iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** XII **Month of publication:** December 2021

DOI: https://doi.org/10.22214/ijraset.2021.39357

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue XII Dec 2021- Available at www.ijraset.com

A Review on Effect of Pile Stiffness on Seismic Response of Structure

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Abstract: Pile foundations are widely employed for a variety of structures on shaky ground. The importance of seismic design in ensuring the effective operation of a structure under severe seismic loading conditions cannot be overstated. For the analysis of seismic forces on a structure, IS 1893 will be employed. This research entails the choosing of a specific form of building structure. A comparison of buildings with and without pile foundations will be shown. Because of the differences in their properties, the seismic behaviour of the various structures differs. The influence of pile stiffness on the structure's seismic response will be investigated. The rigidity of the piling foundation could have an impact on the structure.With the rise in seismic activity, there may be a need for more efficient pile foundation design to withstand earthquake loads. The major goal of this study is to compare pile stiffness with changes in diameter and zone.

***Keywords*: Pile Foundation, STAAD-Pro, Structure, Stiffness, zone, Pile Cap, Load Estimation, Pile cap, Pattern of Pile.**

I. INTRODUCTION

A. Genaral

When the soil beneath the foundation is weak and has low bearing capacity, piles, which are relatively long, slender members that are driven into the ground or cast-in-situ piles, are the most commonly used deep foundation to support massive structures such as multi-story buildings, bridges, towers, dams, and so on. Piles must resist dynamic lateral loads in addition to supporting vertical compression loads, which are typical in off-shore constructions, retaining walls, and structures in earthquake-prone areas. Designing pile foundations for seismic conditions is becoming increasingly important as infrastructure grows and seismic activity increase. Several studies on seismic analysis and pile foundation design were done by various researchers, leading to the development of distinct theories. The seismicity of a structure's location (zone) and the subsurface conditions of the site are used to estimate the loads that operate on it during an earthquake.

Piles can be categorised based on how they act.:-

1) End bearing pile- This type of pile is used to carry weight from the tip of the pile to a suitable bearing stratum while passing through soft soil.Used to transfer load through tip of pile to a suitable bearing stratum, passing through soft soil.
2) Friction Pile-A friction pile is a device that uses skin friction to distribute a load.
3) Uplift pile- Uplift piles are used to secure constructions that are prone to uplift owing to hydrostatic pressure.
4) Laterally – loaded pile- Laterally-loaded piles are used in the building of retaining walls, bridges, and dams.

B. Pile Group

A building is never built on a single pile. Under the structure, the piles are tightly spaced, and the activity of the complete pile group is taken into account. A pile group's bearing capacity is not the capacity of each individual pile multiplied by the number of heaps in the group. The phenomenon that causes this is called as group action of pile. Pile-supported constructions are known to have existed in prehistoric periods, and the Bible mentions timber piles in Babylon. Piled foundations were used to support a wide range of structures in the Middle Ages, particularly in Venice and the Netherlands. They are a useful approach for sustaining structures erected over water and where uplift stresses must be resisted. To resist lateral stresses, inclined or ranked piles have also been employed. Retaining walls, bridge piers, abutments, and machinery foundations are all supported by piles that can withstand both vertical and horizontal loads. Driven heaps, driven and cast-in-place piles, jacked piles, drilled and cast-in-plane piles, and composite piles are the most common forms of piles utilized.

II. METHODOLOGY

A. General

We were going to design a building utilizing staad-pro software and a pile foundation with varied diameter and zone in this assignment. It entails selecting numerous parameters for design purposes, as well as estimating various sorts of loads acting on the structure based on the structure type chosen in accordance with the code's recommendations. It also entails deciding on numerous criteria for the design of pile foundations, as well as determining the stiffness of the foundations after the piles have been designed.

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B. Selection of Building

Structure is a grouping of members chosen in such a way that they serve a single goal. There are various sorts of structures that are maintained, as seen below:

1) *Rigid Frame Structure:* A rigid frame structure is one in which the members are connected by rigid joints.
2) *Load-bearing Structure:* Is one in which the walls take all of the roof's weight and evenly distribute it throughout the foundation strata.

C. Estimation of Load

The structure is subjected to a variety of loads, including dead load, live load, wind load, and seismic load. The load can be determined using the height of the building, the number of occupants, the usage of the building, and the requirements specified in the various regulatory codes.

1) *Self –Weight:* The self-weight of the structure is taken into account while calculating the dead load. The slab's self-weight, the column's self-weight, the beam's self-weight, and the floor finish were all measured. Only the dead load of brickwork is considered in the analysis, not the brickwork itself. In this scenario, all brick walls are considered to be 230 mm thick, even if the internal walls may only be 115 mm thick in fact.
2) *Live Load:* The live load for all floors is the same, while the live load for the roof is different. The distribution of live load is comparable to the distribution of slab self-weight, and STAAD uses the floor load command. For the same reason, I vote yes.
3) *Earthquake Load:* Earthquake load is a term used to describe the amount of damage caused by an earthquake. IS 1893 (Part 1): 2002.

D. Analysis and Design of Building Foundation Using STADD-PRO Software

In practise, commercially accessible software is frequently used to evaluate, design, and detail multi-story buildings. STAAD. Pro SAP 2000, ETABS, SAFE, Nastran, Midas NFX, ANSYS, and STRUDS are some of the commercial software packages on the market. A number of free/open source apps, such as Open Sees, Frame3DD, and IDARC 2D, are also available. Many of these apps can perform analysis and design. Special structural design software are also available, and some engineers have created their own spreadsheets for the design of structural elements (for example, Computer Design Consultants' FRAME, RC Slab, RC Beam, and RC Foundation).

1) *Analysis of G+6 Building:* For buildings with 15 stories, linear analysis is considered sufficient. Regular buildings in high seismic zones with heights larger than 40 m, irregular buildings, and thin buildings subjected to significant wind loads all benefit from dynamic analysis. For important constructions, soil structure interaction should be considered. In critical projects, the response spectrum method of analysis with a site-specific design spectrum will be applied. The non-linear analysis must take into account geometric and material non-linearity. STAAD.Pro is used as an analytical method. This case study considers a seven-story RC structure with three bays in one way with spans of 8 m, 5 m, and 5 m, and three equal bays of 5 m each in the opposite direction. The rest of the information needed for the analysis and design lis listed below.

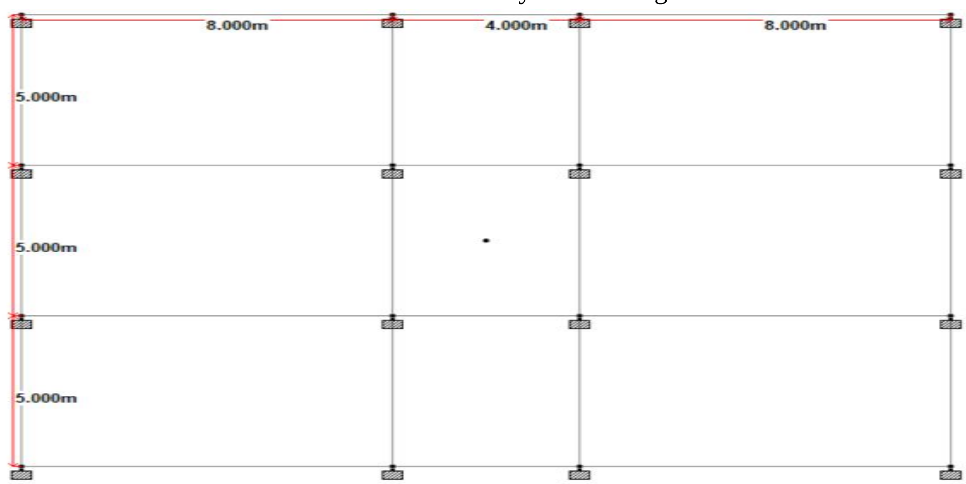

Fig 1. Plan of Building

E. Flow Chart of Methodology

Selection of Building

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Estimation of Load

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Design and Analysis of R.C.C. building by using STAAD-PRO

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Design of pile Foundation by varying Diameter of Piles by using STAAD-PRO

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Calculation of Stiffness Factor in various zones of Seismicity

III. CONCLUSION

A. The pile cap appears to provide a significant contribution to lateral load resistance. By changing the zone there is no change stiffness of pile.

B. In the same zone, altering the diameter of the pile from 500 to 700 mm results in a 32 percent increase in stiffness.

C. The lateral resistance of the pile cap is determined by various factors such as the length of the pile and the position of the pile cap from ground level.

D. The modulus of elasticity of the pile is directly proportional to the pile stiffness; the higher the modulus of elasticity of the pile, the higher the pile stiffness. The pile and cap materials have an impact on the pile cap rigidity.

E. Because the nature of piles is rigid, the behavior of the structure is equally inflexible when it comes to seismic response.

F. It is also depicted, with critical issues to consider for seismic design of piling foundations highlighted.

REFERENCES

[1] Phanni Teja, Barnali Gosh, “Seismic Design Of Pile Foundation For Different Ground Condition” , Journal Of WCEE 2012.

[2] Kitazumeand Terashi, “Behaviour Of Pile Foundation In Seismic Soil Pile Structure And Interaction” Bruceet al.2013.

[3] Madabhushi, S.P. Gopal, “Seismic Design Of Pile Foundation”, Indian geotechnical conference December-2010.

[4] Gazetas. “Effect of the filtering action exerted by piles on seismic response of RC frame building”-1984.

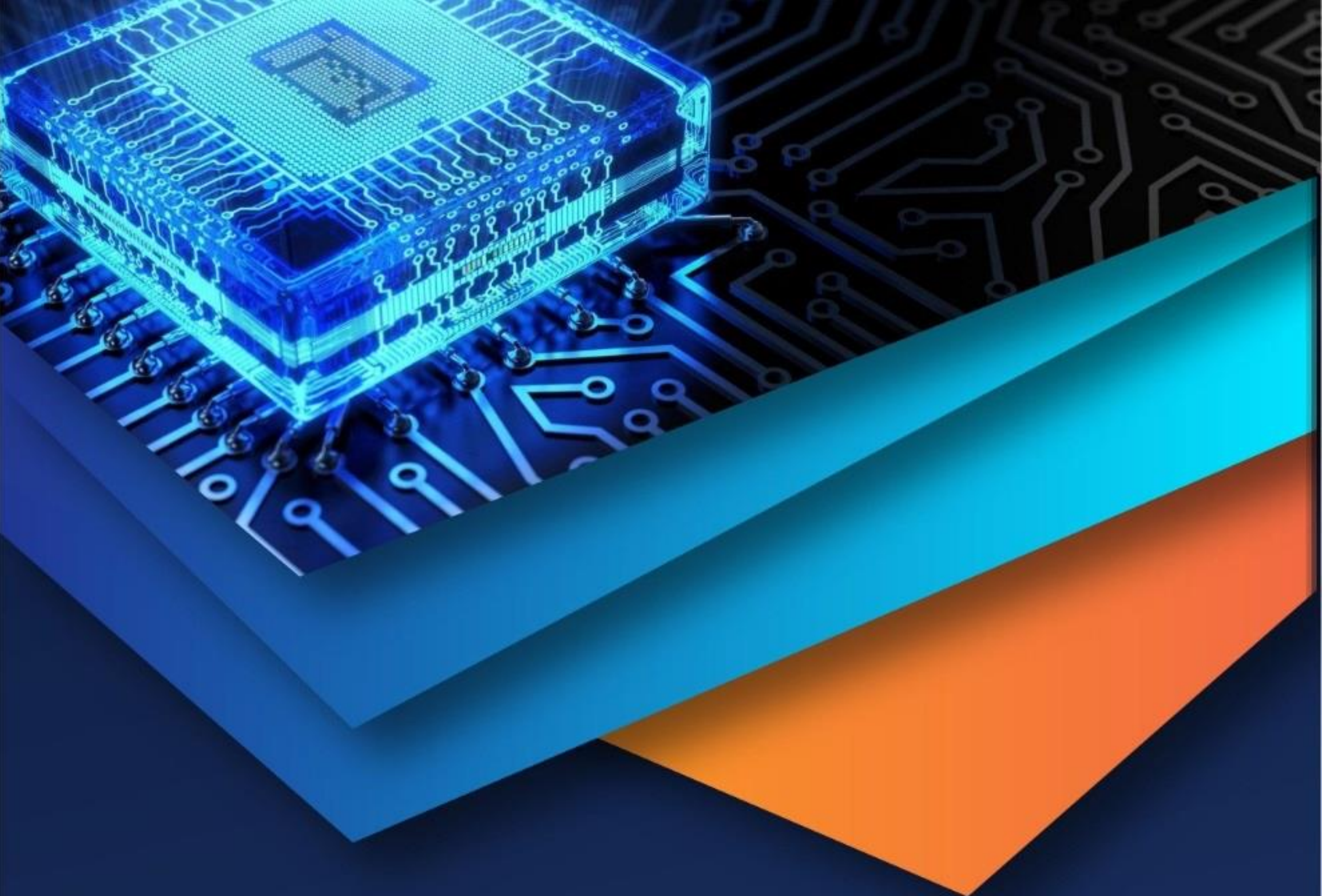
[5] A . Murlikrishna , S. Bhattacharya, “Seismic Design Consideration For Pile Foundation”2011.

[6] Geoffrey R. Martin, “ Seismic Design Of Pile Foundation; Structural And Geotechnical Issue”, Third International Conference on Recent Advances in Geotechnical Earthquake Engineering & Soil Dynamics,2ndApril 1995.

[7] Mario Martinelli, “Dynamic Response of a Pile Embedded in to a Layered Soil”,Journal of Soil Dynamics and Earthquake Engineering,30 march 2016.

[8] Phillip L. Gould, “Seismic Response of Pile Supported Cooling Towers”, Fifth ASCE-EMD Conference on Engineering Mechanics in Civil Engineering, August1984.

[9] Nicos Makris and George Gazetas, “Dynamic pile-soil-pile interaction”-199210S. Bhattacharya, “Seismic Design Consideration for Pile Foundation” ,Indian Geotechnical Conference,15December2011,Kochi.’



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