the type and size of foundation to be provided. Such an interdependent behavior of soil and structure regulating the overall response is referred to as soil structure interaction. This effect of soil flexibility is to be accounted through consideration of springs of specified stiffness. Thus the change in natural period due to effect of soil structure interaction may be an important issue from the viewpoint of design considerations. Also it is usual practice to treat the brick infill as a non-structural element and therefore all the lateral loads are assumed to be resisted by the frame, but performance of buildings in the recent earthquakes (e.g: 1985 Mexico City earthquake, 2001 Bhuj earthquake) clearly illustrates that the presence of infill wall has significant structural implication. Therefore, the structural contribution of infill wall cannot simply be neglected particularly in regions of moderate and high seismicity where the frame infill interaction may cause substantial increase in both stiffness and strength. A review of analysis and design provisions related to masonry infill RC frames in seismic design codes of different countries show that only a few codes have considered the effect of infill in analysis and design of masonry in filled RC frames. On the other hand, the stiffness and strength of in filled frames with openings are not taken care of by most of the codes. Hence the behavior of in filled frames with opening needs to be studied extensively in order to develop a rational approach or guidelines for design. In the last three decades, the effect of SSI on earthquake response of structures has attracted an intensive interest among researchers and engineers.
Figure 1 Plan and Elevation of Buildings
II. Literature Review:

Badry, P. and Satyam, N. (2016) Seismic damage surveys and analyses conducted on modes of failure of structures during past earthquakes observed that the asymmetrical buildings show the most vulnerable effect throughout the course of failures. Thus, all asymmetrical buildings significantly fail during the shaking events and it is really needed to focus on the accurate analysis of the building, including all possible accuracy in the analysis. Apart from superstructure geometry, the soil behavior during earthquake shaking plays a pivotal role in the building collapse. Fixed base analysis where the soil is considered to be infinitely rigid cannot simulate the actual scenario of wave propagation during earthquakes and wave transfer mechanism in the superstructure.

Lu Y., et al. (2016) A comprehensive parametric study has been carried out to investigate the seismic performance of multistory shear buildings considering soil–structure interaction (SSI). More than 40,000 SDOF and MDOF models are designed based on different lateral seismic load patterns and target ductility demands to represent a wide range of building structures constructed on shallow foundations. The cone model was adopted to simulate the dynamic behaviour of an elastic homogeneous soil half-space. 1, 5, 10, 15 and 20-storey SSI systems are subjected to three sets of synthetic spectrum-compatible earthquakes corresponding to different soil classes, and the effects of soil stiffness, design lateral load pattern, fundamental period, number of storeys, structure slenderness ratio and site condition are investigated.

Mitropoulou C.C., et al. (2016) 3D reinforced concrete (RC) and steel building structures have been considered for studying the effect of soil–structure interaction modeling on the structural fragility assessment of such structures. In particular, three foundation models were considered: fixed model where soil–structure interaction is neglected, spring model with single-node Winkler springs and pile foundation model where soil–structure interaction is simulated using beam and quadrilateral finite elements for the pile and soil numerical simulation, respectively. For the assessment of the structural performance and the influence of the various soil–structure interaction numerical simulation models, fragility analysis is applied by considering four limit states.

Shanmugam et al. (2015) The effect of soil-structure interaction on a four storeyed, two bay frame resting on pile and embedded in the cohesive soil was examined. For the purpose of the analysis, simplified idealizations made in the theory of finite elements were used. The slab provided for all storeys were idealized as three dimensional four nodded shell elements. Beams and columns of the superstructure frame are idealized as three dimensional two nodded beam elements. Pile of the sub-structure is idealized as three dimensional two nodded beam elements. The finite element based software program ANSYS was used for the purpose of analysis.

Karapetrou S.T., et al. (2015) Traditionally fragility curves of reinforced concrete (RC) buildings are estimated with the assumption of fixed base structures. The objective of the search was to study whether soil-structure interaction (SSI) and site effects may affect the seismic performance and vulnerability of reinforced concrete moment resisting frame (MRF) buildings and consequently modify the fragility curves. SSI was modeled applying the direct one step approach considering either linear elastic or nonlinear soil behavior while site effects were inherently accounted for to further examine the contribution of site and SSI effects, a two-step uncoupled approach was also applied, which takes into account site effects on the response of the fixed base structure, but neglects SSI effects.
III. Conclusions:

1. The study shows that consideration of different parameter such as soil structure interaction, and location of walls influences time period.
2. Analysis of displacement and base shear of building frame considerably. Therefore it is important to consider to all these parameters in the analysis of structures.
3. Shear walls located in the central part of the multistoried building gives lesser displacement and more base shear compared to other locations.

IV. Acknowledgement

I would like to show my admiration and gratitude to all the concerns who helped and facilitated me whenever I required, during this paper completion, particularly Mrs Gitadevi Bhaskar, my guide for her unconditional support.

REFERENCE
