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# A Review: Earthquake Analysis of Pile Group with Different Variations in Dimensions & Parameters

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***Abstract:*** ***As per demand of current construction many project are running such as metro construction, bridges, tall building, industries, etc. In such type of construction where the soil bearing capacity (SBC) is very low it is necessary to provide pile foundation. Dynamic analysis is also necessary to be carried out for different pile group for earthquake. The stress resting action increases with the group action of piles.***

***The paper studies about pile group, modelling of four piles and eight pile groups are done taking space between them as 2.5D and 3D, where D is the dia. of the pile. Diameter of four pile group is 0.6 &diameter of eight pile group is 0.4, shape chosen to arrange the pile group are Rectangle, Square, Diamond and Staggered .The analysis of different shape pile groups will be done using the response spectrum method based using STAAD Pro. Parameters such as displacement, shear force (SF) and bending moment (BM) are taken in consideration for pile group analysis. Pile cap is analyzed for bending moment in 'y' and 'z' direction.***

***Keywords: Piles, pile cap, laterally loaded piles, SBC, STAAD Pro.***

## I. INTRODUCTION

Seismic analysis is linked to the calculation of the response of a building or other structures to earthquakes. This is part of the structural design process which includes seismic engineering or structural assessment and renovation in areas where earthquakes are widespread. During the earthquake, many buildings collapsed due to a lack of understanding of the inelastic behaviour of the structure. The elastic analysis only gives the elastic capacity of the structure and indicates where the first deflection occurs. It cannot give any information on the redistribution of forces and moments and the failure mechanism. For the study of the inelastic behaviour of the structure, a nonlinear analysis is necessary.

The development of a rational methodology applicable to the seismic design of new structures using available information on ground movement and technical knowledge, while being flexible enough to allow the incorporation of new technologies as they become available, has been supported for some time.

It is the subject of several major research and development efforts around the world. In most cases, a non-linear analysis is used. Seismic or seismic analysis is a subset of structural analysis which involves calculating the response of a structure subjected to seismic excitation. The main seismic inputs include, ground acceleration, speed / displacement data, earthquake amplitude, peak ground parameters, duration, etc. falls into the category of deep foundations. The pile group is a combination of piles with a pile cap that is normally in contact with the ground (Nidhi Gupta et al.). The load applied to the pile cap is distributed over each pile. The ultimate capacity of the pile group is the addition of the individual pile capacity (B. Manjula Devi et. Al.). A pile foundation can be constructed using different materials such as wood, concrete or steel. Pile foundations are mainly used for transfer to the column. And its foundation mainly used the places where the weak layer of the soil, for example the swampy area, the big building, the offshore platform, the defence structure, the dams and the lock structures, the transmission towers. , the inflation pressure, improve the bearing capacity of the soil

## II. GROUP ACTION OF PILE

Load acting on a pile is of higher magnitude then instead of providing single pile, group of pile are used. Fig.(a) showing load acting on single pile with stress bulb. Pile spacing mainly controls the behaviour of pile groups. The gaps should not be too small so that the ground breaks when driving in dense or compressible material. On the other hand, if the gaps are too large, the result can be an uneconomical pile cap. When driving on sand and gravel piles, it is recommended to start driving in the middle of the group and then work outside to avoid difficulties in "tightening" the ground.

Fig.(b) showing load acting on group of piles and a combined stress bulb is formed which is summation of individual pile stress bulb.

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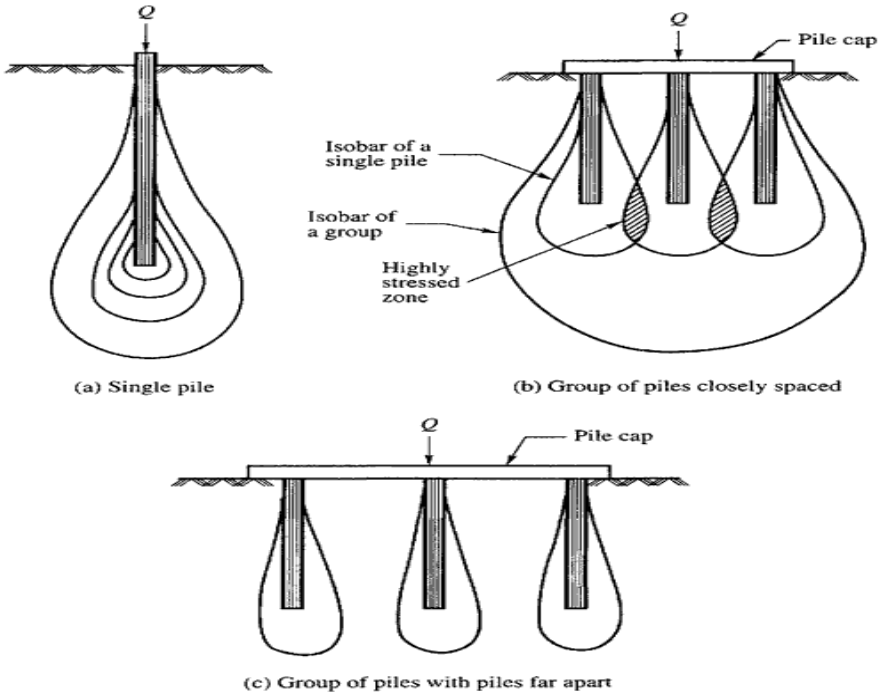



Fig.1 Group action of piles with stress zone effect

Now the combined action of piles is termed as Group action of pile. Panchal and Rangari (2019) used the different diameter pile for determine the group action of pile. The result are summarized in different result for the staadpro analysis by fem methods. Panchal Kushal M, Rangari Sunil M (2019) refer the different arrangement of pile with series and non series ansysis of pile group. so the arrangement also emphasis on the group action of piles. Shen-Kun Yu et .al. (2016)
Refer the other software like FLAC and the data are to be get with the help of P-Y curves for influence of pile. The effects of pile cap with variation of thickness are discussed in it. Kanakeswararao et.al.(2017) deals with lateral and vertical loads on it with cohesive and non cohesive soil types in it. The group action of pile are based on different arrangement, method , different dimensions, soil types , analysis method on which the different researchers deals with group action of pile and pile cap.

## III.LITERATURE REVIEW

The Study of pile and pile group following repute articles are studied which are based on use of different software such Staad pro and different parameters which are described below:

### *A. Pile Group Analysis on Software*

Panchal and Rangari (2019) examined the pile group arranged in series of 2 piles, 3 piles, and 4piles at a spacing of 2D, 3D, 4D, 5D and 6D,D (diameter).for analysis cohesion less soil is taken. The authors made use of finite element method using software STAAD pro. Parameters taken for analysis are deflection, axial force(AF), shear force(SF) and bending moment(BM) for pile in group.
Panchal and Rangari (2019) worked on behavior of pile foundation for a bridge pier in a cohesion less soil ,piles arranged in group of 3 and 4.The shape of pile cap consist of triangular and square for 3 and 4 respectively. The pile systems are subjected to lateral loads. The piles are arranged in series and non series and comparison is carried out between the two. The parameters of study are axial force, shear force and bending moment analyzed on staadpro using finite element method. It is concluded that maximum value of taken parameters are obtained for series arrangement.
Suneetha and Prasad (2017) analyzed on pile foundation in black cotton soil. As black cotton soil shows anonymous behavior with temperature variations. It has a tendency to shrink during summers and expands a lot during monsoon which affects the super structure. In this paper authors have designed a foundation which will protect the structure from ill effects of black cotton soil. For study G+ 2 storeys is chosen and analysis is done by both software and manually.

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Reddy and Kala (2017) modelled on G+5 building in a clay and sandy soil taking live, dead load and weight of structure. Using Staad pro modelling and foundation design is done .The support reactions derived from Staad pro is applied in. It was concluded from their research that sandy soil possesses more bearing capacity than clayey soil. Also in clayey soil the vertical settlement in isolated footing is more than embedded pile. Pile foundation of sandy soil shows more vertical settlement as compared to isolated footing.

Thadapaneni and Ganesh (2017) used various methods to analyse the vertical and horizontal loads applied on structure. To calculate vertical load-Y curve and Vesic's method are used taking cohesion less and cohesive soil. Piles are considered as linear elements and soil interaction effect is taken assuming Winkler soil spring. Using IS code 2911 lateral and vertical sub grade modulus is derived. Using finite element method in Staad pro lateral load is derived; also L-pile software and Brom's method are used.

Sivaraju et. al.(2017) examined the pile subjected to lateral and vertical loads subjected to deflection using finite element method. The vertical loads in piles are distributed in two parts, namely skin friction and end bearing at the base. Using static analysis on c-φ values, ultimate bearing capacity of vertical load in pile is determined for cohesive and cohesion less soil. The deflection occurred in pile is checked using Staad pro software. Calculations for Lateral load carrying capacity, depth of fixity and maximum moment in pile are done using IS Code 2911(Part I/Sec2).

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Sreeshna (2016) includes a simple experiment on B+G+4 building modelling and analysis on Staad pro software using a pile foundation. For calculating dead and live load IS:875 (Part I)- 1987, IS: 875 (Part II)-1987 are referred respectively. The structural components like beam column staircase, slab, shear wall, retaining wall

Zhang et .al. (2016) With the use of FLAC-3D software,3D-Lagrangious analysis is performed in which concrete Piles and different cap size and length subjected to lateral load are investigated using numerical Simulations. With this P-Y curves are drawn and influence of piles on these curves was analysed, it was concluded that with increase in pile cap soil resistance increases. the authors also discussed about the effect of cap on soil with different length.

Jayarajan and Kouzer (2015) worked upon raft foundation analysis taking into account the pile-soil-pile and pile-soil-cap interaction. They discussed about the combined piled raft foundation by calculating relative proportions of load taken by raft &piles, the effect of piles on total and differential settlement. The paper dealt with the analysis of CPRF by simplified methods and finite element analysis. The Software PLAXIS was used.

*B. Group Action of Pile Based On P-Y Curve:*

Khari et. al. (2014) In this paper authors have used previous a series of P-Y curves for single piles. The newly placed P-Y curves were compared with old P-Y curves to determine the soil pile Interaction. For different relative density soil-pile reaction was increased by 40-95% for smooth pile.

Cairo and Chidichimo (2011) discussed about the waves generated by seismic forces through the soil. With these waves kinematic effects are introduced on pile foundation. For this author used lumped –mass parameter models to get the value of kinematic response of pile and P-Y curves are obtained. To affirm the approaches theoretical and experimental comparisons

Devi's and Sawant (2009) selected cohesion less soil and used two grouping arrangements, 3 and 4 pile groups arranged in series. Response of foundation head is considered displacement at top of the pile group and bending moment in pile. Various parameter of the pile group such as pile spacing, pile size, and configuration of the pile group on the behaviour of the pile group.

Bhattacharya and Madabhushi (2008) the author talks about the damage to pile supported structure in a liquefiable soil due to Earthquake. Pile foundation have shown a poor performances again earthquake two Importance theories of pile failure are discussed namely flexural mechanism and buckling Instability. The applied both theories so as to see and compare the better performance of pile Foundation.

Teerawut and Scott (2004) In this paper used to full scale lateral spreading experiments were conducted a pile foundation .the port of Tokachi, Hokkaido, Island, Japan, and single pile use in its foundation . Group of four pile & nine pile group. In this paper some result from the test. Method are used P-Y analysis method analysed the pile response during lateral spreading. The calculated and measuring response of all types of pile foundations.

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## IV. NEED OF THE STUDY

The main scope of the project is to study the behaviour of group action of pile under seismic load. For this different arraignment are taken by varying the basic parameters such as spacing between the piles, dia. of pile, dimensions ex. 2D,3D,(L,2L),length spacing(S,2S) & thickness(T,2T), soil types, seismic zone types, patterns of pile group(square, rectangular, diamond, staggered).. Also pile will be analysed along with super structure. Since with change in topography there is change in soil and also a change in its bearing capacity. The SBC may be low at some place and may be high at other thus making application of pile group desirable at low SBC geography. Seismic analysis of pile group will be studied by different method such as time history analysis, response spectrum, Pushover analysis and equivalent static analysis**.**

## V. CONCLUSIONS

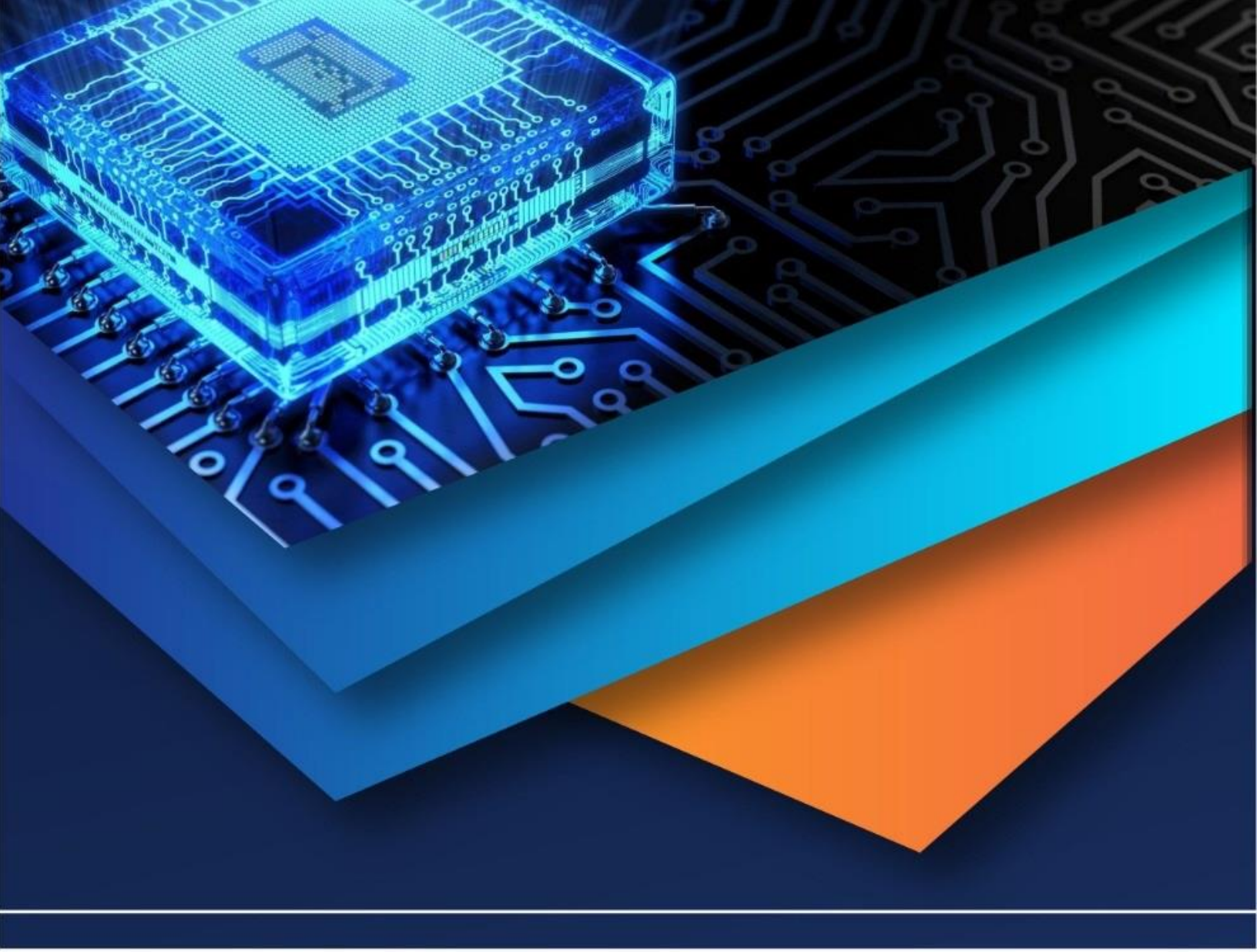
As per the study of different research on pile group by different researches which are mentioned above. It is concludes the following points.

*1)* It is compulsory to analyse the seismic effects on pile before construction.
*2)* The circular shape of pile proved most effective.
*3)* Low bearing capacity of soil. Make it necessary requirement of pile.
*4)* Piles can be used in different shapes, size and spacing between them
*5)* In future Different Analysis of group action of piles by different software.
*6)* In future different arrangement of pile group.

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