

論文 / 著書情報
Article / Book Information

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Title(English)	Centrifuge Modeling and Reliability Assessment of Liquefaction Mitigation Techniques for Shallow Foundations
著者(和文)	KUMARRITESH
Author(English)	Ritesh Kumar
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Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

論文要旨

THESIS SUMMARY

系・コース： 土木・環境工学 系
Department of Graduate major in 土木工学 コース
学生氏名： Ritesh Kumar
Student's Name

申請学位 (専攻分野)： 博士 (Philosophy)
Academic Degree Requested Doctor of
指導教員 (主)： 高橋 章浩
Academic Supervisor(main)
指導教員 (副)：
Academic Supervisor(sub)

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

The title of the thesis is “Centrifuge Modeling and Reliability Assessment of Liquefaction Mitigation Techniques for Shallow Foundations.” It consists of seven chapters. The content of each chapter can be summarized as the following:

Chapter 1: Introduction

This chapter introduces the liquefaction phenomenon followed by the discussion of liquefaction-induced effects on shallow foundations. Extensive literature is reviewed to get a flair of liquefaction through the case histories and recent research developments. Commonly used liquefaction mitigation techniques are discussed, highlighting their limitations and capabilities. Then objectives are narrow down along with the scope of the thesis. A brief outline of different chapters is also presented.

Chapter 2: Reliability assessment of centrifuge test

This chapter discusses the liquefaction-induced effects on the shallow foundation and the reliability assessment of the centrifuge test, considering the nonuniformity in the centrifuge model. Centrifuge test depicted that the shallow foundations resting on the liquefiable ground undergo severe deformation during the strong earthquake. The liquefaction extent in the model ground is found to vary with the nonuniformity of the centrifuge model. The probabilistic correlations between the nonuniformity of the centrifuge model and the response of the foundation-structure system exhibited significant practical importance.

Chapter 3: Centrifuge modeling of induced partial saturation

This chapter discusses the efficacy of induced partial saturation to mitigate the liquefaction-induced effects on shallow foundations under a strong earthquake. The drainage-recharge method is used to make the centrifuge model ground partially saturated. Centrifuge test results consolidated the fact that the compressibility of pore fluid increases because of the inclusion of the air voids within the partially saturated ground. Besides, the partially saturated ground showed overall less permeability in comparison with the fully saturated ground. Larger compressibility of pore fluid and smaller permeability of the partially saturated ground in comparison with fully saturated ground resulted in favorable evolution of excess pore water pressure. Induced partial saturation is found to mitigate the deformation of the foundation-structure system.

Chapter 4: Centrifuge modeling of hybrid foundation

This chapter discusses the development scheme and performance of a hybrid foundation to mitigate the liquefaction-induced effects on the shallow foundation. The developed hybrid foundation is a

combination of the gravel drainage system and friction piles having spiral blades devised under the footing as a hybrid mitigation technique. The presence of gravel drainage increased the dissipation rate (through radial flow towards the gravel drainage zone) of generated excess pore water pressure and reduced the post-shaking settlement. Centrifuge tests results depict that the friction piles having spiral blades at bottom served an excellent means of frictional resistance against the settlement of shallow foundation and reduced the overall deformation of shallow foundation significantly through combined inertial and kinematic interaction with foundation-superstructure and model ground. It is found that the developed hybrid foundation is able to mitigate liquefaction-induced effects on the shallow foundation during the strong earthquake.

Chapter 5: Efficacy of liquefaction mitigation techniques under different strong ground motions

Any structure is prone to experience several moderate to strong earthquakes during its lifespan. This chapter discusses the efficacy of induced partial saturation and hybrid foundation under two different strong ground motions. For the partially saturated ground, it is observed that the maximum potential volumetric compressibility reduces after the first strong ground motion. However, the available capacity of potential volume compressibility is found significant after the second strong ground motion, which signifies the novelty of induced partial saturation to increase the liquefaction resistance of the partially saturated ground. The performance of the hybrid foundation is observed to be diminished in terms of overall footing settlement during the second strong ground motion. The alteration in ground condition after first strong ground motion adversely affected the performance of the hybrid foundation during second strong ground motion.

Chapter 6: Reliability assessment of performance of a granular column

This chapter discusses the reliability assessment of the performance of a granular column considering the nonuniformity of the ground. Numerical results echoed with the general notion that the presence of a granular column increases the overall stiffness and minimizes the liquefaction extent of the ground. The favorable shear reinforcement within the ground is observed due to the granular column. However, incompatibility in shear strain reduction is also noted due to the complex deformation mechanism of the ground treated with the granular column. The spatial nonuniformity in the ground is found to affect the liquefaction-induced ground deformation. Stochastic results depicted that the presence of the granular column reduces the uncertainty in the estimation of horizontal displacement; however, it adversely affects the uncertainty in the prediction of the average surface settlement of the ground. It is regarded that the reliability assessment of the performance of the granular column is essential for better engineering judgment associated with a desired level of confidence.

Chapter 7: Conclusions and recommendations

Conclusions and recommendations of the thesis are presented in this chapter.

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).

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