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Evolution of Ground Deformation Zone on Normal Fault Using Distinct Element Method and Centrifuge Modeling

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The depth and character of the overlying earth deposit contribute to fault rupture path. For cohesive soil, for instance, clay, tension cracks on the ground happen during faulting, limiting the propagation of fracture in soil mass. The cracks propagate downwards while the fracture induced by initial displacement of faulting propagates upwards. The connection of cracks and fracture will form a plane that is related to tri-shear zone. However the mechanism of the connection has not been discussed thoroughly. By obtaining the evolution of ground deformation zone we can understand mechanism of fault propagation and crack-fracture connection.

A series of centrifuge tests and numerical modeling are conducted at this study with acceleration conditions of 40g, 50g, 80g and dip angle of 60° on normal faulting. The model is with total overburden thick, H, 0.2m, vertical displacement of moving wall, ΔH. At the beginning, hanging wall and the left-boundary wall moves along the plane of fault. When ΔH/H equals to 25%, both of the walls stop moving. We then can calculate the width of ground deformation in different depth of each model by a logic method. Models of this study consist of two different type overburden material to simulate sand and clay in situ.

Different from finite element method, with application of distinct element method the mechanism of fault propagation in soil mass and the development of ground deformation zone can be observed directly in numerical analysis of faulting. The information of force and deformation in the numerical model are also easier to be obtained than centrifuge modeling. Therefore, we take the results of centrifuge modeling as the field outcrop then modify the micro-parameter of numerical analysis to make sure both of them have the same attitude.

The results show that in centrifuge modeling narrower ground deformation zone appears in clayey overburden model as that of sandy overburden model is wider on footwall. Increasing the strength of clay will decreases the range of ground deformation. At higher acceleration condition the grounded formation zone become narrower; especially one that is near the fault plane. The results calculated from numerical model show agreement.