Analysis of sliding mechanism of soil material based on non-coaxial finite deformation theory

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基礎・土質工学

Research Institution

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Research Abstract

In order to simulate the formation of localized shear bands, which is commonly observed during large deformation of soils, we first presented a systematic extension of the well known Cam-clay model developed for small strains to the model for finite strain/deformations and then incorporated a non-coaxial tern in the model. Finally, confining the deformation to undrained plane strain conditions, we examined the effects of the non-coaxial term on the shear bands

formation. As a result: 1)The incorporation of the non-coaxial term has no effect on the instantaneous shear modulus for the normal stress difference and it makes the instantaneous shear modulus for the shear stress smaller. 2)The non-coaxial term makes easy of access to the elliptic/hyperbolic boundary. 3)The behavior of the simple shearing modulus, which is proposed here as a new measure to see the accessibility to shear bands formation, shows that, in the neighborhood of critical state, the non-coaxial models are. independentl y of the kinematic constraint, more inclined to instability by localization of deformation than the coaxial model.
Furthermore we investigated the formation of the shear bands by employing the finite element method with a non-coaxial Cam-clay model. This finite element method for finite strains is formulated as a soil/water coupling form based on the updated Lagrangean scheme. A demonstration of shear bands formation is given in a classical rigid punch problem without introducing any initial imperfections into the material elements. We can offer the following remarks as conclusions: 1)Assuming Darcy's law for the notion of pore fluid, we summarized the governing equations for the coupling problem based on the finite strain theory. 2)We derived the finite element formation by discretizing the governing equations based on the updated Lagrangean scheme. The program created here is called SHEBLA. 3)Without introducing any imperfections into the material elements. we demonstrated the formation of shear bands in the ground for the punch problem as the deformation of finite element meshes and also as the localized strain distribution. 4)Observing the process for the formation of shear bands, we found that the shear bands occur for the first time just arround the edge of the loading plate and extend towards the symmetric axis. The stress state of the elements which form the shear bands reaches the hyperbolic region and then finally the parabolic region. The element in which a shear band occurs first, however, does not necessarily pass the E/H boundary first. 5)Observing the effective stress path, we discovered that both the element in the wedge surrounded by the shear bands and the element just beneath the loading plate experience unloading once during the extension of the shear bands. 6)And finally. we found that the distribution of footing stress at bach step is similar to the empirical results for cohesive soils.▲ Less

Research Products (14 results)

All Other

All Publications (14 results)

[Publications] Yatomi,C.,Yashima,A.Iizuka,A.and Sano,I.: "General theory of shear bands formation by anon−coaxial Cam−clay model" Soilsand Foundations,JSSMFE. 29/3. 41-53 (1989)

[Publications] Yatomi,C.,Yashima,A.Iizuka,A.and Sano,I.: "Shear bands formation numerically simulated by anon−coaxial Cam−clay model" Soils and Foundations,JSSMFE. 29/4. 1-13 (1989)

[Publications] Yashima,A.,Yatomi,C.Iizuka,A.Sano,I.and Ohta,H.: "Formation of shear bands by anon−coaxial Cam−clay model" Proc.2nd Workshop on Numerical Methods for Localization and Bifurcation of Granular Bodies,Technical Univ.of Gdansk(In press).

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[Publications] 岩崎好規・澤田純男・プラダンテ-ジ: "個別要素法による砂の繰返し載荷挙動のシミュレ-ション" 土の非排水繰返し試験に関するシンポジウム発表論文集、土質工学会. 131-136 (1988)

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[Publications] Yashima, A., Yatomi, C., Iizuka, A., Sano, I. and Ohta, H.: "Formation of shear bands by a non-coaxial Cam-clay model" Proc. 2nd Workshop on Numerical Methods for Localization and Bifurcation of Granular Bodies, Gdansk in Poland, (in press), 1989.

[Publications] Yatomi, C., Yashima, A., Iizuka, A. and Sano, I.: "General theory of shear bands formation by a non-coaxial Cam-clay model" Soils and Foundations, Vol.29, No.3, pp.41-53, 1989.

[Publications] Yatomi, C., Yashima, A., Iizuka, A. and Sano, I.: "Shear bands formation numerically simulated by a non-coaxial Cam-clay model" Soils and Foundations, Vol.29, No.4, pp.1-13, 1989.