# Studies on deformation mechanism for soil-tool interaction problems

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In the discipline of civil engineering, the bodies of theory for soil-structure interactions have been achieved in order to analyze the bearing capacity of foundations and the stability of slopes, etc. form long time ago. In this paper, the plasticity theory of soil based on those long-standing practices was applied to problems of soil-rigid tool interactions and its applicability was investigated. This paper deals with penetration mechanism by cone penetrometer (the first section) and excavation mechanism by flat simple cutting blade (the second section). The abstracts of these researches are as follows.

The first section deals with the method of characteristics established as a direct method of solving cone resistance in $c$-$\phi$ soil. The bearing capacity of cones was analyzed under the conditions of axial-symmetry obeying Mohr-Coulomb criterion, considering cone roughness and the intermediate principal stress and as an application of these theoretical analysis, an idea for estimating $c$ and $\phi$ simultaneously by using two types of cones which has different tip angle was proposed. Furthermore, Characterization of the deformation behavior of sands around a cone penetrometer was conducted using an X-ray fluoroscope technique in order to establish a clear understanding of the experimental penetration process. From the results, it became clear that the deformation characteristics of the penetrometer in sand significantly depend on the sand state(packing of the grains), while it is hardly affected by the tip form of the penetrometer when the tip angle is comparatively blunt.

The sacond section deals with the model excavation tests using a flat simple cutting blade by means of X-ray TV and X-ray CT method in order to evaluate the excavation mechanism when the blade is advanced even with the sandy ground. Form these experiment, the failure progression pattern and three-dimensional failure structure were visually made clear. Moreover, theoretical approaches by using the method of characteristics and the limit equilibrium method were attempted to this interaction problem. The calculated values derived from the limit equilibrium method were seriously overestimated the actual excavation resistance measured by laboratory model tests, while the solutions obtained by the method of characteristics comparatively agree with the values measured. Therefore, it can be concluded that method of characteristics is possible to apply to the excavation problems.