

Review Article

Behavior of Soil Condition under Theoretical and Practical Approach: A State of the Art Review

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Received 15 Oct 2021, Accepted 10 Nov 2021, Available online 15 Nov 2021, Vol.11, No.6 (Nov/Dec 2021)

Abstract

This article presents a brief review on soil condition of different location & strata with respect to the theoretical and practical aspect. It is found that the properties of the soil are important aspect to role part in the design aspect of foundation & superstructure constructed above on it. The below substructure part analysis such as bore hole, SSI, SBC & other effects. The review concluded that the soil profile is found to distinct properties in all aspect such as index properties, colours, strength etc. It also vary with theoretical approach adopted for the calculation so it is important to study and analyse between theoretical and practical approach and co-relation between them.

Keywords: Soil Structure Interaction, Bore Hole, SSI, SBC, Soil Profile, Foundation, Superstructure

1. Introduction

There has been significant progress in the construction of high-rise buildings in the last two decades. A significant number of these buildings have been constructed in the central region such Indore, Bhopal etc and many more are either planned or already under construction. There are several properties of tall buildings that can have a significant impact on the design of the building, including that the weight of the building increases non-linearly as the height increases, and thus the vertical load that can be supported by the foundation can be significant. Parameters vary by location or by different areas of the crust. Soil Bearing Capacity and foundation depth is major concern from them. So, it is required to analysis the buildings structure such that it is satisfy the ground data such, SBC of soil, Depth of foundation, Earthquake zones, wind parameters etc. through it. The fig 1 shown that the super structure rested on the sub structures (foundation and sub soil), so it is necessary to both are taken the load transfer mechanics and with stand against the all the laterals and axial loads.

Ground-structure interaction

The effect of a structure consists of the effect between the soil (ground) and the structure built on it. The process by which the influence of soil affects the movement of the structure and the movement of the soil is called soil-structural influence (SSI).

The order of the soil is divided from the ground to the ground, and the soil to the point where it meets the main rock.

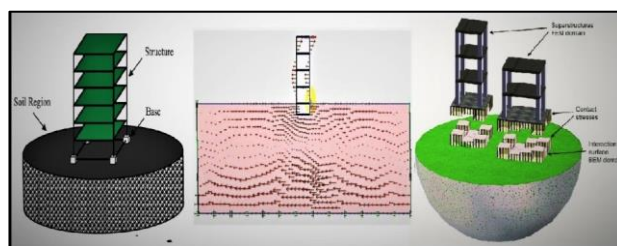


Fig 1: Typical super structure interaction with sub soil and foundation

Analytical Approaches for Soil Structure Interaction

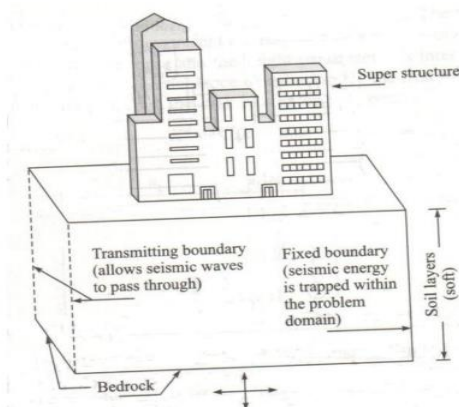


Fig. 2: Typical Soil Structure Interaction phenomenon

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DOI: <https://doi.org/10.14741/ijcet/v.11.6.3>

Two different approaches i.e. The Direct approach The Substructure approaches have been adopted to analyze the problem of soil-building effects and add the effect of soil suitability to the dynamic analysis.

The need for a current scenario is why the behavior of the soil is being investigated under different loads.

2. Review of Literature

For the study of soil parameter and its super and sub base structure, it is required to take the past approach and methodologies based on the same phenomenon, the following articles are studied to get the review for the same are as follows:

Michael P. Crisp, Mark Jaksa & et.al. (2020)

The researcher uses a genetic algorithm to find the most suitable test sites for various pits related to the operation of the pile foundation. The analysis is carried out with single and multi-layered soil. The article was conducted to find out the parameters of a genetic algorithm that leads to high-quality solutions over a period of time. The inspection of the wells, the order of the regular grid, concluded that the optimum site yields good yields in the highest conditions with a 4.2% reduction in construction costs.

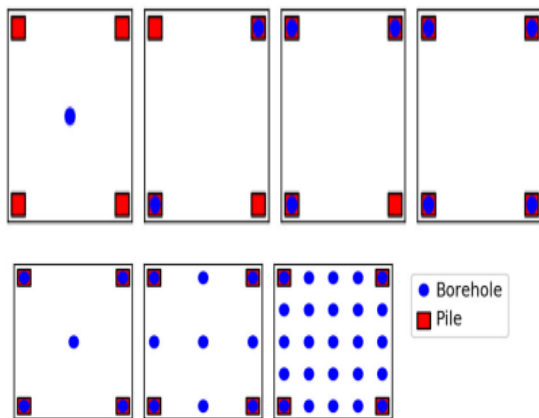


Fig 3: Bore hole and pile arraigments

The various arrangements such that are required to find the optimised no of bole hole and pile for the 40 x 40 m plan of building.

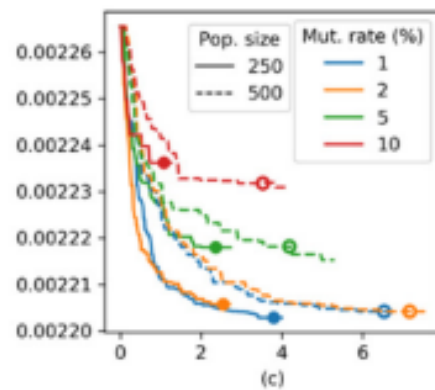
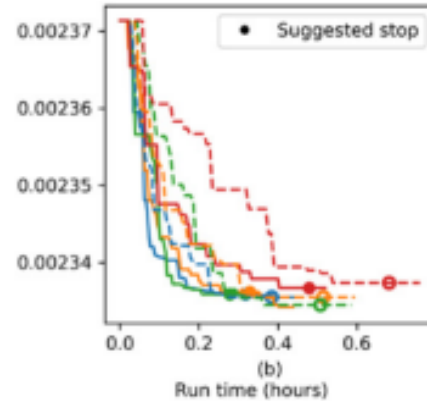
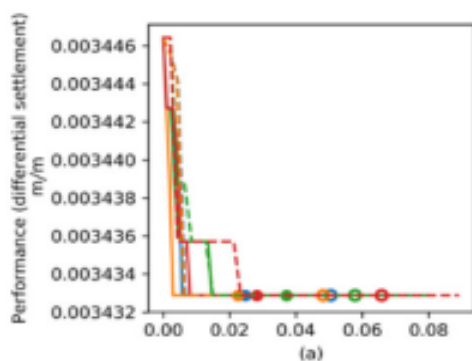


Fig 4: 1, 5, 25 bole hole in a building

Ibrahim Oz, Sevket Murat Senel & et. al. (2020)

The SSI concept introduce for the G+39 Storey High rise for the location of Turkey. The analysis part content the nonlinear models with fixed-base and stiff, moderate and soft soil conditions. The Buildings designed before and after Turkish Earthquake code of 1998 were grouped as old and new buildings, respectively. Different soil conditions classified according to shear wave velocities were reflected by using substructure method. Inelastic deformation demands were obtained by using nonlinear time history analysis and 20 real acceleration records selected from major earthquakes were used. The results have shown that soil-structure interaction, especially in soft soil cases, significantly affects the seismic response of old buildings. The most significant increase in drift demands occurred in first stories and the results corresponding to fixed-base, stiff and moderate cases are closer to each other with respect to soft soil cases. Distribution of results has indicated that effect of soil-structure interaction on the seismic performance of new buildings is limited with respect to old buildings.

Jajoriya M., Vishwakarma A. & et. al. (2020)

The articles modelled the various pile arrangement such That to find optimised pattern under the situation where basic arrangement is no preferable. The use of pile groups on a weak and expansive soil such as clayey soil which have a weaker bearing capacity. The actions

of the heap group, the pattern of the four heaps, were studied. In the study, the distance between the pile groups was taken as $2.5D$ and $3.5D$ is $0.8m$. The diameter of the four pile groups. Various heaps are accepted, such as rectangular, square, and rectangular; diamond 1 and diamond 2. The analysis of the seismic behavior of the various groups of assemblies is carried out by the RSA method of seismic activity. The researcher came to the conclusion that in addition to the square and the rectangle, the diamond pattern could be accepted as an alternative.

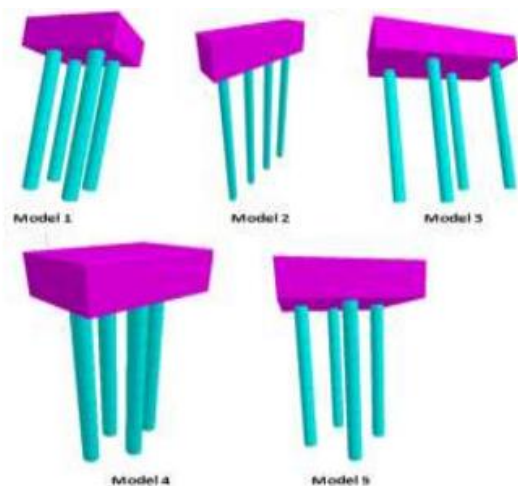


Fig 5: Use of different patterns of pile for medium soil for sub structure

Jajoriya M., Vishwakarma A. & et. al. (2020)

The review articles present the importance of pile group arrangement and its important with respect to bear the axial load on it. The study of review imparts about the Different Variations in Dimensions & Parameters such as diameter, length, Spacing between pile, SBC, Axial load, soil condition, pile arrangements (like Rectangle, Square, Diamond and Staggered etc), spring constant, design of pile cap, pile model analysis etc. The review concluded that pile group arrangement is analysed on before construction is significant use for the group action of piles.

S. Amaresh Babu, Ahmed Zubedi (2019)

The article is focus on base Isolation concept with SSI for various soil strata in place of fixed base consideration. The analysis is carried out by SAP2000 with Fast Nonlinear Analysis (FNA). Total 18 models with G+13 storeys consideration Planned models, which are analyzed as defined models, models that take into account the interaction of the soil structure, and basic isolation models (lead rubber bearings), are analyzed for symmetry and asymmetry. The soil profile considers as the limestone, stiff clay, and loose sand. The results show that for structures located in medium and soft soils, the effects of soil structure are more important than those on hard soil, given the impact of soil

structure, because of the influence of soil structure and non-structural effects. very. The main insulation system is most suitable for hard-to-reach structures. The main shear, floor shifts, and torsion are significantly reduced

Runbahadur Singh, Oshin Victor & et. al. (2019)

The review of past articles on performance of earthquake with absence and presence of shear wall in the structure. The performance based analysis concluded The natural time period of the structure increases when the effect of the soil structure on the main insulated structure is taken into account. For soft and medium-sized soils, the influence of soil structure is predominant. With an increase in the floor volume in the building, the main shear and sliding increase. It can be concluded that the placement of the shear wall in sufficient places is more important in the case of the main shear and relocation. Changing the position of the shear wall will affect the tensile strength, so the wall must be in the correct position. If the dimensions of the shear wall are large, most of the horizontal forces are obtained with the shear wall.

S. M. Hussain, S. K. Tengli (2018)

The article based on the Torsional Effects of Irregular Buildings under Seismic Loads. For that a 14 storey buildings with ETABS analysis by RSA is carried out. Since torsion is the most critical factor leading to major damage or complete collapse of buildings therefore, it is very essential that irregular buildings should be carefully analysed for torsion and the designer should try avoid excess irregularities especially in the multi storied buildings. The results concluded that plan irregularities in structures have significant impact on the seismic response of the structure, especially in terms of displacement and base shear.

D. V. Karandikar (2018)

Quality control in the role of boring in a growing urban environment. Difficulties in indoor pile-up operations, keeping pile-up during boredom, cleaning the pile end zone, determining the length of the socket in deep rocks, non-compliance with the non-compliance criteria, etc. crowded for basement excavations, making the labyrinth even more difficult as they enter the adjacent area. Micro-assemblies are also widely used, despite restrictions on installation and load-carrying capacity / Articles It has been concluded that high-rise buildings are more common. In urban areas, land plots are getting closer to building capacity, requiring more reliable accumulation power. Defective piles just can't be tolerated. The need for higher quality control in the process is becoming a necessity.

Table 1: PPR (Kalbadevi Site) values (Ref. D. V. Karandikar (2018))

Depth	Strata	Penetration (cm/min)	PPR (KN/m/sq. m/cm)	Remarks / pile dia. (mm)
0-4.8	Loose sandy fill	32	880	750
4.8-6.5	Medium Silty sand	8	3500	750
6.5-9	Weathered rock	4	7000	750
Beyond 9	Slightly weathered basalt	2	14000	Remedial Piles, 750 mm

The different strata are getting at different depth and based on them the outcomes are changes.

Nawaraj Kapil, Karthik N.M & et. al. (2016)

The researcher is conducting an analysis of the effects of vertical faults on the construction site and the seismic behaviour of the building during earthquakes. The proposed construction model in Sikkim, India (Seismic Zone 4). The structure was modelled and analysed by RSA taking into account the interaction of soil structure using E-tab software. It was unimportant to be below ground level because of the foundation at each of these levels. Based on the results, it is recommended to test the model with SSI for maximum deflation and minimum shear.

Ghalimath A.G, More Sheetal. A & et. al. (2015)

This paper is related to the seismic analysis of the soil structure. This article presents a proposed methodology for modelling the effects of interaction between soil and construction. Acceptable methods of modelling the soil under analysis for the selected structure. There is a direct and sub structural approach to modelling the interaction of soil and structure. Strength was introduced for both static analysis and dynamic analysis.

S. K. K. Chhetr, K. B. Thapa (2015)

This study aims to determine the effect of SSI on the effects of heavy structure in different soil layers subjected to accelerated earthquake. Three types of medium-height construction frames, including 5-storey, 10-storey and 15-storey buildings, were selected. Using a finite element method under two different boundary conditions, the model of the bare frame and the framed scraper wall were modelled and analyzed: (a) a defined framework (no SSI) and (b) an SSI are considered. From the results obtained shows that the SSI plays a considerable role in seismic behavior of mid-rise buildings. Thus, considering SSI effects in the seismic design of mid-rise moment resisting building frames, particularly when resting on soft soil deposit, is essential.

B. R. Jayalekshmi, H. K. Chinmay (2014)

The article analyses multi-layered reinforced concrete frames with sheared walls, placed in four corners of the outer frame of the core and building, taking into account the flexibility of soil support. The results of the study lead to the following results. The basic natural cycles of the soil-building system are higher than the corresponding values of a building with a field building. Increases soil fertility and increases the height of the building and decreases with the addition of a shear wall. The present study aims to study the difference between the Indian Standard Code and the spectral acceleration coefficient (S/g , basic shear and shear shear) obtained after seismic rules of the European Code. The results thus determined the value of the main shear obtained for the construction of a symmetrical plan, the lowest in buildings with sheared walls in four corners.

S. E. A. Raheem, M. M. Ahmed & et. al. (2014)

Three methods of analysis are used to evaluate seismic-frame-resistant buildings for seismic requirements: equivalent static load (ESL); Nine-time response spectrum (RS) methods and linear time history (TH) analysis. The three-dimensional FEM model is built to analyse the effects of different soil conditions and the number of stories on vibration characteristics and seismic response requirements of construction sites. The numerical results obtained using the conditions of the interaction model of the soil structure correspond to the main support conditions. The power of the story trim, the story moment, the story shift, the story shift, the moments at the end of the beam, as well as the inner columns are analysed. Analytical results from different approaches are used for seismic analysis to evaluate the advantages, limitations, and ease of use of each approach.

H. Matinmanesha, M. Saleh Asheghabadi (2011)

This paper presents an idealized two-dimensional flat strain-limited element seismic soil-structure effect analysis using the Abaqus V.6.8 program. The analysis was carried out taking into account three surface recordings of seismic activity with low, medium and high frequency earthquakes. These analyses evaluated the effects of different soil types (dense and loose sand), in addition to the frequency of earthquakes, the height of buildings, the strengthening of the soil foundation interface, the effect of acceleration, and the spread of stress. The results show that both sandy soils intensify seismic waves in the soil-construction interface due to soil-building effects.

Pradip Sarkar, Biju Kumar Patir & et. al. (2004)

Location: Guwahati. The daily assesses the safety of such buildings in Guwahati in the event of a strong earthquake. Field surveys were carried out on multi-storey buildings in Guwahati and a preliminary

assessment of seismic vulnerability was made. The field survey gathered information on current design and construction experience, quality of materials and constructions, soil characteristics and a general understanding of architects, engineers and builders in Guwahati. Most of the structures are frames that are resistant to the normal moment with a soft ground layer. In very few buildings, RC shear walls have been adopted as side load protection systems. Fiber details have been included in a number of recently built buildings. The existing three-storey three-story building is being analysed by a power spectrum method to assess its weaknesses. It was found that seismic loading exceeded the requirements of many members and the performance goal was not met. The results provide useful information on identifying defective members to be repositioned.

S. C. Handa, Swami Saran, & et. al. (1984)

The Natural Gas Commission of India plans to build a multi-storey building in Dehradun on the outskirts of the Himalayas. Geotechnical surveys have been carried out in place to determine the parameters of the soil for the design of the foundation. It was suggested that the base of the hook could not be provided for the building and therefore the foundation of the heap. The load capacity of the complex was estimated based on the determined soil parameters and was then compared with the results obtained by conducting load tests on the assembled assemblies.

Conclusions

Based on the above different research papers of the different research following point are to be evaluated in it.

- 1) It is found that study of foundation design with respected to soil condition is must require to in the design of high rise and multi-storey buildings.
- 2) The SSI is highly required analysis for pre- defined Experimental testing to judge the soil strata. Maximum researcher agrees for the analysis.
- 3) To evaluated earthquake resisting building under the foundation depth can be evaluated through both manually and software mode and for the analysis of building or any structure using linear and non-linear approach is compulsory.
- 4) The assessment of bearing capacity wither manual and test procedure is required the before the construction of building design.
- 5) The study is also based on use of different types of software used for analysis such ETABS and SAP 200 with 3D FEM analysis.
- 6) The studies of some researchers are based on the testing approach used in the analysis the soil and foundation Foundations and its Failure Mechanism.

It is found that the properties of the soil are important aspect to role part in the design aspect of foundation &

superstructure constructed above on it. Below substructure part analysis such as bore hole, SSI, SBC & other effects. The soil profile is found to distinct properties in all aspect such as index properties, colors, strength etc. It is also vary with theoretical approach adopted for the calculation so it is important to study and analyses between theoretical and practical approach and co-relation between them.

Future Scope

Based on the study of past articles the following point is taken for the study in future work are as follows:

- 1) SSI Experimentation with various in soil strata.
- 2) Case study of soil profile assessment for particular location.
- 3) Software development for the SSI and analysis of soil parameters.
- 4) Codal compassion for soil profile analysis.
- 5) Software mechanism for the behavior of sub structure.

Abbreviation used:

SSI: Soil Structure and Interaction
 RSA: Response Spectrum Analysis
 SBC: Soil Bearing Capacity
 et. al.: and others

Acknowledgment

I extend my deepest gratitude to my guide Dr. Yusuf Ali, HOD & Associate Professor, and my Co-guide Mr. Arvind Vishwakarma, Assistant Professor, Civil Engineering Department, Oriental University, Indore, M.P., India for providing all the necessary facilities and feel thankful for his innovative ideas, which led to successful completion of this review work.

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