Discrete Element Simulation of unconsolidated Ground Deformation Caused by Reverse Faulting - Effect of Layer Thickness-

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Surface rupture and ground deformation due to fault movement have been focused since Izmit earthquake,Turkey(1999) and Chi-chi earthquake,Taiwan(1999) because of the big damages identified on infrastructures located within the zone of faulting.

In order to construct a rational guideline for earthquake hazard mitigation including such ground deformation, it is important to clarify the mechanism of shear-banding inside the ground caused by the fault movement.

Although many analog experiments relevant to the deformation of unconsolidated sand during dip-slip faulting have been performed, the effect of model thickness and shear-banding formation are still not revealed clearly. We conducted a set of reverse dip-slip faulting simulations using the Discrete Element Method including more than 80000 particles to discuss the shear-banding and the ground deformation with the variations of the model thickness and the dip angle. In this study, we prepared rectangular models that have 300m in width and four different thickness(30m,60m,90m,120m). Each model is equipped the dip angles at the model basement from 30degrees to 90degrees with 15degrees interval respectively. Thus, we totally simulated 20 situations.

The simulation results are in good agreement with respect to key parameter(W/H) measured in the experiments, where W and H represent the horizontal distance from the break point of the model basement to the surface rupture point and the thickness of the model respectively. The simulation results also revealed that the parameter(W/H) scarcely has a relationship with the layer thickness of the ground model.

From the detailed displacement field analysis at the stage when the primary rupture reached to the model surface, it was captured that the shape of shear plane switched from the convex downward to upward when the dip angle shifted from 45degrees to 75 degrees. The results of analysis also indicated that the flower structure was formed in the propagation of shear-banding formation within the range of dip angle greater than or equal to 75degrees.

References

[1] Ueta,K., K.Tani: Deformation of Quaternary Deposits and Ground Surface Caused by Bedrock Fault Movements(Part 2)-Normal and Reverse Fault Model Tests-(in Japanese),Abiko Research Laboratory Rep.No.U98048, Central Research Institute of Electric Power Industry,1999.

[2] Jea Woo LEE and Masanori HAMADA:AN EXPERIMENTAL STUDY ON EARTHQUAKE FAULT RUPTURE PROPAGATION THROUGH A SANDY SOIL DEPOSIT, J.Struct. Mech. Earthquake Eng.,JSCS, Vol.22,No.1,1s-13s,2005.

[3] Onizuka,N., M.Hori,K.Iwashita,T.Suzuki:Model Experiment and Numerical Simulation of Dip-slip Fault Formation Using Granular Media,Powders and Grains 2001,pp.297-300,2001.