

論文 / 著書情報
Article / Book Information

| | |
|-------------------|---|
| 題目(和文) | |
| Title(English) | A centrifuge model study on behavior of ground movement and pile group response to tunneling in sand |
| 著者(和文) | Boonsiriltichai |
| Author(English) | Ittichai Boonsiri |
| 出典(和文) | 学位:博士(学術), 学位授与機関:東京工業大学, 報告番号:甲第9897号, 授与年月日:2015年3月26日, 学位の種別:課程博士, 審査員:竹村 次郎,北詰 昌樹,岩波 光保,高橋 章浩,佐々木 栄一 |
| Citation(English) | Degree:, Conferring organization: Tokyo Institute of Technology, Report number:甲第9897号, Conferred date:2015/3/26, Degree Type:Course doctor, Examiner:,,,, |
| 学位種別(和文) | 博士論文 |
| Category(English) | Doctoral Thesis |
| 種別(和文) | 論文要旨 |
| Type(English) | Summary |

論文要旨

THESIS SUMMARY

専攻 : Civil Engineering 専攻
Department of
学生氏名 : Ittichai Boonsiri
Student's Name

申請学位 (専攻分野) : 博士 (Philosophy)
Academic Degree Requested Doctor of
指導教員 (主) : Assoc. Prof. Jiro TAKEMURA
Academic Advisor(main)
指導教員 (副) :
Academic Advisor(sub)

要旨 (英文 800 語程度)
Thesis Summary (approx.800 English Words)

The awareness of tunnel construction under congested underground condition has been concentrated over the last few decades ago. Tunnel excavation causes stress reduction and ground movement due to the ground loss (i.e. over excavation, tail void and failure of tunnel lining). More recently, tunnel machine has been developed to minimize the amount of ground loss but it is difficult to control the induced ground loss from beginning to end of excavation process. The study on the effects of these changes on the adjacent pile foundation is essential when a bored tunnel is constructed in an urban area with many pile foundations. Therefore, physical modeling using centrifuge has been proposed for study tunnel-soil-pile interaction. The centrifuge method can provide ground stress of full scale prototype within a small scale test. The results from centrifuge tests could be contributed to the design of new tunnel excavation or preliminary assessment of existing pile foundations.

In literature review, the important of the soil-tunnel-pile study has been addressed to find the harmful effect to adjacent pile foundation. The development of numerical calculation and physical modeling using centrifuge have been introduced to investigate the soil-tunnel-pile behavior due to lack of recorded data on the real site construction. Numerical calculation is convenient for study the complex behavior under various conditions but there are some uncertainties about the proposed method. Physical model has been justified validity to investigate this complex interaction. However, the results of complex interaction are insufficient and need for further investigation, especially in the pile group foundation. Therefore, the development of centrifuge modeling of pile foundation was firstly proposed, the fundamental of ground movement caused by tunneling was clarified, and the mechanical response of pile group and the safety preliminary assessment were investigated.

In this research, the mechanical tunnel machine has been utilized to simulate tunneling process by reduction of the diameter. This tunnel machine can reduce or increase the diameter in co-axial direction from small to large ground loss ratio. The process will create clear boundary condition for evaluating the complex phenomena. The careful model preparations such as constant pouring of air pluviation method, the installation of holding unit for measured equipment, relative positions of short and long pile groups, and tunnel

machine preparation were explained. The displaced vectors of ground movement have been traced by Particle Image Velocimetry (PIV) method. The displacement vectors have been tracked within divided patches by the sequence images. The accuracy of PIV depends on the quality of images. The results are divided into ground movement behavior and pile group response.

From PIV result, the surface and subsoil settlement profiles could be represented by Gaussian distribution curve from small (2%) to large (15%) ground loss ratio. For cases without pile groups, surface settlements measured by PIV at the front of the model shows good agreement with those measured by the potentiometers at the central cross section line of the model, which verifies the applicability of PIV for measuring the subsurface displacements. The observed depth variations of settlement trough width parameters (X_i) show good agreement with an empirical relation derived from sandy soils at small ground loss ratio. The X_i values decrease with increasing ground loss ratio, implying the validity of tunneling method used in this study. In addition, widths of the settlement trough (X_i values) decrease almost linearly with depth. The pile group induces more settlement above the tunnel. This trend is more significant for the cases with small C/D ($=1.5$) and the cases with large ground loss ratio. Zones of influence are defined referring Jacobsz et al., (2004) and a boundary (line c) between less movement and large movement zones are determined by the liner line on $2X_i$ depth variation.

The behavior of pile group could be closely related to the zone of influence where the pile end rests, and also to the relative position of the pile end in the zone. In particular, the pile group experiences large lateral movement and inclination when the front piles rest in or close to Zone B and the rear piles in Zone D. The measured axial force increased with increasing the ground loss ratio for the piles resting in Zone D. While for the pile resting in or close to the Zone B, the end bearing load decreased during tunneling. The relative pile depth in the less displacement zone (Zone D) and the pile cap movement were significant affected the shape of bending moment profile. Furthermore, the average of relative piles depth in the less movement zone (Z_{da}/L) can be used as a parameter, which incorporates the effects of relative horizontal distance (X_p) and relative positions between pile end and tunnel center (Z_{pe}). The average of relative piles depth in the less movement zone (Z_{da}/L) could be used to estimate the allowable ground loss for assessment during preliminary design.

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1 copy of 800 Words (English).

注意：論文要旨は、東工大リサーチリポジトリ (T2R2) にてインターネット公表されますので、公表可能な範囲の内容で作成してください。

Attention: Thesis Summary will be published on Tokyo Tech Research Repository Website (T2R2).