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Pile Foundation Associated to Metro Rail Hyderabad

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Abstract: **In consideration of geological strength of the structure, pile foundations are commonly adopted for various types of multi storied and industrial structures, bridges and offshore structures. Pile foundation is generally used in the areas where the stability of the soil is low. It can be done by drilling the pile from the ground surface until it reaches the hard strata. The safe design is very important to ensure efficient functioning of various structures even under severe loading conditions. In the design process, ground conditions (soil type) play an important role in terms of loads transferred to foundation and foundation capacity. This paper presents design of pile foundations for different ground conditions. Estimation of loads, for a typical structure considered being located in specific site, for different ground conditions according to Indian standards are presented. Design considerations based on various theories evolved on pile foundation performance concepts under loading conditions are discussed.**

Keywords: **A sophisticated support system solution for various structures which significantly enhances the quality of strength provided, pile foundation, ground conditions, soil stability, piling standards.**

I. INTRODUCTION

Pile foundations are one of the types of deep foundations. They are used in case soft/silty/clayey type of soils. As in such case of soils going for normal foundations may not be possible either from economical point of view or may not be possible at all in case u want to construct near seashore etc., these are the foundations which transfer load to greater depths, where there is strong strata / load reaching that point is minimal. These are pipe shaped, we have different types of pile foundations. Pile foundation is required when the soil bearing capacity is not sufficient for the structure to withstand. This is due to the soil condition or the order of bottom layers, type of loads on foundations, conditions at site and operational conditions. Many factors prevent the selection of surface foundation as a suitable foundation such as the nature of soil and intensity of loads, we use the piles when the soil have low bearing bridges and dams. A pile foundation consists of two components: Pile cap and single or group of piles. Piles transfer the loads from structures to the hard strata, rocks or soil with high bearing capacity. These are long and slender members whose length can be more than 15m.Piles can be made from concrete, wood or steel depending on the requirements. These piles are then driven, drilled or jacked into the ground and connected to pile caps. Pile foundation are classified based on material of pile construction, type of soil, and load transmitting characteristic of piles.

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Figure 1

II. BLOCK DIAGRAM

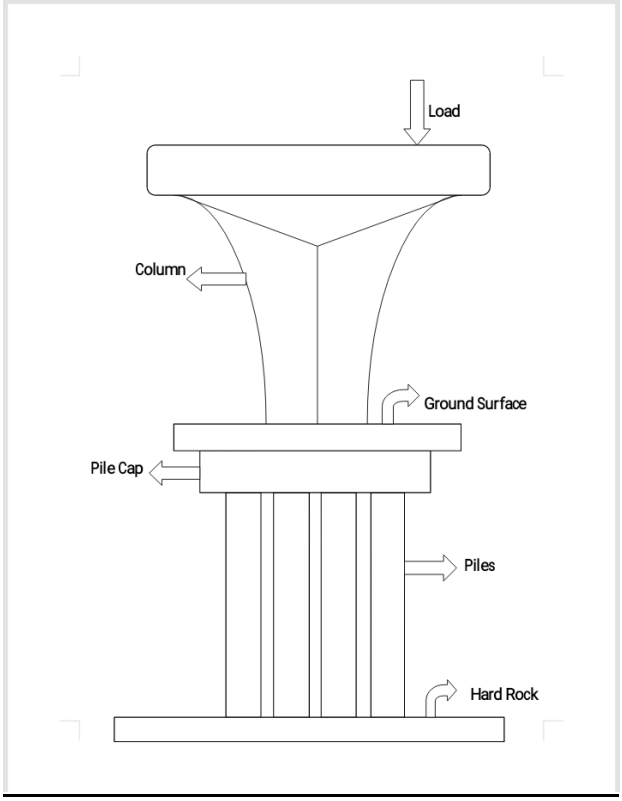

Figure 2

This block diagram shows the cross section of pile foundation. The piles are inserted under the ground until it reaches the hard strata. A pile cap is provided above the piles. It usually forms part of foundation of the structure or support base for massive loads. Column is used to transfer the loads to the piles.

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III. METHODOLOGY

The installation process and method of installations are equally important factors as of the design process of pile foundations. pile installation methods are installation by pile hammer and boring by mechanical auger. In order to avoid damages to the piles, during design, installation Methods and installation equipment should be carefully selected .If installation is to be carried out using pile-hammer, then the following factors should be taken in to consideration.

- The size and the weight of the Pile.
- The driving resistance which has to be overcome to achieve the design penetration.
- The available space and head room on the site
- The availability of cranes and
- The noise restrictions which may be in force in the locality.

3.1 Pile driving methods (displacement piles):

Methods of pile driving can be categorized as follows

- Dropping weight
- Explosion
- Vibration
- Jacking (restricted to micro-pilling)

3.1.1 Drop hammers:

A hammer with approximately the weight of the pile is raised a suitable height in a guide and released to strike the pile head. This is a simple form of hammer used in conjunction with light frames and test piling, where it may be uneconomical to bring a steam boiler or compressor on to a site to drive very limited number of piles.There are two main types of drop hammers:

1. Single-acting steam or compressed-air hammers
2. Double-acting pile hammers.

- Single-acting steam or compressed-air comprise a massive weight in the form of a cylinder. Steam or compressed air admitted to the cylinder raises it up the fixed piston rod. At the top of the stroke, or at a lesser height which can be controlled by the operator, the steam is cut off and the cylinder falls freely on the pile helmet.

- Double-acting pile hammers can be driven by steam or compressed air. A pilling frame is not required with this type of hammer which can be attached to the top of the pile by leg-guides, the pile being guided by a timber framework. When used with a pile frame, back guides are bolted to the hammer to engage with leaders, and only short leg-guides are used to prevent the hammer from moving relatively to the top of the pile. Double-acting hammers are used mainly for sheet pile driving.

3.1.2 Pile driving by vibrating:

Vibratory hammers are usually electrically powered or hydraulically powered and consists of contra-rotating eccentric masses within a housing attaching to the pile head. The amplitude of the vibration is sufficient to break down the skin friction on the sides of the pile. Vibratory methods are best suited to sandy or gravelly soil.

3.1.3 Jetting:

To aid the penetration of piles in to sand sandy gravel, water jetting may be employed. However, the method has very limited effect in firm to stiff clays or any soil containing much coarse gravel, cobbles, or boulders.

3.1.4 Pile driving by vibrating:

Vibratory hammers are usually electrically powered or hydraulically powered and consists of contra-rotating eccentric masses within a housing attaching to the pile head. The amplitude of the vibration is sufficient to break down the skin friction on the sides of the pile. Vibratory methods are best suited to sandy or gravelly soil.

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IV. FLOW CHART

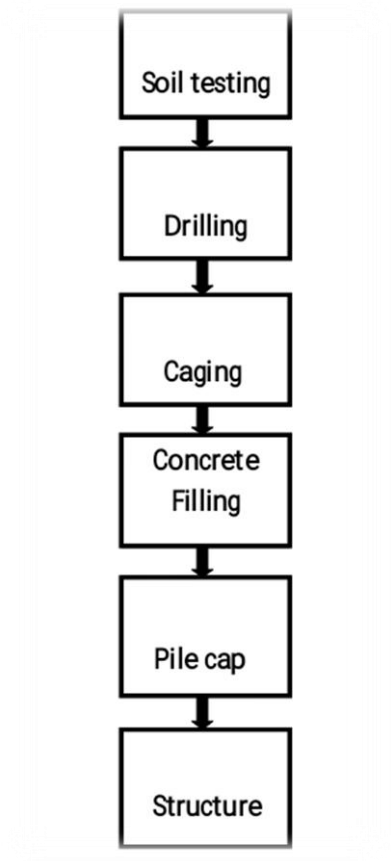

Figure 3

V. DATA

Utility checking is conducted in order to finalise the exact location of the digging building the pile and installation of the pile is done as per the drawing approved by the consultant. The key operations involved in the pile construction are pre tube driving, boring pile hole, Reinforcement cage fabrication, lowering of cage in to the bore, concreting, etc.

A road clearance of 5.5 m is ensured below the viaduct structure. The foundation shall be open foundation at most of the locations though pile foundation socketed in rock may be necessary at certain isolated locations. The superstructure shall be pre-cast segmental construction which will cause minimal inconvenience to the road users.

The other key aspects are it accommodates two directional tracks, built on single pier, made up of single box.

5.1 Grade of concrete Use:

M-30 : Pile cap and open foundation

5.2 Design stipulations :

Characteristic compressive strength of concrete = 30 N / mm2

Maximum size of aggregates = 20 mm

Degree of workability = Very Good

Compaction factor = 0.75

Degree of quality control = Very good

Pile integrity test is conducted to assess the condition of the pile .

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5.3 Automation for Data Logging and Pile Installation Monitoring Systems

Data logging and pile installation monitoring system was introduced on Multipurpose Integrated driven piling rigs to eliminate manual recording and reporting and to improve the installation process of driven cast-in-situ piles. Manual data recording errors are eliminated and it is also possible to send the data from the piling rig to any desired place through internet.

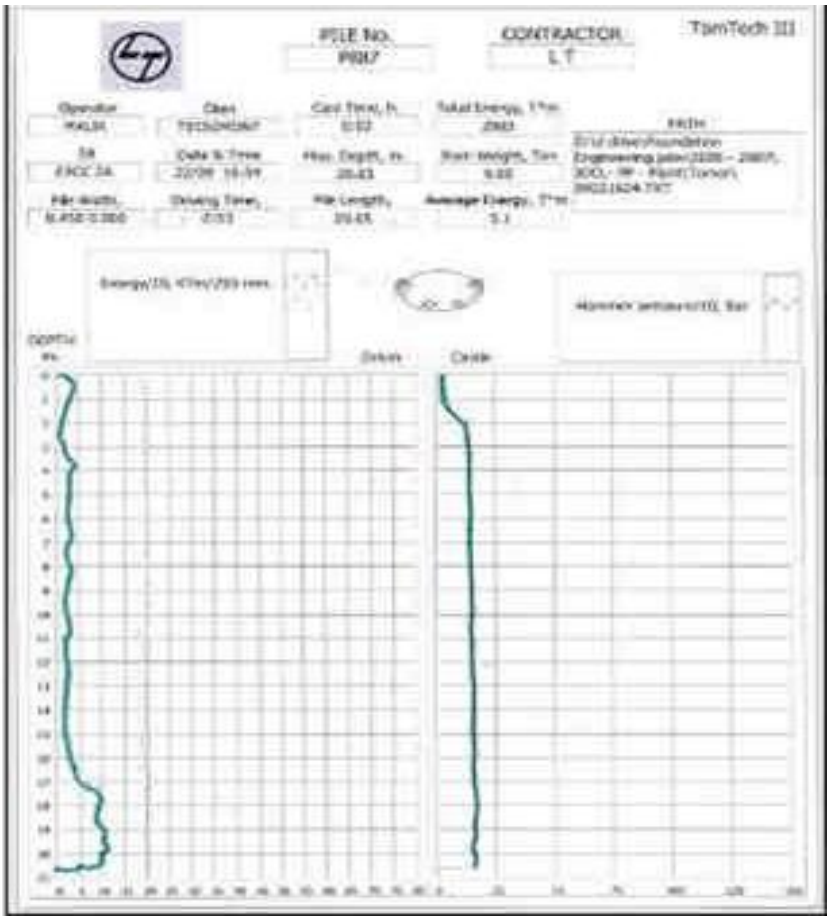

Figure 4

Figure 5

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5.4 Geo Technical Investigation:

Geotechnical investigations were carried out along both the corridors upto a depth of 10 m in soft rock and 3 to 4 m in hard rock. Soil and rock samples were collected and tested in laboratory. The top layer of soil is generally reddish silty sand with clay. The layer is medium dense. Below this, is a layer of soft rock and a layer of hard rock. For the elevated section shallow foundation on soft rock and pile foundation upto 1.2 m dia socketed In rock is recommended. The bearing capacity of soil is not likely to cause any problem for the foundations. Section shallow foundation on soft rock and pile foundation upto 1.2 m dia socketed In rock is recommended. The bearing capacity of soil is not likely to cause any problem for the foundations.

5.5 Pile Cap:

It usually forms part of foundation of the structure or support base for massive loads. Column is used to transfer the loads to the Piles.

5.6 Technical data:

The diameter of the pile is 1200mm with Bullets and core barrel auger pile and 1.2m Depth and 13 as per portal pillar cap 7.5*2. Pile foundation is used where the soil Bearing capacity is than 75 Kn/m.

5.7 Recommendations:

Following recommendations are being made for this extension. However the type and depth of foundation should be decided based on the detailed soil investigation at the time of execution of this line. Safe Bearing capacity for the footing laid on the fractured rock at depth of 3m and on hard rock at a depth of about 5m may be taken as 45 t/m^2 and 75 t t/m^2 respectively. Chemical analysis of the soil shows that all the relevant parameters viz. pH, chlorides and suphates are within permissible limits. No additional precautions are needed while concreting the foundations

VI. APPLICATIONS

As far as deep foundations are concerned there are no. of types of deep foundations and pile foundation is among one of them; uses of Pile Foundation depends on the type of pile used, the intended function for which the pile is used, the load which is to be applied on the pile and the type of material which is used for the construction of the pile.The following are the uses of piles.

A. End Bearing or Compressive Strength:

Sometimes we use the piles to achieve the required compressive strength in the soft soil; in that case we use the piles to transfer the load through that soft soil to a suitable bearing stratum by using the end bearing or toe bearing property of the pile.

B. Scour Depth:

To build a structure within the water and on the water river or canal bed; we have to build the foundation through the river bed and within the scour depth.

For River Ravi in Pakistan the scour depth is 30 to 35 cm below the bed. In these sorts of situations if we go for shallow foundation we might have to use coffer dam or some diversion which is very uneconomical.

C. Tension or Uplift:

Piles are usually used to carry compressive nature of load through tip bearing or end bearing; but in case of tall structures or like towers there might be tension that must be resisted by piles. For example for a tower carrying high power transmission lines the thrust of wind might produces over turning that must be resisted by the tension piles; other options include use of deep foundation or thick raft which is sometimes uneconomical.

VII. CONCLUSION

By the observation it shows that pile foundation is used where the soil stability is less. So the pile foundation is mandatory in such places where the soil is less stable for the heavy constructions such as bridges, flyovers etc. Low bearing capacity soils having weak physio- mechanical properties requiring thorough investigations especially when pile foundations are to

be constructed. Depending on the type of structure, soil conditions, expertise and finance, driven piles (displacement piles) foundations installation techniques mostly used include: dropping weight- hammer, explosion, vibration, jacking, screwing, jetting or combination of any of these.

ACKNOWLEDGMENT

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