International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 06 | June-2018 www.irjet.net p-ISSN: 2395-0072

# ULTIMATE LOAD BEARING CAPACITY AND SETTLEMENT OF TRIANGULAR SCREW PILE BASED ON DESIGN PARAMETERS

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**Abstract-** *A helical anchor pile is a deep foundation. Its purpose is to transfer a structural load to deeper, stronger and less compressible materials bypassing weaker and more compressible material that would be unsuitable for the support of a conventional shallow foundation. Centre of interest of this paper is to ascertain load dispersion, to study load carrying behavior of triangular concrete screw pile, to compare the variation of helical pitch on load bearing capacity of screw piles.FEM analysis is used to calibrate the model in order to expand the knowledge and to compare the result obtained from the respective models.*

***Key Words***: Foundation, bearing capacity, screw piles, triangular screw pile, settlement of foundation.

## 1. INTRODUCTION

Screw piles, are also known as screw anchors, helical piles, and helical anchors helical piles was introduced by Alexander Mitchell in 1836 for supporting lighthouses. In the last decade the use of screw piles has considerable increase, nowadays they are used to support and rehabilitate structures subjected to compressive axial load. Screw piles are classified in to two based on shaft depth and helix depth ratio (H/D)>5 then it is said to be deep pile, and otherwise as shallow piles.

**Fig-1.1:** Concrete screw pile

Screw piles are wound into the ground much like a screw into wood. One of the great advantages is that unlimited pile length can be attained through the addition of extension segments. Moreover, installation of helical pile is a vibration free process therefore the use of screw pile is very much desirable in urban area due to its minimal level of noise and less vibration to the neighboring structures. Screw piles are installed using various earth moving equipment fitted with rotary hydraulic attachments.

**Fig-1.2:** Installation of crew pile

The axial capacity of helical piles is influenced by the pile geometry, embedment depth, the overburden pressure, and soil strength. The failure mechanism of the helical piles is a function of the embedment depth and vertical spacing of the helices. Helical Pile behavior can be categorized by the occurrence of deep and shallow failure modes. The failure plane in the case of shallow anchors extends to the ground surface, whereas in the case of deep anchor behavior, failure is localized around the helices and failure planes are fully restrained within the soil mass.

Two failure mechanisms are possible for helical piles depending on the vertical spacing of the helices. When the spacing of helices is large enough, the pile capacity can be obtained based on the ''individual bearing method'' In this method, each helical plate is considered as an individual plate. For small values of spacing ratio failure tends to occur along the cylindrical failure surface circumscribed by the helices in this case cylindrical shear method is used which connect the top and bottom helices.

Screw pile foundations are still used extensively, and their usage has extended from lighthouses to rail, telecommunications, roads, and numerous other industries where fast installation is required, or building work takes place close to existing structures. Most industries use screw pile foundations due to the cost efficiencies and - increasingly - the reduced environmental impact. 'Screwing' the foundations in the ground means that there is less soil displacement so excess soil does not need to be transported from the site, saving on transportation costs and reducing the carbon footprint of the project. The main benefits of screw pile foundations include: shorter project times, ease of installation, ease of access etc.

### 1.1 Scope and Objective

- To study the load carrying behavior of concrete and steel screw piles.
- To compare the variation of the helix pitch on load bearing capacity of screw piles in general.

## 2. GEOMETRY

Different models of screw piles are created by varying pitch of the thread in the screw pile. Circular shape shaft is used in all the models with a length of 1000mm and the thread is triangular in shape. Also pitch of the thread is also changed in 80mm, 60mm and 45mm.Modelling of soil and screw pile is done in ANSYS workbench.

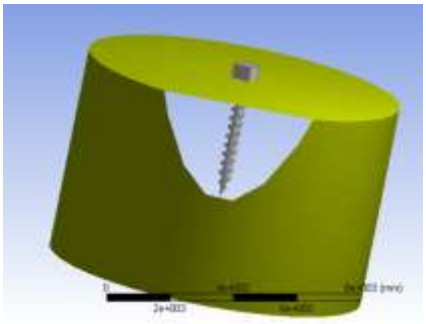

**Fig-2.1:** Screw pile with triangular thread with in the soil

## 3. MATERIAL MODELS

In the ANSYS workbench each material is modeled as solid bodies. A material property is an intensive, often quantitate, property of some material Different properties like density, tensile yield strength, compressive yield strength, poisons ratio etc will be different. Therefore each properties are given to each solid bodies to make it conform to realistic material.

Material used for the construction of the screw pile is concrete with M35 grade concrete and Fe415 grade reinforcing steel. Diameter of the steel used are 6mm, 8mm and in the pile cap 12mm diameter steel is used.

**Table-3.1:** Material properties of concrete

| Parameter | Value | Unit |
|---|---|---|
| Density | 2300 | Kgm3 |
| Young's modulus | 3E+10 | Pa |
| Poisson's ratio | 0.18 | Pa |
| Shear modulus | 1.2712E+10 | Pa |
| Bulk modulus | 1.5625+E10 | Pa |
| Yield strength | 2E+07 | Pa |

**Table-3.2:** Material properties of soil

| Parameter | Value | Unit |
|---|---|---|
| Density | 1750 | Kgm3 |
| Young's modulus | 1.34E+7 | Pa |
| Poisson's ratio | 0.3 | Pa |
| Shear modulus | 1.1167E+07 | Pa |
| Bulk modulus | 5.1538E+06 | Pa |
| Yield strength | 1E+06 | Pa |

## 4. ANALYSIS RESULT AND DISCUSSION

In this study three models where modeled with pitch of the thread as 80mm, 60mm and 45mm.From the analysis it is found that the triangular screw pile with 80mm pitch provided for the screw pile thread with shaft diameter 70mm shows a maximum total deformation of 0.03781m and minimum total deformation as 0

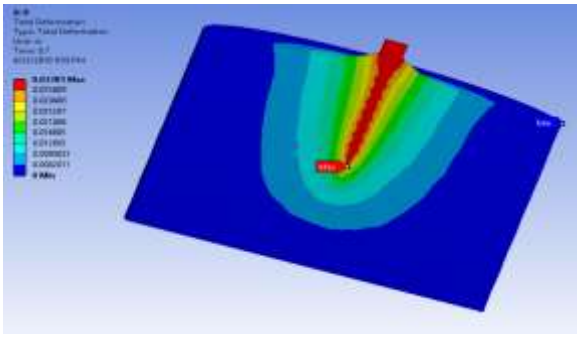

**Fig-3.1:** Total deformation

Equivalent stress of screw pile with 80mm pitch is found to be maximum at the bottom tip end of the screw pile and the maximum value is 1.0865e6 and the total deformation is found to be minimum at the top of the pile and the value is found to be 1.2072e5.

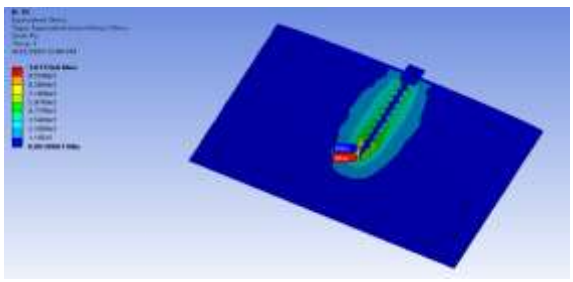

**Fig-3.2:** Equivalent stress

## 4. CONCLUSION

Settlement in a structure is defined as the distortion or disruption of part of a building due to unequal compression of its foundation, shrinkage such as that which occur in timber-framed buildings as the frame adjusts its moisture

content or undue load being applied to the building after its initial construction. From the analysis it is found that that screw pile with 60mm pitch (ten numbers of threads) undergoes more sliding when the force is increased. In the case of screw pile with pitch as 45mm (12 numbers of turns) the sliding distance is found to be less than that of screw pile with 10 numbers of turns. Comparing with screw piles having 12 and 10 numbers of turns the sliding distance is found to be less in the case of screw pile with 8 numbers of turns.

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