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Numerical Study of efficiency of the Vacuum Preloading in Weak Clay Treatment (a case study)

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ABSTRACT

This paper describes the behavior of soft soil foundation under Surcharge and with and Without prefabricated vertical drains (PVDs) or Vacuum Preloading base on a trial embankment which was built in Bangkok International Airport, Thailand. An analytical solution considering the variation of soil permeability and compressibility was adopted. Three scenarios were modeled and analyzed for Bangkok airport as: Model A: Application of surcharge load alone (i.e., no vacuum and PVD installation), Model B: Application of surcharge load combined with PVD (i.e., no vacuum application), Model C: Application of surcharge load combined with PVD and 60 kpa constant vacuum preloading and Model D: Application of surcharge load combined with PVD and field vacuum that was applied on site. The associated settlements at the embankment centerline are predicted and compared with the available field measurement. The field data show that the efficiency of this soil treatment technique depends on the magnitude and distribution of vacuum pressure. The height of surcharge and consolidation time can be significantly reduced in comparison with the conventional method of surcharge alone or surcharge and pvd alone. The findings of this study are expected to be useful to design engineers involved in the construction of embankments on weak grounds.

Keywords: surcharge, soil treatment, vacuum consolidation, PVD

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1. INTRODUCTION

Although the technology of vacuum preloading is highly used in many projects all over the world, it is still unknown in Iran. Due to the rapid increase in population in many countries, the construction activities have become concentrated in low-lying marshy areas and reclaimed lands, which are comprised of highly compressible weak organic and peaty soils of varying thickness. These soft deposits formed by peat or clay have very low bearing capacity and excessive settlement characteristics, affecting major infrastructure including buildings, roads, and rail tracks [1-3]; Therefore, it is

necessary to stabilize the existing soft soils before commencing any construction activities in order to prevent excessive and differential settlements. The technique of installing prefabricated vertical drains (PVDs) combined with fill surcharge and vacuum preloading has been used to avoid the unfavorable stability issues relating to high surcharge embankments. The effectiveness of the PVDs combined with vacuum preloading has been discussed by [4] and [5]. In this method, the vacuum head can be distributed to a greater depth of the subsoil using the PVD