On Deformation of Granular Material in Simple Shear

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Abstract

Starting with simple frictional-dilatancy model in simple shear, a deformation model is analitically introduced. This model is evaluated by experimental results. Then, the author develops more reasonable model based on experimental evidences. In this paper, the author's state parameter S plays an important role.

Keywords: Simple shear, Shearing deformation, Entropy, Sand, Granular material

Introduction

For a study of shearing deformation of granular materials, to bigin with, the behaviour in simple shear condition must be appreciated. In this case, attention must be focussed on two important features: friction and dilatancy. Paying attention to these foundamental characteristics peculiar to granular materials, the author originally proposed a new parameter S to measure degree of shear deformation (Moroto, 1976). The reason to introduce the parameter S is as follows. The plastic work done due to shear is largely depending on deformation path and only the form of

$$S=\int \frac{(\text{increment of plastic work done})}{(\text{confining pressure})}$$

an interesting state parameter for specifying degree of shearing process.

In this paper, adopting a simple friction-dilatancy model, the author analitically derives the parameter S and a function φ obtained from the normal condition. Thus the characteristics of shear deformation is appreciated. Then, this simple deformation model is evaluated by refernece to existing experimental results.

Next, based on experimental evidence, the author's state parameter is studied and a more reasonable and realistic deformation model is proposed.

Simple Model

Starting with a simple two deformtional model illustrated in Fig. 1 where the sample is subjected to shear stress τ under normal stress σ, the resulting shear distortion and volume change are expressed by shear strain γ and volumetric strain v respectively. In the sample, a

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