別紙第１号様式　　　　　　　　　　　　No.1

博　士　論　文　の　要　旨

専攻名　　　システム創成科学　専攻

氏　名（本籍）　　徐方（中国）　　　印

博士論文題名

Method for Predicting Lateral Displacement of PVD-improved Deposits under Embankment Loading

（PVD 改良地盤における盛土荷重による側方変形予測法）

要旨（２，０００字程度にまとめること。）

A method has been proposed for predicting the maximum net lateral displacement (δ_{nm}, the maximum outward lateral displacement subtracting the maximum inward lateral displacement) of prefabricated vertical drains (PVDs) improved deposits under embankment loading with and without the application of vacuum pressure. The method is based on the results of a series of large-scale laboratory model tests and more than 30 field case histories.

For the laboratory model tests, the model box has dimension of 1.5 m in length, 0.62 m in width and 0.85 m in height. The embankment load was applied using air pressure through Bellofram cylinder systems. The model tests were mainly designed to investigate the effects of embankment loading rate (*LR*) and the undrained shear strength (s_u) of the model ground on the lateral displacement. The test results indicate that: (1) the normalized lateral displacement (*NLD*), i.e. the ratio of maximum lateral displacement (δ_m) to the ground surface settlement (S_f) at the centerline of the surcharge loading area ($NLD = \delta_m / S_f$), almost linearly increased with the increase of *LR*; (2) Under the same loading condition, *NLD* reduced with the increase of s_u.

Except the embankment loading rate and undrained shear strength of the ground, there are other important parameters affecting the values of *NLD*, i.e. magnitude of embankment load, ratio of vacuum pressure to the embankment load, and deformation and consolidation properties of soft subsoils. To consider the effects of all these factors on *NLD*, a synthetic parameter termed as a ratio of an index load (p_n) to s_u of the deposit (*RLS*) has been adopted. p_n is calculated as the total embankment load (p_{em}) subtracting the sum of p_{em} and the absolute value of vacuum pressure (p_{vac}) multiplied by the average degree of consolidation (U) of the PVD-improved zone corresponding to the end of embankment construction. The reason for using the values of U and s_u corresponding to the end of embankment construction to calculate *RLS* is that at that time the system has the largest applied surcharge load and a relatively small undrained shear strength, i.e. lower factor of safety (FS). There are many field cases showed that the maximum lateral displacement occurred at this time point. For each model test, the values of *NLD* and *RLS* have been analyzed and the laboratory test results verified that *RLS* is a controlling factor of *NLD*.

Further, more than 30 field case histories of embankments constructed on PVD-improved grounds have been collected from different countries and the corresponding values of *NLD*

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and *RLS* were analyzed. The all analyzed results of *NLD* and *RLS* from both the laboratory tests and the field case histories were depicted together in a *NLD*-*RLS* plot. It shows a general trend of *NLD* increases with the increasing of *RLS*. Using regression analysis, a bilinear range was proposed for the *NLD*-*RLS* relationship for predicting the maximum net lateral displacement (δ_{nm}) of PVD-improved deposits under embankment loading with and without the application of vacuum pressure.

In using this method, the value of *RLS* and the settlement, S_f, can be calculated prior to an embankment construction. And then from the *NLD*-*RLS* relationship, a value of *NLD* is obtained, and therefore δ_{nm} can be predicted. It is recommended that the proposed method can be used as a design tool in engineering practice.