International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 4 Apr 2022, pp: 304-308 www.ijaem.net ISSN: 2395-5252

A Review Study on Aspects of Monopile as Bridge Foundation

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Submitted: 01-04-2022 Revised: 06-04-2022 Accepted: 11-04-2022

ABSTRACT: Piles have been used in Road and Railway Bridges. Monopile foundations are now more simple than type construction and standard foundations. Several equations have been provided to estimate the level of optimization of monomers based on traditional design techniques. Both perpendicular and lateral loads are always subordinated to the Monopiles. A Monopile foundation is studied in order to find a good idea for Monopile design. It primarily illustrates why a Group pile foundation is preferable than a Monopile bridge foundation. In this paper, a literature is review on study the Aspect of Monopiles as bridge foundations is reviewed. The motivation behind this study is to analyze the primary performance of monopile foundation and group pile foundation. The text concludes by providing suggestions for what type of foundation is adopted in bridge foundation for better performance on structural criteria and parameters.

KEYWORDS: Mono-pile, Group-pile, Foundation.

I. INTRODUCTION

In today's world, pile foundations are employed to support large structures and can serve as both a load carrier and a soil buttress. Pile foundations are used in bridges, transmission halls, coastal structures, and other massive buildings that are susceptible to lateral stresses. In the construction of buildings susceptible to earthquakes, soil movement, waves, and other natural calamities, the resilience of pile foundations to lateral loads is critical.

Piles have been used for foundation purposes by humans since prehistoric times. However, their behaviour is far from clear, and a substantial amount of research is being conducted on the subject. The field is evolving, with continuous advancements in technologies, analysis methods, and design approaches. In truth, pile design is a complicated process that relies significantly on practical facts, despite being founded on theoretical soil mechanics notions. These piles may sustain either vertical or lateral loads, or a combination of both. Due to the difficulty of analysing piles under combined loading, it is now standard practise to test piles individually for perpendicular loads to assess bearing capacity and agreement, as well as side loads to determine flexural behaviour. Mono-columns are usually constructed independently of vertical and lateral stresses, with the assumption that the effects of these loads are unrelated. The connection among vertical and horizontal burdens is not considered in the general sub-grade response method of analyzing side-loaded piles. Due to the mix of longitudinal and lateral stresses, pile reactions under combined loads may vary dramatically Pile responses under pure vertical or horizontal loads. Pile foundations were originally intended to transfer vertical loads to the soil.

II. TYPES OF FOUNDATION

In general, a foundation is one of the most significant components of a structure, as it serves as a link between the structure and the ground, transferring load from one to the other. Because one of the most important aspects in type selection is economic feasibility, it is briefly explored with each type. Following are the types of foundations used in construction.

PILE FOUNDATION:

An end bearing or skin disunion is a kind of end bearing or skin disunion that is used to sustain the structure and convey the cargo to a certain depth in a pile foundation. Larger constructions and circumstances where the soil at shallow depth is inadequate to withstand excessive agreement uplift and other difficulties are frequent uses for pile foundations.

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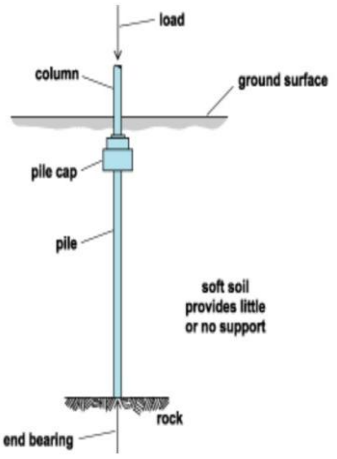

Fig.1 Pile foundation

GROUP PILE:

The combined bearing capacity of the individual piles that make up a pile group may or may not match the bearing capacity of the pile group as a whole. If the piles are suitably spread out, the group capacity may reach the total of the individual capacities. When numerous close-spaced piles are put together, the soil pressure created as resistance will overlap, lowering the piles' bearing capacity. In this scenario, collective action limits the capacity.

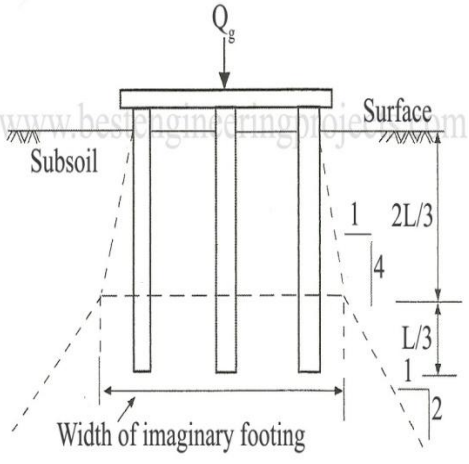

Fig.2 Group pile foundation

MONOPILE:

The Monopile foundation is an easy structure to make. It's applicable for structural stability and performance improvement. An 3.5 to 4.5 metre diameter steel Casing is used as the base. Depending on the kind of underground, the pile is pushed anywhere from 10 to 30 metres into the ground.

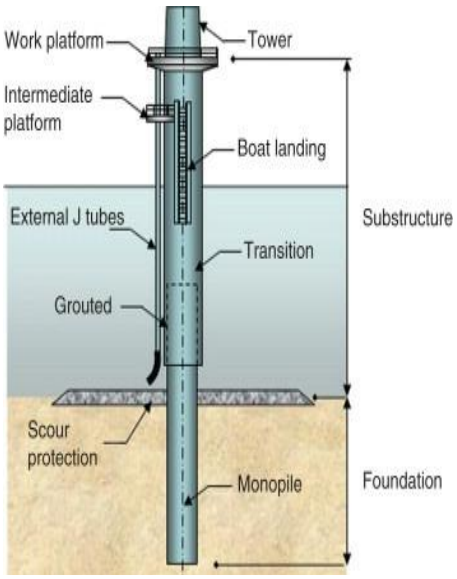

Fig.3 Monopile foundation

III. PARAMETER OF LOAD APPLICATION ON MONOPILE

- Compression and tension capacity of the pile material
- The area of deformation of the pile, as well as the bending moment capacity.
- The status of the pile's top and bottom.
- The pile was loaded eccentrically.
- Soil Characteristics.

IV. LITERATURE REVIEW

Technical papers from India and other countries are examined in order to determine the significance and need of this study in the context of monopile and group pile design. It gives an overview of the literature review.

[1]. **"Development of dissipative controlled rocking system for bridge columns supported on monopiles".** Monopile-supported bridge columns with dissipative controlled rocking connections are examined in this paper. In the proposed association, a blend of post-tensioning and inside unbound dispersants will be used allow the bridge substructure to self-centre and dissipate energy during an earthquake. This document gives an overview of the experimental work that will be done on a one-third size bridge pier at the University of Canterbury. Numerical analyses also reveal the results of the comparison between a monopile-based pier and a fixed-foundation-based one, in terms of the anticipated reaction.

[2]. **"Soil-Structure Interaction study on Group pile over Monopile foundation".** In this study, monopile foundations were found to be simple and

easy to construct, as well as being used as a standard foundation today. This paper primarily focuses on the soil interaction of group piles over monopile foundations. This illustrates why a monopile foundation is preferable than a group pile foundation. Using a monopile foundation reduces the number of piles. Monopile foundations are superior to group pile foundations in terms of strength and suitability for any type of soil. In these conditions, the results are good and acceptable. Monopile foundations are used in deep-water bridges.

[3]. **"Frequency effects in the dynamic lateral stiffness of monopiles in sand: insight from field Tests and 3D FE modeling".** As a result of this approach, the fundamental recurrence of the worldwide framework is changed past only the pre-oil frequencies. With coastal wind assiduity rapidly spreading across the globe, geotechnical research is focusing on foundation optimization for large-periphery monopiles. When it comes to cyclic/dynamic loading circumstances, monopile analysis and design still have a lot of reservations. This study's goal is to provide fresh information on the dynamic soil-monopile interaction.

[4]. **"A study on the effect of pile cap on the vertical impedance of a single pile".** In this study, pile foundations are utilized to support Impedance functions for pile foundations in various modes of vibration, which is a crucial step in the analysis of pile supported structures using Soil Structure Interaction (SSI). The effects of a pile cap bearing with the ground are ignored by the majority of accessible vertical impedance expressions derived from analytical and numerical models. In this paper taking the diameter of pile cap to diameter of pile was varied in multiples of pile diameters. The site consisted of irregular layers of silty sand and clayey sand, with relatively hard level occurring at 15 to 20m vertical extent. There is a technique known as sub-structuring that may be used to determine the influence of soil profile heterogeneity on pile cap impedance in multilayered and homogeneous soil profiles.

[5]. **"Behavior of Single Pile in Liquefied Deposits during Earthquakes".** Investigations of inertial loads generated by the soil touches the super structure; as well kinematic interactions between the surrounding soil and the pile are required for these operations. In this research the response of the mound is greatly influenced by the depth of the liquefied layer. At the point where the liquefied layers meet the non-liquefied layers, the bending moments are highest. When the liquefied soil layer reaches 60% of the all out thickness of the soil layer, maximum bending moments occur. The input parameter for soil-pile interaction in the liquefied state is investigated in this work. There are five levels on the stratum in this test, and the pile diameter is 50cm. When liquefied soils were compared to non-liquefying soils, the pile reaction was significantly increased.

[6]. **"Design of Single Piles Using the Mechanics of Unsaturated Soils".** According to the study author, data on the saturation soil saturation strength and soil water properties curve are also used to examine fluctuations in the column capacity of single piles in response to matrix suction. The updated and approaches for determining maximum shaft bearing limit with regards to single heaps raised in unsaturated soils have shown promising outcomes in designing practice. To evaluate the last shaft obstruction of heaps in unsaturated soils, this study uses a refined version of the Skempton methodology, the Chandler and Burland method, and Vijay vergiya and Focht method all of which were previously employed. According to the authors, the average substrate utilized in this study was a barrel shaped tempered steel bar with a breadth of 20 mm.

[7]. **"Experimental investigation into pile diameter effects of laterally loaded mono-piles".** The material of this paper is single-pile foundations in sand, which gives the findings of model experiments. A geotechnical centrifuge was used to conduct the testing. The point of this study was to inspect the impact of periodic side loads lateral capacity and stiffness of large diameter monopiles. These large dimensions are beyond the legitimate range of the most commonly utilised design methodologies. Static lateral capacity and stiffness were shown to increase significantly with increasing pile diameter from D=2.2m to D=4.4m during cyclic load testing in this study. L/D = 5, Id = 60 percent, e=2.4-e=4.8m eccentricity, and this test was performed with an L/D of 5.

[8]. **"Single Pile Simulation and Analysis Subjected to Lateral Load".** In this concentrate on 3D limited component examination was utilized to confirm single substrate performance in the lateral loading state. Both indirect and square samplings were used to inspect the impact of heap shape on heap reaction. Analysis of L/B slenderness ratio L/B was examined in this study. The piles were modelled using a linear elastic model. In this study, pile slenderness ratio (L/B) influences pile

deformation caused by lateral loads. Compared to long piles (L/B=8.3), short piles (L/B=8.3) have less lateral end deflection for the same force. In the case of short stock (L / B = 8.3,12.5), the inverted position is 1/5 from the bottom.

[9]. **"Single piles in Lateral Spreads: Field Bending Moment Evaluation".** The bending response of the single-stack foundation subject to lateral diffusion was evaluated using two simplified engineering methods for boundary equilibrium (LE) developed in this study. Use of two- and three-layer soil profiles, they're evaluating six centrifuge models to determine whether they can accurately recreate single reinforced concrete piles. The maximum continuous pattern in centrifuge tests is between 100 and 200 kNm. According to the results of this research, the deep single area of continuous lateral pressure of 10.3 kPa per unit area of the pile cap was estimated to be the maximum single piles tested in the range of 15%. According to this author, six models of single-stunt piling centrifuges were used to develop the two LE technologies presented in the paper.

V. CONCLUSION

From a review of Literature revealed that

- By using a monopile foundation we can reduce the structure compared to the group pile foundation and also decreases the number of piles.
- It may be possible to achieve optimum performance by positioning a relatively small number of piles in the right place rather than using more heaps or increasing the raft thickness.
- In monopile case, the vertical load reduces the maximum bending torque as well as the lateral deformation when subjected to single rod lateral load.
- Safety against a bearing capacity failure, average settlement and different settlement are the quantities to be controlled by monopile foundation.
- Monopile foundations are suitable for the stability of structures and improve performance.

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