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Laboratory Simulation of Shear Band Development in Growth Normal Fault

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According to the studies about active faults in metropolitan Taipei area, it has been indicated that Shanchiao Fault at the western rim of Taipei Basin is a highly active normal fault. Slip of the fault can cause deformation of shallower soil layers and lead to the destruction of infrastructures, residential building foundations and utility lines near the influenced area. It was interpreted that Shanchiao Fault is a growth normal fault based on geological drilling and dating information. Therefore in this study, a geological structure similar to growth normal fault (such as Shanchiao Fault) was constructed to simulate the slip induced ground deformation after an additional layer of sedimentation formed above the deformed normal fault. In this study, a sand box under gravity condition was formulated with non-cohesive sands in order to investigate the propagation of shear bands and surface deformation of a growth normal fault.
With the presence of sedimentation layer on top of the deformed soil layer due to normal fault, the shear band developed along the previous shear band and propagated upward to the sand surface with a much faster speed comparing to the case when there is no sedimentation layer (i.e. normal fault only). The offset ratio of 1.3∼1.5% (defines as the fault tip offset displacement over the thickness of soil layer) for this particular growth fault simulation is required in order to develop a shear band toward the ground surface. Based on the test results, it is concluded that if there is any seismic activity of Shanchiao Fault, with a smaller offset displacement from the fault tip, although the depositional thickness of the upper layer is very thick, the shear band could still be propagated to the ground surface and cause severe damages to the important facilities and infrastructure with Taipei Basin. Therefore, seismic design integrated with the knowledge of near-ground deformation characteristics due to this type of fault need to be emphasized in current building codes, especially for critical facilities such as the nuclear power plant.
Key words: Shanchiao Fault, Growth Normal Fault, Sand Box Test, Shear Band, Offset Ratio