International Journal For Technological Research In Engineering
Volume 7, Issue 5, January-2020 ISSN (Online): 2347 - 4718

AN EXPERIMENTAL STUDY AND DESIGN OF VERTICAL DRAINS FOR GROUND IMPROVEMENT

Shahid Mohammad[1], Abhishekh Sharma[2]
[1]M.Tech Scholar, [2]Assistant Professor and HOD, Dept of Civil Engg., Galaxy Global Group of Institutions-133102 (Haryana)

ABSTRACT: Nowadays, ground improvement soft clay soil is often achieved by combined loading with installation of prefabricated vertical drains (PVD's). Due to Installation of vertical drains disturbed zone (smear zone) is created it leads to excess pore water pressure. PVD's have recently become most popular method for soil improvement in Srinagar, as it is more economical for improving the performance of soft soil. It is estimated that the rate of consolidation occurs more rapidly when a drain is larger in size. Vertical drains are installed in two stages, vacuum preloading method and feasibility of its effectiveness. The reason of the research was to enhance practical knowledge of the mechanical behavior of clay imperative to preloading conditions and contact between vertical drains and clays. Reliable practical knowledge of these correlations for certain clay is crucial for CRS tests for horizontal as well as vertical drains. Due to CRS tests we can estimate the rate of coefficient of consolidation as well as hydraulic conductivity of soil. For design procedure the soft clay is assumed to be isotropic. In order to hold the dissimilarities in properties various numbers of parallel tests should be conducted and partial factor of safety (FOS) in the designing of PVD's is recommended for future research. Concerning the drain clay contact, a brief study on smear effects for the period of installation of vertical drains is important. It is estimated by various test that the rate of consolidation in clay is influenced less due to smear effect as compared to hydraulic conductivity of soil. To study the conduct of two embankments construct on clay soils, steady with vertical drains focused to vacuum loading. A several drain study is performed and the ground measurements are balanced with a sequence of numerical model calculations.
KEYWORDS: Prefabricated Vertical drains (PVD's), Smear Zone, Consolidation, Hydraulic conductivity of soil.

I. INTRODUCTION

India has a long coastal region having complex soft clay extended to a depth of 10 m to 30m.The improved demand of land for various uses as housing, industries, sea, airports and available limited space. Vertical drain is a common and effective technique to improve the quality of soft soil such as marine clays and marshy soils. Nowadays, Preloading with vertical drain, vacuum consolidation, stone columns and deep soil mixing has been used throughout the world. The initial type of vertical drain was sand drain which consists of a borehole with sand. The earliest form of vertical drains was sand drains, introduced Sand Wicks which were useful over sand drains relating to ease of construction, reduce smear effect and due to minor drain cross section and drain stability. Preloading is the simplest and most economical method to ease settlement and develop the bearing capacity of soft soil. The concept of vacuum loading with combined vertical drains was first introduced and successfully by Kjellman (1952).The fill load is less preferred as compared to vacuum load because vacuum load can be applied more rapidly to very soft ground and there is less or impossibility of undrained failure Cognon et al(1994).The preloading method PVD in a soft soil deposit can shorten take care of time for the behavior of ground improvement raising the rate of consolidation (Figure 1). There are various studies by researchers on vertical drain by designing embankments on soft soil by using analytical method, modified radial consolidation solution, to define slopes of normal consolidation and recompression lines. The effects of overlapping disturbed zones, caused by using prefabricated vertical drain were evaluated. The effectiveness of non-traditional patterns in drain installation was examined by comparing circular or triangular verses circular and parallel drain wall patterns. The PVD's were further studied by using analytical solution to know amount of consolidation and rise in pore pressure in elliptical cylindrical coordinate system by installation of prefabricated vertical drain shorten the drainage path as compared to without prefabricated vertical drain. To ease different settlement and develop bearing capacity of the soft soil, by using preloading is the simplest and most economical method. While compressiblesoilsaredistinguishedbyextremelylowpermeabilityandsignificant thickness,it enhances the pore water pressure in soft clay soil and reduces the atmospheric pressure by applying a vacuum suction into inaccessible soil mass, product the soil consolidation occur and valuable stress without alter total stress. In case of preloading only, the time required is to realize the required amount of consolidation reduces few months instead of decades. Setting up of vertical drain can the decrease preloading period considerably by reducing drain age lane through a distance inradial direction(Figure 2), for theconsolidationpointhaving acomparativelytosquareof itslengthtodrainagelane.

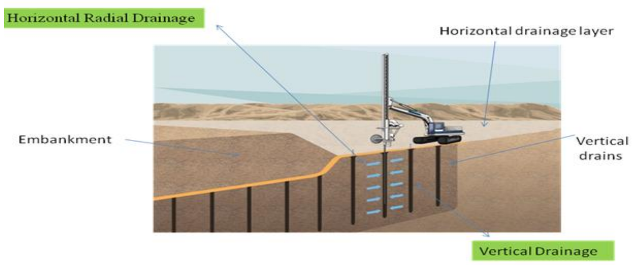


Figure 1 Close view of Vertical drains

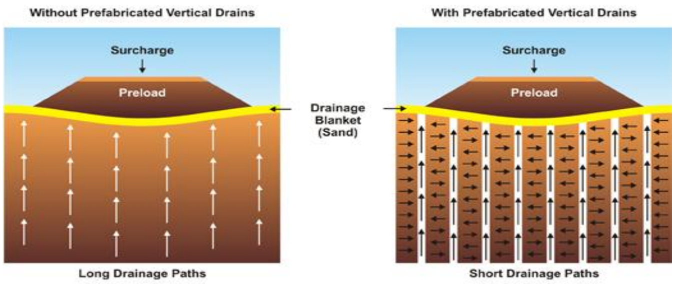


Figure 2 Without PVD and Without PVD's

II. METHODLOGY

The vertical drains are installed by the following three methods:

- Displacement techniques
- Drilling methods
- Washing methods

Group Explanation	Particular Techniques	Observations
Displacement Techniques	Driving Shaking Washing	In this method disposal shoe with orwithout mandrel is used.
Drilling Methods	Rotary method, Percussive methods with casing Auger by hand	In this method disposal shoe with or without mandrel is used.
Washing Methods	Rotary wash jet Weighted wash jet head on flexible hose Washed open Ended Casing	In prefabricated drains the sand which is washed in jet pipe are not used.

Table 1 Methods of Installation of Vertical drains.

III. RESULTS AND DISSCUSSION

Figure 5.5 illustrates the evaluation of surface settlement calculated by LVDT in tests 1and 2, with and without the function of vacuum pressure. In the first phase of loading, sample with 60k Pasurcharge load shares with 110k Pavacuum pressure provesa settlement of 30mm in 14days, while the sample with merely 60k Pasurcharge load produces 20mm settlement inside the same phase of time. Parallel type of settlement division is exposed by the second phase of loading.

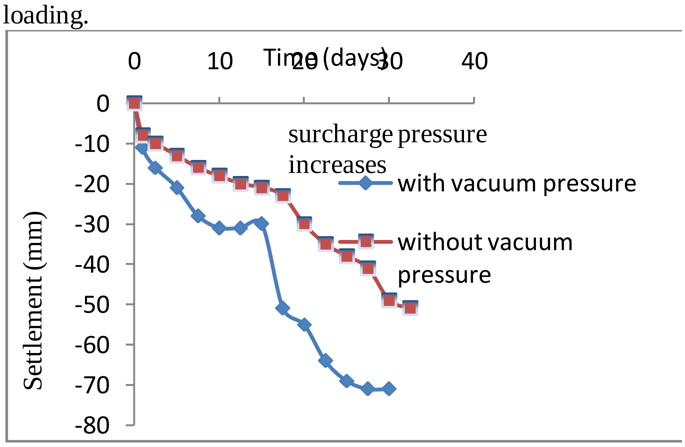


Figure3 Surface settlement associated with surcharge

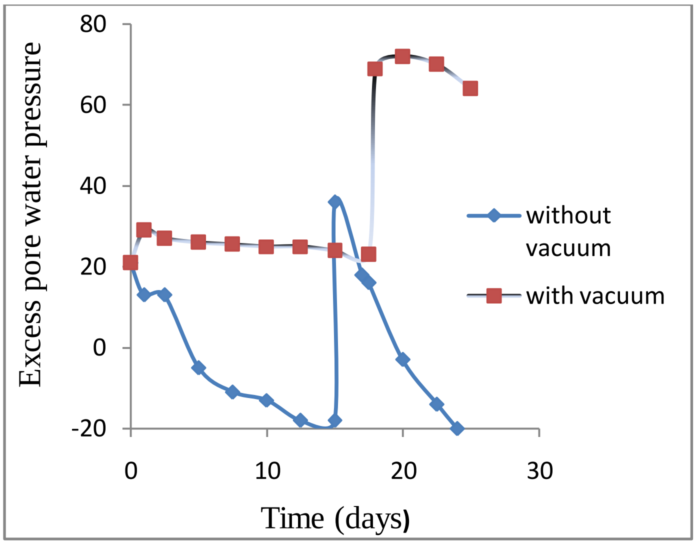


Figure 4 Measured excess porepressure at transducer T3 load and combined surcharge and vacuum loading.

The judgment clearly designate that the speed of consolidation due to merge vacuum preloading and surcharge is more valuable in comparison with the predictable multi-phase surcharge loading at the identical time. The excesspo repressur escalculated at transducer T3 placed 485mm from foundation and transducer T6 that is placed 245 mm from the foundation are given below in Figure 7 The excesspo repressur escalculated attransducer T3 placed 485mm from foundation and transducer T6 that is placed 245mm from the foundation are given below in Figure 4.6. The exact position of the 2 transducersis shown previous in Figure4.4. Data visibly show that the submission of vacuum pressure gathers speed the pore water pressure debauchery, which is inconcurrence with the settlement dimensions.

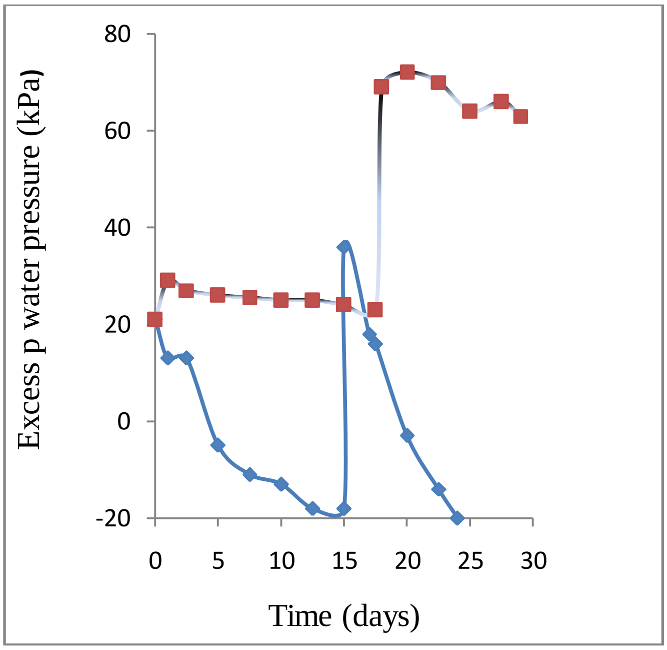


Figure5 Measuredexcess porepressure at transducer

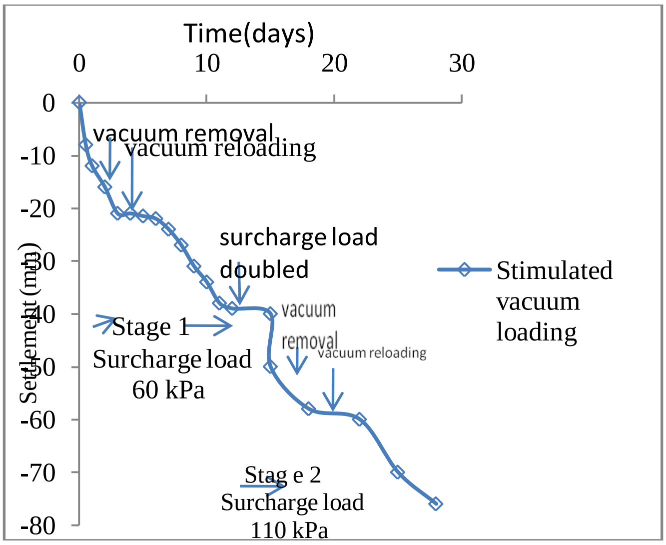


Figure 6 Surface settlement, surface settlement related T6 with motivated vacuum loading

Transducer T3 analysiss how that pore water pressure be considerably greater than the projected value of 40kPa (load increment) during the opening time period, but transducer T6 readings do not show any unpredicted trend. This is for the reason that transducer T3 shows some Mandrel-Cryer effect due to its situation way from drainage face, whereas the Transducer T6 was nearer to the PVD. As no one of these transducers was located shut to the drain, the vacuum pressure division beside the drain depth might not be investigating in greater detail. The suction calculated at the piston at transducers T6(Figure5) and the plane settlement was calculated by LVDT in Test 3 are given in Figure 6. Transduce revaluations specify that

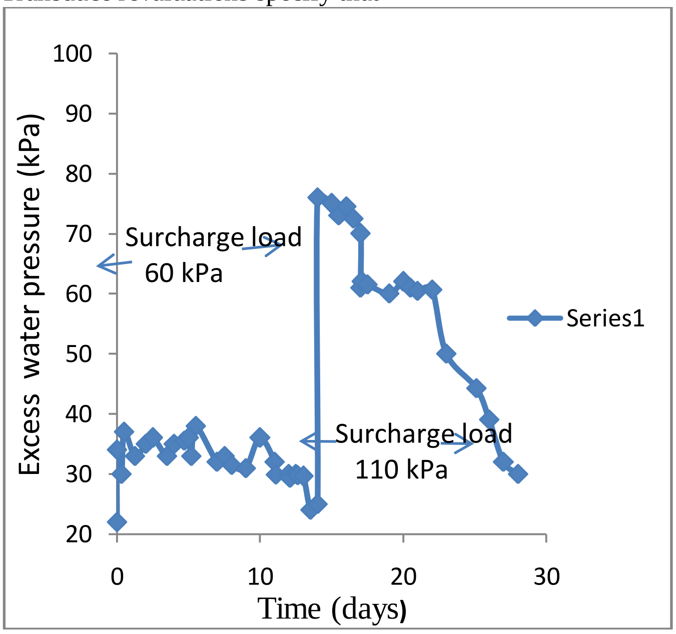
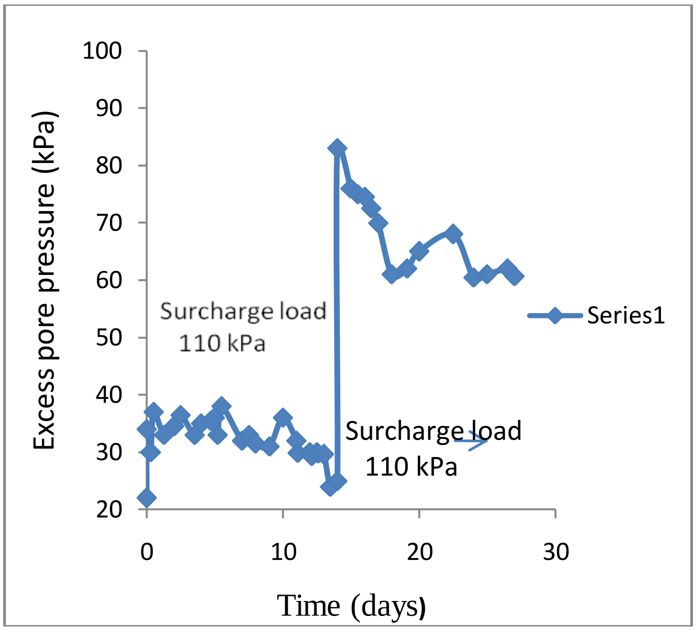


Figure 7 Pore pressure measured at transducers T2 and T5



That maximum calculated vacuum pressure be around 90k Pa by this depth. The succeeding liberate vacuum pressure eagerly decreasessuction, and there submission vacuum pressure enlarges the suction hastily towards 90k Pa over again. This is also designates that suction beginning shrinks through drain depth, as most of the suction of 110k Pa may well not be continued the length of the intact drain length. The different settlement connected amid combined surcharge and vacuum load be given in Figure 7, and it evidently reveals the cause of resubmission and vacuum loading by equivalent change of slope of settlement plot.

IV. CONCLUSION

A comparative study has been done on prefabricated vertical drains, it enhances speed of consolidation and dissipates more quickly excess pore pressure as compared other methods like deep soil mixing, vacuum consolidation, preloading with vertical drain, stone columns, etc. Prefabricated vertical drains are beneficial to stabilize slopes and prove to be effective and safer when slopes are in the critical state. Due to insertion of mandrel excess pore pressures are generated and leads to greater zone of disturbance to overcome this problem the cross section area of anchor plate and drain should be adopted carefully for the soil. Foundation on the knowledge through the land renovation and extra soil ground enhancement projects, various practical assessments are used to make prefabricated vertical drains for ground renovations. Various aspects which affecting the presentation of vertical drain for example, the selection of soil parameters, the smear effect, the quality of the drain and the type of mandrels are conversed. A technique which is able to be recognized to behavior quality control tests for prefabricated vertical drains is presented. In conclusion, the ground performance through this technique that is prefabricated vertical drains is totally cost effective and eco-friendly.

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