Nat. Volatiles & Essent. Oils, 2021; 8(5): 4607 – 4611

NVEO
Natural Volatiles & Essential Oils

A Study On Response Of Rcc Space-Framedstructure Under Coupled Effects Of Soft Soils

N Jitendra Babu[1], B Kameswara Rao[2]C Ravi Kumar Reddy[3]

[1]Research Scholar, [2]Professor, [3]Professor&Head of Department
[1&2] Department of Civil Engineering, Koneru Lakshmaiah Education Foundation, Guntur, Andhra Pradesh, India-522502.
[3]Civil Engineering, KallamHaranadhareddy Institute of Technology, Guntur, Andhra Pradesh, India-522019.

Abstract:
Designing of RCC frames should be considered for not only gravitational and lateral effects but also for coupled effects of soil on foundation which is referred as Soil-Structure Interaction. Deformation caused by internal strcture resisit the various stress is considered while designing the structure. Mode shapes conider as the performance of structure. This if interaction effects were considered in determining the mode shapes, the final total deformation can be used to determine efficient total deformation. In this research, mode shapes and response spectrum were studied for RCC frame with isolated footings considering interaction between footing and soil and neglecting the effects of soil interaction.
KeyWords:**Soil Structure Interaction, Modal Analysis, Response Spectrum.**

I.INTRODUCTION

As India lies on The Indian Plate which is even though a minor tectonic plate which is been straddling the eastern hemisphere, this also causes an major effect to the structures at the time of seismic wave targets which causes cyclic stresses between foundation and soil mass [1]. This is accountable for considering the various footing, foundation size studies in analysing the structure. The consequences and deformations and oscillations caused in ground shows a high impact on the super structure response. This is the basic point in which engineers should consider in designing the structure considering soil mass stress effects on the structure [2]. In this paper an attempt was made to find the total deformation of structure under modal analysis. A Bay frame spanning in three dimensional axis was considered with isolated footings. Modal analysis was conducted considering and neglecting the soil structure interaction effects [3].

II.LITERATURE REVIEW

P Ravi Prakash et al. (2017) has derived force-deformation relations from Euler-Bernoulli beam theory on a frame with non-linear thermo-mechanical analysis subjected to fire [4, 5]. The results were expressed in terms of temperature-dependant stability and bowing functions.Structural members were discretized with 2D mesh for thermal analysis and for structural analysis line elements were use dbase don structural stiffness.This analysis has resulted in efficient predicting the response of RCC frames [6].

Umer Farooq et al. (2015) has done research using ANSYS on RCC Frame using Fine Element Analysis and the results were compared with experimental test data for RC beams [7, 8]. From the study it was concluded that FEA gives efficient results in analysing the frames. Algorithms developed with FEA were observed to be in line with experimental data.

Dr. G Ravi et al. (2015) has analysed an RCC frame with ten storeys for response of the frame. Flexibility effect and Non-linearity of the soil is accounted through Winkler's approach in multilinear isotropic model (MISO). Soil Structure interaction analysis has resulted in stress, displacement, base shear, storey drift, period and frequency of the structure which are very closer to the original structure. Those provided an analytic part neglecting soil mass effect [9].

Prof.P.A.Sangaveet al. (2015) has done SSI analysis for a 13 storey RC Space frame shear wall frame resting on soft soil under the effect of seismic loading. Transient analysis was done for the total system using seismic coefficient method. Response for the structure with SSI effect was determined from the analysis and as compare to the conventional results [10, 11].

I Bhuvana Rekha, N Lingeshwaran, Sunny Agarwaland Sateesh Madavarapu (2021) has studied the effect of soil structure interaction for an RCC frame with plinth beam supported on pile group embedded in cohesionless soil. Conventional design and nonlinear finite element analysis was done for the frame and was compared with conventional analysis results. Factors such as shears, moments, drifts and rotations were drawn for comparision study [12]. From the results and comparision statement it was concluded that decrease in rigidity of plinth beam reduces the shear force and bending moment of frame. Also it was concluded that soil structure interaction should be considered in designing of frames [13].

Ravikumar C Reddy and Gunneswara T D Rao(2012) has studied about the effect of soil interaction on drift and rotation of column footing junction and moments and shears of the frame. An RCC frame with plinth beam supported on pile footings were considered for this test and vertical loads were assigned in static condition [14, 15]. Conventional analysis and Finite element analysis was done and compared the results were compared. For Finite element analysis, nonlinear vertical springs were assigned along the pile depth and at the tip of pile. ι-z curves and p-y curves were drawn for the pile group. From the results it was concluded that bending moments and shear forces were reduced in finite element analysis compared to conventional analysis.

III.METHODOLOGY

Mathematical Modelling

Soil below the structure is assumes as homogenous, isotropic and elastic medium. Elastic modulus, poisons ratio and density of soil were considered ass inputs of soil medium. The structure was assumed to be RCC frame with Elastic Modulus, Poissons Ratio, Density of concrete and ultimate compressive strength of concrete as inputs. Size of soil was considered and 30m X 30m in plan with 7 m depth [16].Contact region was developed by manually selecting the line bodies of frame and solid body of soil. Meshing was done to the whole stricture considering the mesh element size to be 0.1 m. Loads were considered as gravity and modal inputs considering modal analysis for all the fixed supports at base. Supports at midlevel i.e., beam column joints were not considered for modal analysis to avoid discrepencies in mode shape generation. Relative displacement was considered as response input for the seismic analysis. The following are the input data for analytical work.

Table:1 Input Data for Frame and Soil Mass

Structure	Description	Input Data
RCC Frame	Floors	G+4
	Bays: X-direction	3
	Bays: Y-direction	4
	Slab to Slab distance	3.6 m
	Bay width	X=4 m; Y=4 m

	Slab Thickness	0.15 m
	Elastic Modulus E_c	25 GPa
	Poissons Ratio of concrete μ_c	0.15
Soil Mass	Elastic Modulus E_{soil}	0.027 GPA
	Poissons Ratio of soil μ_c	0.3

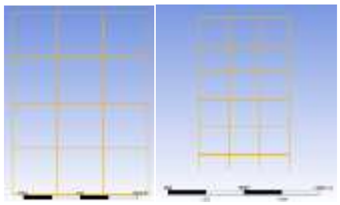


Fig.1 Plan and elevation of the considered frame.

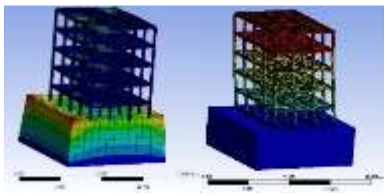


Fig.2 Total Deformation for Static analysis and Modal Analysis

IV. RESULTS AND DISCUSSIONS

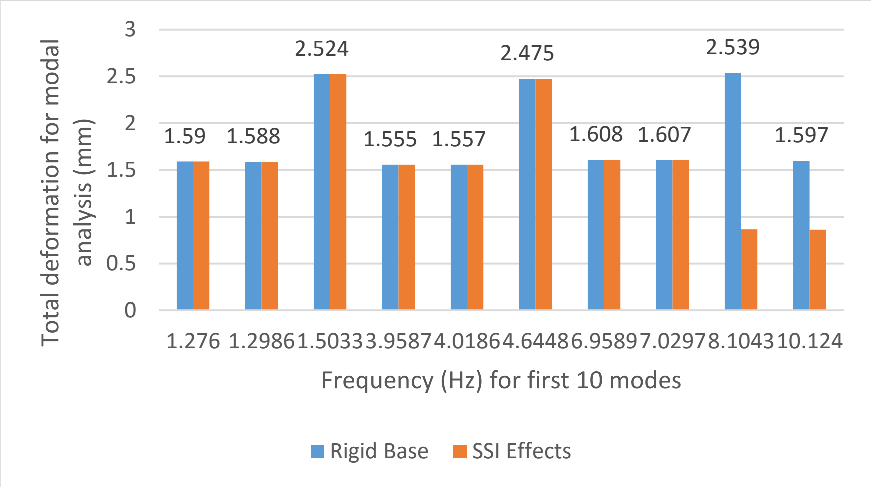
The following is the analytical results for RCC Frame with isolated footings considered and rigid base and resting on elastic clayey soil mass. Frame Characteristics such as Axial Force, Static Total Deformation, Total Shear Force, Total Bending Moment, Modal Total Deformation were determined for the frame and compared with rigid base condition.

The following are analytical results showing the comparison of various parameters between both the conditions.

Table:2 Comparison of Results for RCC Frame with Rigid Base and Frame with SSI Effects.

Description	**Frame with Rigid Base**	**Frame Resting on Soil Mass**
Axial Force	2.812 kN	631.7 kN
Total Shear Force	21.156 kN	21.075 kN
Total Bending Moment	22.744 kN	22.57 kN
Static Total Deformation	1.893 e^{-003} m	5.228e^{-003} m
Direct Stress	19476 Pa	4.641 e^{006} Pa
Min Combined Stress	7494 Pa	4.324 e^{006} Pa
Max. Combined Stress	1.585 e^{006} Pa	4.641 e^{006} Pa

From the above results, a very large difference in Direct stresses, Combined Stress were observed. It can be understood that soil mass on which frame is rested shows an upward pressure which in turn results in development of stresses between foundation and soil medium. Where as a very low variation is observed in Shear force and Bending Moment Criteria. This might be due to that SF and BM's were developed in the frame itself.



From the above data it was observed that for mode-8, for frequency 7.0297 total deformation for rigid base frame was 1.607 mm and for frame resting on soil mass was 1.606 mm.

For Mode-9, for frequency 8.1043 total deformation for rigid base frame was 2.539 mm and for frame resting on soil mass was 0.865 mm.

For Mode-10, for frequency 10.104 total deformation for rigid base frame was 1.597 mm and for frame resting on soil mass was 0.863 mm.

From Mode-1 to Mode-7, the total deformaitons for both the frames were same as observed.

VII.CONCLUSION

From the studies done on RCC frame with Isolated Footings considering and neglecting Soil-Structure Interaction effects as two cases and comparisions drawn from the results, The following conclusions were made.

1. Soil Structure interaction definitely shows an impact on response characteristics of RCC frame when compared to the conventional analysis.
2. Normal stresses were observed to be less in SSI effects when compared to conventional analysis might be due to the development of coupling moments at the soil-foundation junction.
3. The total deformation due to SSI effects were large compared to conventional analysis.
4. Axial force in the frame due to SSI effect is very large compared to conventional analysis due to the upward pressure developed from soil mass developing cyclic stresses between soil-foundation-structure.

REFERENCES

1. Edward Tsudik. (2013), Analysis of Structures on Elastic Foundation, J Ross Publishing.

2. Selva Durai, A.P.S. (1979), Elastic analysis of Soil Foundation Interaction, Elsevier Scientific Publishing Company.
3. Wolf, J.P. (1985), Dynamic Soil Structure Interaction, Prentice Hall, Englewood Cliffs, N.J.
4. IS: 1893 (Part 1): 2002, Criteria of Earthquake Resistant Design of Structures – General Provisions and Buildings, Fifth Revision, BIS New Delhi.
5. Dutta and Roy "A Critical Review on Idealization &Modeling For Interaction Among Soil-Foundation-Structure System"
   Computer & Structure 80,1579-1594, 2002.
6. Halkude, S.A., Kalyanshetti, M.G. and Barelikar, S.M. (2014), Seismic Response of R.C. Frames with Raft Footing Considering Soil Structure Interaction, International Journal of Current Engineering and technology.
7. National Building Code of India (1983).
8. Subramanian, N. (2008), Design of Steel Structures, Appendix C, 1396-1400.
9. Pandey, A.D., Prabhat Kumar and Sharad Sharma. (2011), Seismic Soil-Structure Interaction of Buildings on Hill Slopes, International Journal of Civil and Structural Engineering, Vol. 2, 544-555.
10. IS 456:2000. Plain and Reinforced Concrete- Code of Practice, BIS New Delhi.
11. J. Noorzaei, M.N. Viladkar, and P.N. Godbole, Nonlinear soil-structure interaction in plane frames, Eng. Comput., 11, 1994, 303 316.
12. Singh, B Akash; Lingeshwaran, N;Seismic Study Of G+ 5 RC Framed Structure Supported On Raft Foundation, International Journal of Civil Engineering and Technology, Vol8, pp. 467-476, 2017.
13. Lingeshwaran, N; Poluraju, P; Experimental study on seismic performance of bed joint reinforced solid brick masonry walls, Journal of Environmental Protection and Ecology, Vol 21, pp. 830-839, 2020, SCIBULCOM LTD PO BOX 249, 1113 SOFIA, BULGARIA.
14. Sarath, Chintakrindi V Kanaka; Kumar, K Ashok; Lingeshwaran, N; VigneshKannan, S; Pratheba, S;Study on analysis and design of a multi-storey building with a single column using STAAD. Pro, Materials Today: Proceedings, Vol 33, pp. 728-731, 2020, Elsevier.
15. Rekha, I Bhuvana; Lingeshwaran, N; Agarwal, Sunny; Madavarapu, Sateesh; Seismic soil structure interaction of reinforced concrete frame building supported on foundations, IOP Conference Series: Materials Science and Engineering, Vol 1136, pp. 12005, 2021, IOP Publishing.
16. Chowdary, M Satya Sai Kiran; Kumar, Y Himath; Lingeshwaran, N;Seismic analysis of tall concrete and steel diagrid structure using response spectrum and time history method in e-tabs, IOP Conference Series: Materials Science and Engineering, Vol 1136, pp. 12005, 2021, IOP Publishing.
17. Rajaram.A., Dr.S.Palaniswami . Malicious Node Detection System for Mobile Ad hoc Networks. (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 1 (2) , 2010, 77-85
18. Dr.S.Palaniswami, Ayyasamy Rajaram. An Enhanced Distributed Certificate Authority Scheme for Authentication in Mobile Ad hoc Networks. The International Arab Journal of Information Technology (IAJIT).vol.9 (3),291-298.