Parametric Study on The Performance of Raft Foundation With Interaction of Flexible Base and Fixed Base Infill Frame Model Using Staad Pro. Software

Rahul Kushwaha
Department of Civil Engineering,
Sagar Institute Of Reaearch
Technology and Science ,bhopal,
India,
rkrahul.kushwaha@yahoo.com

Sachin Nagayach
Department of Civil Engineering,
Sagar Institute Of Reaearch
Technology and Science ,bhopal,
India,
Sachinnagyach@gmail.com

Ruby Singh
Department of Civil Engineering,
Sagar Institute Of Reaearch
Technology and Science ,bhopal,
India,
rsingh.ruby.sing@gmail.com

Abstract—In present work the effect of soil-structure interaction is studied on infilled R.C. building frame resting on raft foundation.A G+7 4 bay by 4 bay infill R.C. residential building supportedon soft soil and situated in Zone III as per IS:1893 (Part 1)-2002is analyzed using STAAD Pro software.The masonry infill wall is modelled by using an equivalentdiagonal strut element. The width of equivalent diagonal strut iscalculated by Hendry's approach.Analysis is carried out on fixed base infill frame and flexiblebase infill frame models.The results obtained from the analysis of flexible base infillframe are compared in terms of story shear, floor displacement,story drift, time period and settlement of raft with fixed baseinfill frame to evaluate the effect of soil structure interaction.

The soil structure interaction causes non uniform settlement ofraft foundation which in turn modifies the forces anddisplacements in structure-foundation-soil system.The results obtained from the analysis indicate that story shear,floor displacement, story drift and time period considerablyincreases in flexible base infill frame system compared to fixedbase infill frame system.The deformation pattern of raft shows non uniform settlement ofraft foundation..

Keywords—strut element, soil structure, storey shear, floor displacement.

I. INTRODUCTION

In conventional approach of analysis and design of structure, the structural engineer consider the base of R.C. building as fixed and avoid the compressible nature of soil. But in reality it has been seen that the supporting soil system allow the deformation up to some extent due to its compressibility. This compressible nature of soil causes decrease in the overall lateral stiffness of R.C. building. This may increase the natural time periods of the structural system. Such increase in lateral natural period, considerably effect the seismic behaviour of R.C. building frame resting over raft foundation. In general the effect of masonry infill wall is ignored in design and analysis of R.C. structures which may cause unsafe design. In analysis if the effect of infill is taken then the weight of the R.C. building got increased. The earthquake movement generates inertial forces and these forces are proportional to the weight of the structure, although, infill will increase the strength and stiffness of the R.C. building and reduces natural period. Hence for safe design, the effect of infill masonry wall should be considered.

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Hence for safe design, the effect of infill masonry wall should be considered.

R.C. structures with masonry work infill wall have been broadly used for commercial, industrial and residential development in various seismic zones.

Masonry infill boards generally consist of concrete blocks or bricks used to fill the space between R.C. frame.

The brick work infill boards are most of the time not considered in the analysis and design of structure and regarded as non-structural element.

But some investigation has proved that practically presence of infill walls significantly affects the seismic reaction of a R.C. building frame.

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The earthquake movement generates inertial forces and magnitude of these forces increases with the weight of the building, although, infill will increase the strength and stiffness of the R.C. building and reduces natural period.

Thus for safe design, the impact of infill masonry wall should be considered.

II. EASE OF USE

Infills are satisfactorily isolated from the RC building casing to such an extent that they don't interfere with the casing under lateral deformations. The whole lateral force on the building is conveyed by the exposed R.C. building frame only.

Infills are fabricated integrally with the R.C. building frame, yet considered as nonstructural components. The whole lateral force on the building is conveyed by the exposed R.C. building frame only. This is the most widely recognized design approach utilized in the developing countries.

Infills are fabricated integrally with the R.C. building frame, and considered as structural components. The stiffness offered by brick work infill wall is considered in the analysis and design of the R.C. building. The forces from this investigation are utilized in the design of R.C. building frame elements and joints.

The concept of structure-soil-structure interaction by conducting a literature review in the area of study.

They done three case studies on dynamic structure-soil-structure interaction analysis that considers adjacent tall buildings modeled

Initially analysed considered building frame by convention approach i.e. taling fixed base condition and support reactions were computed for different load combinations and the sizes of foundation for different supports were computed by using STAAD FOUNDATION software.

Then they replaced the fixed support by a spring of equivalent foundation stiffness to perform flexible base analysis and calculated the maximum total settlement and differential settlement between footings.

Based on results, they concluded that soil compressibility causes settlements of foundations, alter the support reactions, redistribution of forces in beam and column and also affects the requirement of reinforcement for design.

By computer programs as a reference and concluded that the taller building increased the response of a shorter building adjacent to it and a shorter building decreased the response of a taller adjacent building when the distance between the adjacent buildings are varied and the base shear in taller buildings is higher as compared to shorter adjacent building.

They also observed that the effects of structure-soil-structure increases time period, base shear and displacement when the distance between adjacent buildings are varied.Very few studies have been done to see the effect of wind on soil structure system.

The reduction of diagonal compressive stress of the brick masonry wall plays an important role especially for increase in inter-storey drift in non-engineered building structures. The Young's modulus is also an important parameter in buildings.

The results show that infill wall increases the stiffness. The increase in the opening area will decrease on the lateral stiffness of infilled frame.Infill wall enhance the horizontal stiffness and strengthen the frame. If the frame is rigid which shows about 70% decrease in the lateral displacement values obtained.Reduction in displacement capacity is proportional to the building height. The effect of parameters as opening size, first soft store and wall thickness fades as the building height increases.The building height parameter is found to affect the results of masonry infilled buildings in a manner that the percentage increase in stiffness due to the contribution of moment of inertia of walls is inversely proportional to the building height.In the present work, an analysis is performed to evaluate the effect of soil-structure interaction under gravity and seismic loading on infilled building frame with raft foundation resting on soft soil.

In conventional analysis, generally the effect of soil compressibility is not considered however this compressible nature of soil causes settlement of structure, reduction in stiffness of structure and variation in structural member forces. To assess the effect of the infill wall on the analysis results the procedures given by Hendry is considered, and comparison between fixed base and flexible base R.C. building frame model made.This is the most widely recognized design approach utilized in the developing countries.Infills are fabricated integrally with the R.C. building frame, and considered as structural components. The stiffness offered by brick work infill wall is considered in the analysis and design of the R.C. building. The forces from this investigation are utilized in the design of R.C. building frame elements and joints. The concept of structure-soil-structureinteraction by conducting a literature review in the area of study. They done three case studies on dynamic structure-soil-structure interaction analysis that considers adjacent tall buildings modeled.The finite element method (FEM) is a process of discretizing the structural components into a smaller element, keep up the constitutive laws of material, boundary conditions, in order to obtain results with higher accuracy. Though, this method is mostly limited to small structures as it requires high computation equipment besides taking somewhat longer time. The application of a finite element method (FEM) to assess the effects of cracking and separation between the frame and infill of an infilled frame structure was studied by Haddad (1991). The lumped weight due to dead loads is 12 kN/m2 on floors and 10 kN/m2 on the roof. The floors are to cater for a live load of 4 kN/m2 on floors and 1.5 kN/m2 on the roof. Determine design seismic load on the structure as per new code

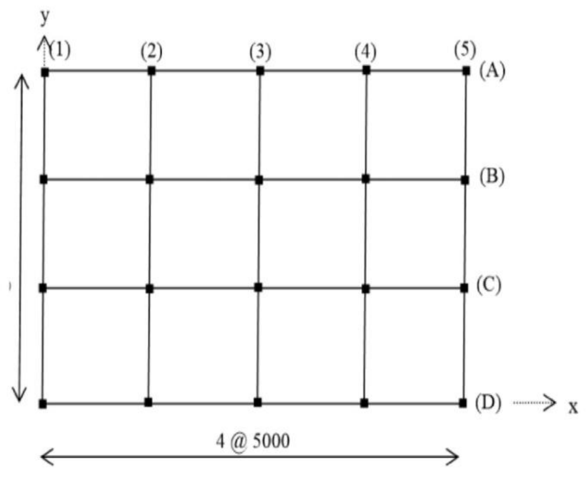


Fig: 1 frame model

The problems of 1st order static analysis, 2nd order p-delta analysis, geometric non-linear analysis, buckling analysis, dynamic analysis, response spectrum etc. can be performed easily.

As a result of analysis of multi-storey building frame the node settlement, support reaction, member forces, stresses etc. can be easily evaluated.

In present work super structure is analysed and designed by using STAAD.pro software and foundation size is calculated by STAAD foundation software.The increase in displacement for maximum case is found 6.99 times of fixed base infill frame.

The Table 17 indicates that the story drift is increasing inflexible base infill frames compare to fixed base infill frame.

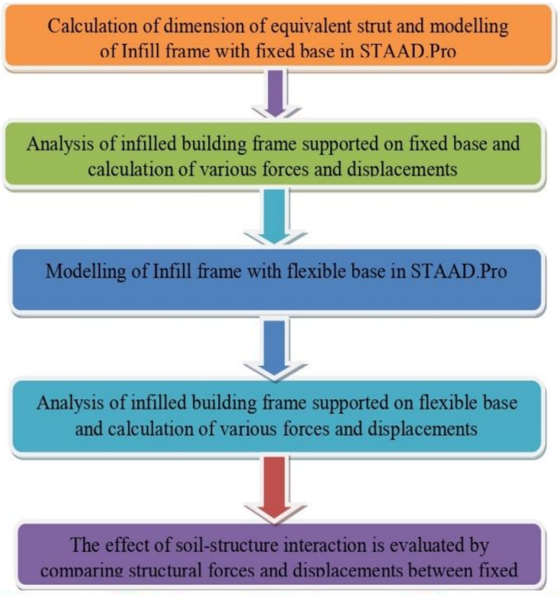
This increase in story drift is found to be 6 times compared to fixed base infill frame.

The Table 17 indicates that the time period for flexible base infill frame is considerably increases compare to fixed base infill frame.

The time period increase is found 1.7 time of fixed base infill frame model.

This ratio shows that considering the Soil structure interaction in dynamic analysis of RC building frame the time period is increased.

Hence ignoring effect of SSI may leads to Seismic vulnerability



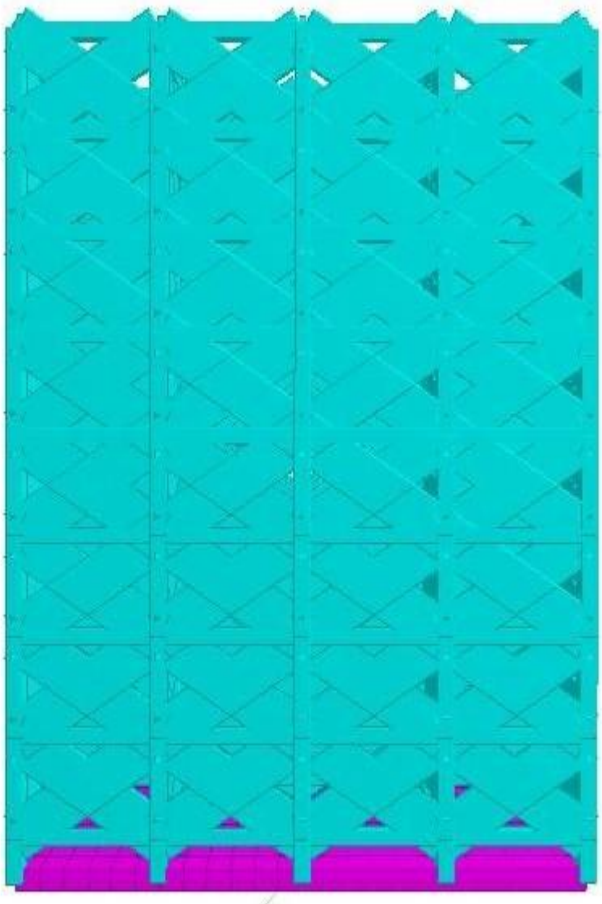


Fig. 2 3D frames With soil intearction

a) Positioning Figures and Tables:

Table 1: Time period for fixed base and flexible base

mode	Time period		
	Fixed base	***Flexible base***	***ratio***
1	0.55	0.94	0.585

III. CONCLUSIONS

1. To evaluate the effect of soil structure interaction on Story shear.
2. To evaluate the effect of soil structure interaction on Floor displacement.
3. To evaluate the effect of soil structure interaction on Story drift.
4. To evaluate the effect of soil structure interaction on Time period
5. To observe the variation in Support settlement pattern between fixed base and flexible base infilled building frame model.STAAD stands for Structural analysis and design computer Program

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