CONSTRUCTION TECHNOLOGY OF CAST-IN-SITU PILES IN EXPRESS-WAY PROJECT FROM JEHANGIR-CHOWK T0 RAMBAGH

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Abstract

The present system of transportation in Srinagar City is highly inadequate, with the area covered by transportation being only 3% against 10%–14% in metro cities. A thorough survey was conducted and an Express-Way has been proposed from Jahangir Chowk to Rambagh along Airport Road which is being financed by Asian Development Bank (ADB). Srinagar city is located along the banks of river Jhelum, while studying geological history it is clearly understood that this area has been flooded often and hence the soil found is because of alluvial depositions of River Jhelum. Such alluvial deposits are consistently associated with matrix of highly decomposed organic silts/peat/trapped partially decomposed fibrous organic matter etc. Critically low soil bearing pressure is only found in alluvial soil (mud or silt), wet sand or poorly compacted fill. There are also rare cases of soils that have adequate bearing potential in dry weather, but which change to low bearing potential in wet weather. After a series of soil-exploration tests and as per the Codal-Design analysis of this prestigious project, it was found to provide a deep foundation because in these soils formed by alluvial deposition the bearing capacity was very less and one such type of foundation , pile foundation, was employed in this project .Furthermore no hard-strata was found beneath and hence the best possible solution was to use Friction Piles. Srinagar, the capital city of Jammu and Kashmir state of India also falls in the Zone-V of the BIS-code of Practice (IS-1893-2002) which makes it vulnerable to Seismic-Disasters and earthquakes and Friction Pile also takes that thing into consideration .In this paper we are going discuss about how piling of this project was done.

***KeyWords*: Transportation, Express-Way, Alluvial, Depositions, Soil-Exploration, Foundation, Friction Piles, Seismic-Disasters**

1. INTRODUCTION

Piles are columnar elements in a foundation which have the function of transferring load from the superstructure through weak compressible strata or through water, onto stiffer or more compact and less compressible soils or onto rock. They may be required to carry uplift loads when used to support tall structures subjected to overturning forces from winds or waves.. Combinations of vertical and horizontal loads are carried where piles are used to support retaining walls, bridge piers and abutments, and machinery .Construction of cast-in-situ bored pile is a concealed work. Without proper construction methods or adequate quality assurance measures, it is prone to various types of quality accidents, leading to schedule delay and economic losses. This is especially true for this project in which super-long piles with unusually large diameter were used. To address the problem, construction organization design and construction technology for pile foundations of this project were discussed repeatedly and adequate prevention measures were taken in key construction process. Based on soil-exploration, among different types of piles frictional pile (cast in-situ) was found most feasible and thus same type of pile was used in said project. Friction piles are those piles which are installed in soft soils, such that the load is transferred through friction along the length of pile.

1.1 Excavating

Bores required for piling were dug by manual rotary piling rig complete with casing Adaptor and Casing Oscillator. The usual duration of time required for making bore for each pile varies from 2-hours to 3-hours.As per the design the depth of each pile from Ground-Level(G.L) is 23 meters ,thus bore depth being remains within the same range. The bore depth is controlled by automatic-sensors, fitted at base of rig or is measured manually with the help of sounding chains of known length. While boring operation, it is necessary that the walls of excavated region remain intact and do not collapse. Thus for preventing stuffiness and for stabilizing the respective sides of bore hole Bentonite solution is continuously pumped by high pressure reciprocating pumps/vertical pumps. The overflow slurry which combines with bored mud, soil, sediments etc is passed through channels and is collected in sediment tanks where sediments can settle and bentonite can be re used. Bentonite is an adsorbent ,alumuniumphyllosilicate, impure clay consisting mainly of montmorillonite. There are different types of bentonite, each named after respective dominant element, such as potassium(K),sodium(Na),calcium(Ca),and aluminum(Al).Among all these we found sodium based bentonite used at field because of its excellent colloidal properties. Sodium bentonite expands when wet, absorbing as much as several times its dry mass in water. The usual density of bentonite solution is 1.05 gms/cc to 1.10gms/cc, marsh cone viscosity 30 to 40 and pH value 9.5 to 12.

Figure-1 Rig fitted with auger on work (boring)

Figure-2 Emptying of cylinder on ground (through alternate clockwise and counter clockwise motions).

1.2 Hole cleaning

During the concrete pouring process, the concrete in the hole would have problem of rising and slurry mixing in if the slurry possesses excessive relative density and sand content. However, if the slurry viscosity is excessive low, the sand particles' sedimentation in the slurry will accelerate and the hole would collapse which is not avail for wall protection and deslagging. The thickness of slummage will reduce the bearing capacity of the pile and should be cleaned as thorough as possible and the hole cleaning includes replacing original slurry, changing the performance of slurry in the hole and slummage wiping out. When the hole reaches designed elevation, the diameter, gradient, depth is checked according to the standard. After that, deslagging is carried out by pumping with the slurry cycle system of the drill constantly while fresh water is poured in to the hole to make the indexes of relative density, viscosity, sand content and slummage thickness, which is 1.08, 18Pa.s, 1.5% and 100mm respectively, meet the requirement of the code,. During the slurry replacing and hole cleaning, the water head should be maintained to prevent hole collapsing. Hole cleaning should be done as soon as possible after the checking, otherwise the mud bored will subside and result in difficulties of hole cleaning or even hole collapsing.

1.3 Reinforcement of pile-cage

In reinforcement of piles corrosion free Fe-500 for high strength and mechanical properties is used, according to codal design. If the reinforcement cage is very long i.e. not possible to handle in one lift, the cage will be lifted one by one and spot welded at the joints. Reinforcement of pile with a depth of 23mts is attained by using two cages i.e.; lower cage and upper cage ,each having a length of 12mts, both these cages are welded at each junction, to make it as a single unit. The reinforcement in the pile shall consist of the following:-

a) *Vertical bars or main reinforcement bars*

16mm dia bars @24 bars arranged and welded equidistantly around a series of stiffners (which are in circular shape and their sole aim is to provide the respective shape.

b) Longitudinal/Ties/Spacer bar Reinforcement

Reinforcement provided shall be as per approved design with respect to diameter, numbers and should run through the entire length of the pile. In this project we noticed, that diameter of these bars vary within the length of pile in case of upper cage .From top initial 1.2 mts were having 16mm dia bars, next 7.5mts were having 10mm dia bars, next 1.5mts were having 16mm dia bars and rest of ist cage i.e; 1.8mts again having 10mm dia bars .This is done so as to prevent failure of pile upon lateral loads (usually seismic and wind loads).

Cover:-Clear cover to reinforcement is as per approved design (min 75mm).the basic reason for cover is to prevent corrosion of bars.

(3.1) Crane fitted within rig used to lift and drop reinforced cage into the pile bore

(3.2) Upper and lower cages are welded (using arc welding) to make it work as a single unit

(3.3) Hooks are provided on top of upper cage just before lowering it without any supports.

Figure-3 Sequence of laying a pile cage

1.4 Flushing and concreting

After cage lowering, 200mm diameter tremie pipes in suitable lengths are to be lowered in the hole. The operation is done by lowering one tremie pipe after another and connecting them threading to maintain water tightness throughout its entire length .Gap between the pile base and tremie is between75mm to 100mm.Tremie head is provided for maintaining flushing activity. The bore is flushed by fresh bentonite slurry through the tremie head. Flushing is done to remove all the loose sediments which might have accumulated on the founding strata. Flushing operation is continued till the consistency of inflowing and outflowing slurry is similar.After flushing is completed tremie head is removed and funnel is attached to the tremie pipe. Before actual concreting is done, concrete sample is taken and its workability is determined by using slump test. The slump value of concrete should lie within range of 150mm to 200mm.At times we come across with less workable concrete whose workability is increased by using plasticizers or super-plasticizers in adequate proportion. Plasticizers are mainly derivatives of lignosulphonates (a byproduct of paper industry).At same time concrete sample is taken and in filled in cube mouldings for determining its compressive strength after 28 days. Temperature of concrete sample is also determined and should exceed 5°C.The site engineer always takes a note of these properties of all concrete trucks mounted in-transit mixtures, which come from batching plant and either approves it or provides necessary guidelines for its improvement before actually using it. The concrete mixing transport truck maintains the material's liquid state through agitation, or turning of the drum, until delivery. The interior of the drum on a concrete mixing truck is fitted with a spiral blade. In one rotational direction, the concrete is pushed deeper into the drum. This is the direction the drum is rotated while the concrete is being transported to site. This is known as "charging" the mixer. When drum rotates in the opposite direction, the Archimedes-screw type arrangement, forces the concrete out of the drum.

(4.1) A transit mixer carrying concrete **(4.2) Tremie pipe**
arrangement

Figure-4 concreting of pile

Figure-5 Slump test carried for concrete

After completing slump test, concreting of pile is done through tremie pipes. Concrete is drained in the funnel fitted at top of tremie pipes, the total concrete quantity in the funnel should be more than the volume of entire pile plus free space below pile ensuring water tight concreting through tremie. As the concreting proceeds the tremie pipes are to be removed one by one, taking care that the tremie pipe has sufficient embedment until whole pile is concreted. Sufficient head of green concrete is maintained to prevent inflow of soil or water in concrete, thus concreting is a continuous process from toe to top of pile. The concreting of pile is done upto a minimum of 300 mm and at field we found it about 1.5mts to 2mts above cut-off level. On an average at site it required 26.05 cubic meters of concrete, for concreting of each pile.

CONCLUSIONS

The preparation before construction must be sufficient, the completion of design and construction of drilling platform is the precondition and guarantee of completion of the large diameter pile in deep water construction.

Influenced by wind and mechanical vibrations , the platform and casing waggles, forward intersection method is feasible for construction surveying and precisely positioning of steel pipe pile and casing driving and steel cage suspension. In the process of percussion drilling, measures are taken to ensure the hole drilling. Such as the water head in the hole is kept 1.5m higher than that of outside the hole by pumps in and outside the hole.Procedures of hole cleaning, tremie installation, secondary hole cleaning and concrete pouring are very important, every step must be done carefully because any carelessness would result in failure of the construction.

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