Study The Impact On Soil Structure Interaction By Using Various Parameter of PEB and CSB

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Abstract -*In this chapter literature survey is included. The present theories and practices are referred by some of the resources like IEEE explorer, fundamental technical papers from journals and conferences, latest technical papers, patent information, research thesis, international and national workshop proceedings, research institute publications, authorized websites and reference books etc. There are many cases in civil engineering for which interaction between structure and ground has to be considered. Hence during the earthquake excitation forces and other lateral forces on the structure, behaviour of soil strata under the structure plays an important role.*

Key Words:Soil structure Interaction, PEB, CSB, STAAD Pro. , Foundation.

1.INTRODUCTION

Steel is extensively used in the construction of industrial building of larger spans where concrete construction is not feasible or when construction time is critical. Steel is easy in construction, low cost, availability of manpower for erection & fabrication, hence it is popular in Indian construction industry. Now a day's steel structures are used as industrial shed for various purposes. Such as warehouse, workshops and various industrial units. These industrial structures are as follows:

1. Conventional truss shed building.(CSB)
2. Pre-Engineered building.(PEB)
3. Truss less roof sheds (shell structure).

In case of industrial building, the economy of the structure plays an important role. In large spans the design is made economical in order to minimize the use of materials, costs, and installation efforts. Manufacturer adopt Pre Engineering Building concept to reduce the costs. Pre-engineering Buildings are the structures fabricated at factory o exact size of light gauge metal standing seam roof and steel purlins spanning between rigid frames with light gauge metal wall cladding. If we go for conventional truss steel structures, time frame will be more, and also cost will be more, and both together i.e. time and cost, makes it uneconomical.

1. Aijaz Ahmad Zende, Prof. A. V. Kulkarni Aslam Hutagia**"Comparative Study of Analysis and Design of PreEngineered-Buildings and Conventional Frames"**MTechStudenst, Professor, Civil Engg. Dept, B.L.D.E.A's College of Engineering and Technology, India.

In some large industries they want long span without column obstruction and Pre Engineered Buildings (PEB) are better option for such requirement which reduced time and cost as compared to conventional structures. This paper involves the relative study of static and dynamic analysis and design of Pre Engineered Buildings (PEB) and Conventional steel frames. Staad Pro software is used for designing and compared with conventional type, in terms of weight which in turn reduces the cost. This paper compare three examples. Two examples for comparison of Pre Engineered Buildings (PEB) and Conventional steel frames and third example for longer span Pre Engineered Building structure. In the present work, structure is designed for dynamic forces, which includes wind forces and seismic forces. Wind analysis has been done manually. Structures with long span need to be carefully designed with respect

to its weight, deflections (sway) and also foundation forces. We can use the high strength steel plates (Fe 350) in PEB structures, lighter but high strength cold form purlins, and 550 Mpa Galvalume profiled sheets. The PEB structure gives reduced weight structure of high tensile steel grades with good quality control of the structure.

2. George Gazetas,' Member, ASCE **"Formulas and charts for impedances of surface and embedded foundations"**

For instant calculation of the dynamic stiffness (K) and damping coefficients (C) of foundations harmonically oscillating on/in a homogeneous half-space set of formulas and dimensionless chart is given .All modes of vibration, a realistic range of Poisson's ratios, and a practically sufficient range of oscillation frequencies are considered. The foundations with rigid basement of any realistic solid geometric shape. A companion paper (Gazetas and Stokoe 1991) presents evidence from model tests. The two papers aim at encouraging the practicing engineer to make use of results, when studying the dynamic response of foundations.

This paper presents a entirely set of straight forward formulas and graphs covering (1) Nearly all foundation base shapes; (2) surface and partially and fully embedded foundations; (3) all many the modes of vibration and a reasonably adequate frequency range; but (4) only reasonably deep and uniform soil deposits which will be modeled as a homogeneous half-space. This conclude that : a complete set of results found or easily obtained for a homogeneous half-space , and that keeps minimum number of problem parameters to quantify the role of partial embedment and of basement shape.

3. MariosApostolou_, George Gazetas, EvangeliaGarini**"Seismic response of slender rigid structures with foundation uplifting"**School of Civil Engineering, National Technical University, Athens, Greece (2006)

From this paper come to know that, during strong earthquakes shaking rigid structures come up from their supports. The surface of either a rigid base or a linearly elastic continuum supports the structure. The governing equations of motion obtained from large-displacement approach allowing lengthy calculation of the nonlinear response even under near-overturning conditions. The conditions for uplifting which gives large angles of rotation and sometimes overturning obtained from this study.

4. George Gazetas and Kenneth H. Stokoe II,2 Members, ASCE**"Simple physical methods for foundation impedance"**Benerjee PK, Butterfield R, editors.
ELSEVIER Applied Science; 1987. P. 44-90

Unfavorable sequences of long- duration pulses in the excitation amplifies the geometrically nonlinear response. Moreover, the practice of estimating ground accelerations from overturning observations is rather misleading and meaningless is concluded by the overturning response of a toppled tombstone.

5. Harada T. , Kubo K., Katayama T.**"Dynamic Soil Structure interaction by Continuum formulation method",***Report* No. 190, institute Of Industrial Science, university of Tokyo, 1981.

In this study for the dynamic problem each spring is accompanied by an associated dash pot in parallel. By taking use of dynamic theories are available in the studied results for foundations, closed-form expressions are derived for the various springs and dash pots of case with rectangular and circular plan shape. The response of a case to static and dynamic loading at its top, and to kinematic ally induced loading arising from vertical seismic shear wave propagation, is then studied parametrically. The relative study with results from three dimensional finite element analysis and possible theoretical methods performed the reliability of the model, its easy extension to multi-layered and nonlinear inelastic soil gives rise to such need.

6. George Mylonakisa, Sissy Nikolaoub, George Gazetas (2006) **"Footings under seismic loading: Analysis and design issues with emphasis on bridge foundations."**ELSEVIER Soil Dynamics and Earthquake Engineering, pp. 824–853, 2006.

The data on seismic analysis and design regarding spread footings obtaining the dynamic stiffness of the footing, kinematic response, the conditions under which foundation–soil compliance must be incorporated in dynamic structural analysis, importance of properly modeling the effect of embedment, the conditions under which the effect of radiation damping is significant, comparing the relative importance between kinematic and inertial response. The paper gives set of graphs and tables for stiffness and damping in all modes of vibration, for a variety of soil conditions and foundation geometries. The paper gives parametric studies on the seismic response of bridge bents on deep footings in layered soil.

7. HoomaTorabi, Mohammad T. Rayhani,**"Three dimensional Finite Element modeling of seismic soil–structure interaction in soft soil",** ELSEVIER Computers and Geo technic spp. 9–19, 2014

This paper describes the reliability of the numerical model verified by results from an experimental soil structure interaction centrifuge test by parametric studies. And performance of linear elastic structures underlain by soft saturated clay is evaluated. The rigid slender structures are highly susceptible to the soil structure interaction effects including different of natural frequency and excessive base shear demand. Structure foundation stiffness and aspect ratios were difficult parameters for controlling coupled foundation structure performance.
Occurrence of resnance problems are avoided by frequency content of input motion and structure.

8. M.E.BoostaniDarmian, M. AzhdaryMoghaddam, and H. R. Naseri**"Soil structure interaction in steel braced structure with foundation uplifts",**IJRRASVol.7, Issue 2, (2011)

To understand the structural role, we have to study the effects of soil-structure interaction. Usually soil-structure interaction studies are done with the expectation that the foundation is fixed to the soil. During strong earthquake motions, it effects uplift in some parts of the foundation which may occur depending upon the type of soil on which structure is located. Paper investigates the nonlinear behaviour of varied steel braced structures placed on differing types of soil with different hardness. This can help in better understanding of the actual role of structure during an earthquake. Results shows that for structures allowed to foundation uplift, and softer the soil, the change will be higher in seismic response.

9. Mr. Nitish Kumar, Mr.Praveen J, **"Study of Soil Structure Interaction Effect on Multi-Storey RC Frame Structures Resting Over Raft Foundation under Earthquake Caused Agitation",**IJCSER Vol. 4, Issue 1, pp. 95-102, 2016.

The seismic performance of superstructure is understood by this investigation which includes the complex dynamic interaction between superstructures. A Finite Element Method is used to model soil structure interaction analysis of raft foundation supported framed structures by SAP 2000 V14 software. This paper gives the time history analysis and base shear, roof top displacement of the building frames resting over raft foundation and soil media. The effect of soil-structure interaction plays a significant role to increase the time period, bending moment in X and Y direction, lateral displacement. The structure is affected by soil structure interaction, the structurefoundation-soil mass shows an effective approach.

10. Nirav M. Katarmal, Hemal J. Shah,**"Seismic Response of RC Irregular Frame with Soil-Structure Interaction".** IJSDR, Issue 4, 2016.

The non-linear behaviour soil during earthquakes shows complex seismic response. The flexibility of soil is ignored and fix base condition is assumed for seismic design. The purpose of this study is to investigate different ways of considering soil flexibility in the soil structure interaction with respect to the response in the super structure. Software SAP2000 in used. The soil hard, medium hard, and soft soil are taken in consideration. The soil is modeled as spring model and the gerorge Gazetas equation gives the stiffness. The effect of soil

structure interaction on natural time period, base shear, roof displacement, are studied and discussed. The earthquake is used, to find out the effect on structure when the structure hit by long duration and see how the response is modified, when soil effects are taken into the consideration.

11. Halkude S.A.Ȧ, Kalyanshetti M.G.Ḃ and Barelikar S.M.Ḃ
"Seismic Response of R.C. Frames with Raft Footing Considering Soil Structure Interaction"ḂCivilEngg. Dept., Walchand Institute of Technology, Solapur, IndiaVol.4, No.3 (June 2014) International Journal of Current Engineering and Technology

In the conventional method of design of foundation flexibility of soil mass is ignored which is probably going to affect the performance of structure. In the proposed study an effort is formed to know the effect of soil flexibility on the performance of building frames resting on foundation. The purpose of this study is to elucidate and investigate different approaches of considering soil flexibility within the soil structure interaction analysis (SSI) with regard to the response within the superstructure.

12. Vivek Garg, M.S. Hora,**"A review on interaction behaviour of structure foundation soil",** International Journal of Engineering Research and Applications, Vol. 2, Issue 6, pp.639-6

The present study is concentrated on SSI analysis of symmetrical space frame of two bay in both x and y direction, 2 storey, 2 bays in both direction, 5 storey and 2 bay in both direction, 8 storey resting on raft foundation with fixed base and flexible base. Three types of soil i.e. Hard, Medium Hard and Soft Soil are used. The soil flexibility is incorporated within the analysis using Winkler thought way and elastic continuum approach (FEM model). SAP-2000 is used for developing these models. The results of SSI on various structural parameters i.e. natural period of time, base shear, roof displacement, beam moment and column moment are studied and discussed. The comparison is formed between the approaches of SSI modeling i.e. Winkler thought way (spring model) and elastic continuum approach (FEM model). The study reveals that the SSI significantly affects the response of the structure. The approach for elastic continuum (FEM model) has proved to be the effective approach for consideration of elastic continuum beneath foundation.

13. R. M. Jenifer Priyanka, N. Anan, Dr. S. Justin,**"Studies on Soil Structure Interaction of Multi Storeyed Buildings with Rigid and Flexible Foundation"**IJETAE Volume 2, Issue 12, 2012.

Though the structures are supported on soil, most of the designers don't contemplate the soil structure interaction Associate in nursing its succeeding result on structure throughout an earthquake. Completely different soil properties will have an effect on unstable waves as they go through a soil layer. Once a structure is subjected to Associate in nursing earthquake excitation, it interacts the inspiration and soil, and so changes the motion of the bottom. It implies that the movement of the complete ground structure system is influenced by style of soil additionally as by the sort of structure. Tall buildings are speculated to be of designed construction in sense that they could are analyzed and designed to satisfy the availability of relevant codes of apply and building bye-laws. IS 1893: 2002 "Criteria for Earthquake Resistant style of Structures" provides response spectrum for various styles of soil like onerous, medium and soft. an effort has been created during this paper to review the result of Soil-structure interaction on multi high-rise buildings with numerous foundation systems.

14. A.D. Pandey, Prabhat Kumar and Sharad Sharma**" Seismic soil structure interaction of building on hill",**Journal of Civil Structure Engineering, 2011

This study reviews the response of buildings subjected to unstable forces with Rigid and versatile foundations. Multi high-rise buildings with fastened and versatile support subjected to unstable forces were analyzed underneath completely different soil conditions like onerous, medium and soft. The buildings were analyzed by Response spectrum methodology exploitation software system STAAD

professional. The effect on building frames like Lateral deflection, drift of construction, Base shear, Axial force and Column moment values for all building frames got during this paper.

15. **"Soil structure interaction for building structures",**NIST GCR12-917-21, NEHRP consultants.

There are three linked systems which are affected by interactions between which response to a structure to earthquake shaking and they are the structure, the foundation, and the soil underlying and surrounding the foundation (FEMA, 2009). Soil structure interaction analysis ability that collect response of these systems to a specified ground motion. In other words we can terms Soil-Structure Interaction (SSI) and Soil Foundation-Structure Interaction (SFSI) ,as to describe this effect in the literature. In the report, the foundation is considered as a part of the structure, and the term SSI has been adopted. This report presents a blend of the body of knowledge contained in SSI literature, which has been distilled into a concise narrative and harmonized under a consistent set of variables and units.

The need for optimization-

Effect of SSI in traditional construction practices is conveniently neglected. This can be valid for certain cases like small structures and in stiff soils. But SSI have prominent effect on heavy structures like Industrial sheds, high rise structures, bridges etc. Accordingly study of SSI on multi story buildings has been carried out in large extent, but in case of steel industrial building study of SSI is narrow and limited. The effect of SSI on different types of industrial sheds can be studied considering seismic performance.

Problem Statement-

Comparison of the Pre-engineered building structures and Conventional truss structures with respect to soil structure interaction in case of three types of soil i.e. soft soil, medium soil, and hard soil. Vast study are done for the analysis of the economical structures by comparison of various configurations of PEB structures and Conventional truss structures. Cost comparison for few cases in the form of steel weight is carried out.

Hence, to provide the optimal design solution for sheds of medium to large spans during engineering the above project is formulated.

Future scope-

Following are the future scope of the project work.

1. To study the effect of SSI on parameters like vertical deflection, self weight of PEB and CSB.
2. To Study and compare design of connections for PEB and CSB taking effect of SSI.
3. Compare the effect on cost of PEB and CSB structure under influence of SSI.

Proposed Methodology:

To achieve the objectives following steps are follow.

Step 1: Literature review relate to soil structure interaction on steel structure.

Step 2: Finalization of structural configurations and load combinations.

Step 3: Preparation of results using STAAD Pro software.

Step 4: Analysis and Design of pre-engineered buildings and conventional truss building or different span for different soil strata on STAAD Pro.

Step 5: Manual design calculations.

Step 6: Preparation of results and discussion.

Conclusion-

Effect of SSI in traditional construction practices is conveniently neglected. This can be valid for certain cases like small structures and in stiff

soils. But SSI have prominent effect on heavy structures like Industrial sheds, high rise structures, bridges etc. Accordingly study of SSI on multi story buildings has been carried out in large extent, but in case of steel industrial building study of SSI is narrow and limited. The effect of SSI on different types of industrial sheds can be studied considering seismic performance.

Reference-

1. IS 1893(part I):2002-criteria for earth quake resistant design of structures.
2. IS 875 (Part 3): 1987-design imposed loads (other than earthquake) for buildings and structures.
3. IS: 800 -1984: "Code of practice for general construction in steel".