別紙様式第 2 号 Form2
(都市イノベーション学府 Graduate School of Urban Innovation)

論 文 要 旨
Summary of Dissertation

2023 年 12 月 21 日
Date (YYYY-MM-DD):

専　攻 Department	Civil Engineering
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論文題目 Title	DESCRIPTION OF STRESS-STRAIN BEHAVIOR OF CRUSHABLE SOILS WITH POROUS PARTICLES
和訳または英訳 Translation (J->E, or E->J)	多孔質な粒子からなる破砕性土の応力ひずみ関係の記述

Crushable soil, marked by its low material strength and the existence of porous particles, presents considerable challenges for geotechnical structures. Investigating the properties of crushable soil, particularly in relation to interparticle porosity through experimentation, is a complex undertaking. To tackle this challenge, the objectives of this study are as follows: 1) Formulate theories to comprehend the behavior of this soil, 2) Construct a model for predicting its mechanical response, taking into account porous particles, and 3) Investigate the impact of intraparticle voids on its overall behavior through simulations.

This study laid the foundation for characterizing crushable soil with porous particles, presenting a theoretical framework that outlines key concepts and variables for measuring voids within particles and the soil matrix. The initial section proposed a function connecting particle porosity to particle size, facilitating the integration of average intraparticle voids before and after crushing. Visual aids were used to illustrate changes in interparticle and intraparticle void composition under loading conditions. Additionally, the study delves into the mechanical properties, incorporating experimental data from Wesley (2007) on Waikato pumice sand, and includes further information on Akadama sand from the author's research group's past experiments.

Utilizing the proposed theoretical framework, a constitutive model was developed for crushable soils, seamlessly integrating intra-particle voids. Particle porosity is estimated, intricately tied to particle size and responsive to changes induced by crushing. The evolution of particle size distribution is driven by increasing stress and strain. The average intra-particle void ratio is calculated, exerting influence on the overall void volume. The interaction between intra-particle and total voids is introduced through the yield surface formulation, and elastoplastic conditions are efficiently determined by the constitutive framework. This, in turn, furnishes a stress-strain relationship tailored for soils featuring porous particles and the impact of crushing.

The validation and parametric studies of the developed constitutive model were further conducted to numerically investigate crushable soils containing porous particles. These studies involved simulations of challenging scenarios that are

difficult to replicate experimentally, including variations between crushable and noncrushable soils with identical frictional properties and changes in initial intra-particle void.

The constitutive model, through rigorous validation and parametric studies, demonstrates its adaptability in capturing variations in both inter-particle and intra-particle voids. Numerical simulations further reveal insights into the effects of intra-particle voids on soil compressibility and peak strength. Additionally, the model highlights the significance of particle porosity, showing that higher porosity in crushable soils results in reduced dilatancy and lower strength—a crucial insight into the intricate interplay of factors influencing the crushable soil's mechanical behavior.

4,000 字以内

Must not exceed 4,000 Japanese characters or 1,600 words.