Pile Foundation for skewed bridge using slow and old machinery.

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Abstract—Great Taj Mahal is built on well foundation. Well foundation can be constructed on the dry bed or after making sand Island. Cassions are relatively easy to construct provide sinking operations are smooth without much hindrance. Well foundation have many constructional difficulties, viz prolonged sinking period, tilting etc. These problems become worse and take more time when working season is winter. Especially in Indian Areas like Jammu & Kashmir where technology lacks. The only thing Engineers can do is to wait till working conditions become suitable. A case study is presented in this paper exploring the feasibility of pile foundation

Index Terms—well foundation, pile foundation, equipments used, pile construction, Archimedes's principle.

1 INTRODUCTION

. Well foundation is a massive substructure required to extend deep inside the river. The Depth of this foundation is chosen considering the grip length and bearing capacity of soil. Well foundation has to resist overturning heavy Scour. Well foundations are advisable where heavy scour at flood time would bare the piles and lead them to buckling. Pile foundations are required for the transmission of structural loads through deep water to firm stratum. Some of the problems encountered in well foundation are making of temporary sand Islands, sinking. tilting, keep eye on the level instruments. Most of the problems the engineers face are especially in winter .In rural areas, technology lacks and still in areas like Kashmir, old technology is used for the implementation of the work. In winter it is very difficult to work outside in the hazard conditions especially when old type winch crabs are used for the construction of well and pile foundation.

The rest of the paper has been categorized as follows: Section 2 Consists of the proposed system, Section 3 involves the system implementation, and Section 4 includes conclusion

2 PROPOSED SYSTEM

In this section I have explained the whole procedure
Fig. 1 explains the first stage of the well foundation by making a temporary island for the construction of well foundation. This process of making island as shown in Fig1 is costly and much hectic and lengthy procedure .The hammer which is shown in the figure is fixed with two boats.

. This hammer is made of timber and is required to construct the first stage of the well. The timber should be strong enough to resist the blow from the hammer. The material required for the island is usually sand and gravels known as puddle. This is the first process and it is the temporary enclosure built to exclude water from the working area and to permit free access for the further construction. The bund which is first constructed by sand and gravels require protection on outer sides, against being washed away and same can be provided by by sand bags.

(Fig. 1 First stage of well foundation. On going project near convent school in Kashmir)

When the bund is completed, the next stage is laying of cutting edge and building well curb. The inner conical shuttering should be preferably be of timber. The reinforcement of the well curb should then be fixed and the outer shuttering assembled. The outer shuttering should be of steel plates. The well can be concreted after this process. It is advisable to give curing time of seven days. After curing process is complete, the steining process is started. The maximum height of curb and steining recommended to build before open sinking is 2m.As shown in the figure 2, the steining process with 2m at a time .Sinking is usually done after allowing at least 24 hours of setting and curing for each lift. During initial sinking, the well curb may be sunk with hand i-e by sending men down and excavating by showel and taking out soil till the curb sinks and gets a grip up to depth of 1.5m.After the initial sinking the winch crab is used for dredging. The main problem encountered by winch crab is tilting and it is necessary to take care of tilting .Make sure the tilting is within permissible limits.

Fig. 2 shows the initial concreting of the well and starts in lifts (2m lift each) .A pathway is constructed for investigating the well.

One of the main concerns in this foundation is technology. The next figure will show us the manually operated machine for dredging the well .The winch is connected with the bell dredger for sinking the well.

Fig.3.A manually operated machine for dredging the well. This requires the shear leg arrangement and bar bell dredger for cutting the material inside the well. The machine is connected to the dredger through the guy wires and shear legs. The shear legs are placed on the bund and properly levelled. The dredger is connected through the pulleys and is operated by winch. This method is usually adopted for normal soils. For stiff soils different methods are adopted. More methods adopted for sinking while passing through the stiff layers are

1. Surface treatment
2. Jetting.
3. Blasting.

II. SYSTEM IMPLEMENTATION

The process for sinking the well is slow. As we can see that the technology is lacking to carry out an engineering project. The machine used above for sinking operation requires system of pulleys and wires. This process of sinking is used on slow track constructions. In India especially in under developed areas like Jammu & Kashmir (Srinagar), process of sinking the wells usually take years. Sophisticated machines are not available in these areas for construction works.

PILE FOUNDATIONS

. Pile foundations are used extensively for the support of buildings, bridges, and other structures to safely transfer structural loads to the ground and to avoid excess settlement or lateral movement. They are very effective in transferring structural loads through weak or compressible soil layers into the more competent soils and rocks below. A "driven pile foundation" is a specific type of pile foundation where structural elements are driven into the ground using a large hammer. They are commonly constructed of timber, precast prestressed concrete (PPC), and steel (H-sections and pipes).

Historically, piles have been used extensively for the support of structures in Boston, MA. This is mostly a result of the need to transfer loads through the loose fill and compressible marine clays that are common in the Boston area. Driven piles, in particular, have been a preferred foundation system because of their relative ease of installation and low cost

A bridge is under construction over River Jhelum near convent school in Jammu & Kashmir (Srinagar), India. The Pile and well foundation have been used. Pile foundation is easy to construct as compared to well foundation. Under two abutments, pile foundation is used. Cast in situ piles can be shell or shell-less pile. Both shell and shell-less piles were constructed. Piles constructed on G.P.O side are Shell less Pile. Soil was firm and was in conjunction with bentonite slurry. Other side of bridge (Convent side) was Shell Pile, strata was full of boulders and was hard. Boulders were removed manually and steel shell was driven to certain depth (5m). Piles constructed on this side (CONVENT SIDE) were without bentonite.

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Fig. 4 .A hammer is inserting the casing in the bore hole by winch crab. This is the first stage of the pile foundation. The method used for the construction of the pile here is direct mud circulation method.

Above fig. shows the winch crab with chisel for boring the pile. This process of piling is usually time consuming and require much care. The casing is inserted in the pile. The machine used here for boring is usually not used today. The availability of sophisticated machines for bore drilling capable of piercing through rocks has now made it possible to go for large diameter pile and longest pile. But in this project the sophisticated machines were not available. Machines like impact hammer for pile driving is not used in Srinagar, India.That is why even a small project take years to complete.

Left in casings has the following advantages:

1: Improve resistance to corrosion for main bars.

2: Provide additional restraint against lateral buckling.

Sometimes casings can be removed from the bore after pouring the concrete in the bore.

Sometimes during Boring, soil was added in pile. To make the strata of pile soft ,soil can be added in the bore during boring the pile .To prevent the collapse of sides bore, Steel shell was placed in the pile on convent side as shown in fig 5. On the other side (G.P.O side) bentonite was used. Bentonite can't provide 100% safety. Sides of bore (diaphragm walls) can still collapse besides adding bentonite. Sometimes piles can be bored to some extra depth. For example during construction of a pile on convent side, the bore collapses. It was difficult to remove the chisel from the bore. After 2hrs the extra dill rod was inserted and boring was started. This technique can help in removing the chisel from the bore hole whenever it collapses. The load carrying capacity of the piles can be determined from the following formulas:

i) Static Methods
ii) Dynamic Formulas
iii) Pile Load Test

Mostly frictional force is neglected while determining the Load carrying Capacity. Every time, especially rural areas where technology lacks, the more concern is methodology

Most difficulty arises due to presence of sand in the soil. The presence of sand in the soil can be felt in river banks. In these conditions Bentonite sometimes cannot prevent walls from collapsing. After drilling operation are over, reinforced steel Cage is inserted in the bore before concreting. Each bored pile can be constructed in three days as compared to well foundation. Most engineers can say piles having diameter 1.2m for river bridges are analogous to well foundation. But still the mode of construction is different and problems are different.

Fig 5 Steel shell or liner inserted in the pile.

Up to 5mtr depth, the liner is inserted. One shell in 1.25 meter and they are welded together. After that the shell is driven inside.

A) CONCRETING PROCEDURE

Concrete used for pile was M.30 Design Mix. When the reinforced cage is inserted properly by which crab, then concreting is started. Tremie Pipes are used for Concreting. Concrete is poured in the hopper. According to the procedures, before concrete is placed, the bore hole is bailed dry water. Concrete is placed in presence of water in bore. Whenever concrete falls through the termie in the bore hole, water comes out every time. Water present in the bottom of piles comes out. Archimedes Principle is involved here "WEIGHT OF SOLID DEPOSITED IS EQUAL TO LIQUID DISPLACED". When the concreting procedure is complete, we can notice that water and mud coming out of the pile. Concrete which is dropped initially through the tremie in the bore comes out from the bore at last. It gives us an idea that only fresh concrete remains inside the bore hole. The problem that occurs while concreting the piles is choking. Concrete gets choked in termie due to presence of air in the tremie. Modern technology has overcome this problem by placing ventilation tubes in the pipes. These ventilation tubes or hoses have advantage in under water concreting. They release the trapped air inside the tremie pipes. But where ventilation tubes cannot be provided due lack of technology, problem can be solved by providing a circular ring in the hopper just above the hole of hopper. The circular ring covered with cloth, attached with a spring

or a rod can be installed in the hopper. Whenever the Concrete is placed in the hopper, the winch crab lifts the hopper and the ring will exert a downwards force on the concrete. By this technique Choking can be prevented. Another method by which choking can be prevented is that in every tremie we can make small holes like made in the strainer type wells. In those wells those strainers prevent the entry of sand and dirt in the pipe .Likewise tremie can be made like this. We can make the small holes in the tremie which will release the air in the pipe but not the concrete.

4 CONCLUSION

As far as choice for deep foundation goes, well foundation and pile foundation are two different options available. Well foundation is time consuming and difficult to construct. It is a time consuming structure. It is related with many problems like prolonged construction, sinking that leads to tilting etc.But now universally pile foundation is adopted on all important bridges. Pile can be constructed in two or three days. There is no problem of sinking, tilting etc.Pile is time saving and easy to construct as compared to well foundation. The only doubt persists on whether the pile can withstand floating debris. Hence piles are the natural choice for bridge foundations in future.

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