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Consolidation of Soil by using Prefabricated Vertical Drains

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***Abstract*—** Insertion of PVD and Preloading is one of the most popular methods used to expel the water from the soil mass. As the water gets expelled, the shear strength of soft soil enhances appreciably and achieves the well consolidated mass. In consolidation process the most important task is to remove the water from soil mass. In natural process the water has to travel entire depth of the soil mass if the porous media is available, the water has to travel at least 50% of the depth which takes years. Hence in this paper we have used the prefabricated vertical drains (PVDs). PVD is the insertion of the artificial water drainage path which shortens the travel distance to just the radius of the drain (PVD) influence zone, this accelerates water expulsion process thus the consolidation is achieved.

Keywords- *Consolidation, Prefabricated vertical drain (PVD), Poly Vinyal Chloride (PVC), Drainage path.*

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I. INTRODUCTION

The idea of waste of water from soil mass through vertical channels was created by "Walter Kjellman" in 1940s. He created it for an alluvial sort soil. To build the structure on the delicate soil having less shear quality is exceptionally troublesome errand. The Civil designers everywhere throughout the world are confronting this issue from hundreds of years, rather from times when individual endeavoured to set up its initially developed staying in the delicate earth. One of the imaginative techniques is to utilize the pre-assembled vertical channels. Pre-assembled Vertical Drain is only a trough made up of PVC/plastic which serves as water depleting way wrapped in the sack made out of non-broiler geo-fabric matt, which serves as a channel which captures and stops the finest of the dirt particles on its external divider and just the water particles can go through it.

II. IMPORTANCE AND SCOPE

The importance of PVD is to permit pore water in the soil to seep into the drain, by which the collected pore water can be transmitted along the length of the drain.

The jacket material consists of non-woven polyester or polypropylene geotextiles that function as a physical barrier separating the flow channel from the surrounding soft clay soils and a filter to limit the passage of fine particles into the core to prevent clogging.

The plastic core serves two vital functions, namely: to support the filter jacket and to provide longitudinal flow paths along drain even at large lateral pressure.
Scope of the study is to understand and find out the mechanism of consolidation of soil, for achieving the required level of consolidation.

The PVD shall be inserted up to required level of consolidation. And the depth preferably the same are inserted in triangular grid so that three dimensional consolidation process get accelerate, due to minimum distance the water particle has to travel to reach the artificially inserted water trough, depending upon the compressibility, porosity, water content, drainage condition and depth of the soil mass.
The PVD are to be designed also the preloading and has to be working out theoretically for monitory the migration of water particle through the soil mass. The piezometer tube is inserted at regular interval. The settlement gauges are provided required/ designed spacing which are used for monitory settlement process.

III. METHODOLOGY

There are various methods of consolidation of soft soil. In this paper we have used prefabricated vertical drains.

3.1 Prefabricated vertical drains

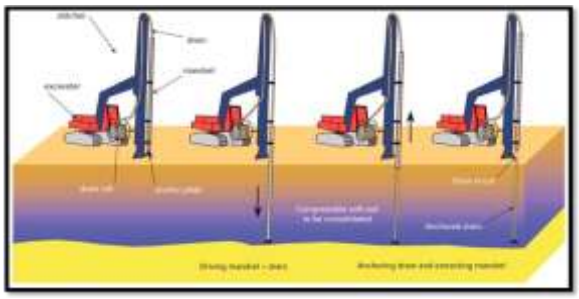

Fig.3.1.1 Installation Method Of PVD

Wick drains, also known as Prefabricated Vertical (PV) drains and Vertical Strip Drains (VSD), consist of synthetic band-shaped material that is installed vertically into

soft soils in order to accelerate preconstruction preloading programs.

The drains are approximately 4 inches wide by ¼ inch thick and composed of a plastic strip with drainage channels, wrapped in a filter fabric. The installation of the drains is performed using vibratory hammers and/or static methods, and the wick drain layout typically consists of a triangular or square pattern.

3.2 Installation method

Following procedure is being followed at the JNPT Site for placing prefabricated vertical drains (pvd):

Fig.3.1.1. shows the installation process of PVD.

Step 1: Over the marshy land which is at -2m R.L., filling the murum / good earth up to + 4.8m R.L.

Step 2: Laying aggregate filter blanket total 400 mm thick in 200mm thick each layer, comprising of aggregate size 10-20mm.

Step 3: Using stitcher machine PVD are inserted till refusal.

Step 4: Spreading of geotext fabric.

Step 5: Laying murum / good earth up to + 6.8m RL, laid in layers of 300 mm thick each layer compacted to 98% standard proctor density.

IV. MATERIALS AND PROPERTIES

4.1 Installation Rig

1. Type of Base Machine: Excavator of suitable mode CAT EL200B or larger model
2. Size (CAT EL200B): 3.18m x 4.45m
3. Weight (CAT EL200B) : 20 ton
4. Pushing Force : 5.5 – 20 ton
5. Mandrel Lifting and Pushing : Hydraulic gear drive
6. Mast Height : 8m

4.2 Typical Mandrel Dimensions

1. Weight of Guide and Mandrel : 1.5 to 4 ton
2. Length of Mandrel : 12 to 20m
3. Cross-sectional Area of Mandrel : 60 to 70 cm^2
4. Maximum Installation Depth : 11 to 19m

Fig.4.2.1Insertion Of PVD

V. ADVANTAGES OF PVD

1. High water discharge capacity.
2. Fast and easy installation.
3. Deep installation exceeding 40 m in depth is possible.
4. Proven performance under different soil condition.

VI. FUTURE SCOPE OF PREFABRICATED VERTICAL DRAIN

The preloading accelerates the process of consolidation. New technologies such as vaccum dewatering accelerates expulsion of water at higher rates and the consolidation process gets faster Inducing vibrations in the body of the soil mass may accelerated the process

Heating the soil mass underneath for expulsion of water from soil mass are also being experimented in foreign nations.

World over civil engineering community are doing more and more research in this subject.

VII. CONCLUSION

In the process of natural consolidation more time is required. And hence to overcome this difficulty we have to use the method of prefabricated vertical drains which required less time for consolidation. If the spacing between prefabricated vertical drains is reduced, the time required for consolidation process reduces drastically.

The marshy lands containing very soft soils upto very large depths can be used for developments in economical way with much ease. Specially in the areas like seaports this technique proves to be the best.

VIII. REFERENCES

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