Drained and undrained shear experiments on fine-grained quartz sand with a large displacement in a high-speed ring-shear apparatus

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In this study, shear experiments were performed on water-saturated fine-grained quartz sand (silt) to simulate fluidized (liquefied) fault deformation at a shallow depth. In the experiments, a ring-shear apparatus developed for the study of landslides (Sassa, 1997; 2000) was used. An artificial sand made by grinding silica sandstone was used, same as that used in the previous study of the same type experiment with this machine (Wafid Agung, 2004). Cylindrical space of the sample box (inner and outer diameter is 120mm and 180mm, respectively) was filled with oven-dried sand specimen firstly. Sand specimen was then saturated with the help of CO2 gas and de- aired water. After infiltration of water, sample was consolidated at normal stress of 500kPa for an hour before to start shear loading. During shear loading, shear stress was increased at a constant rate of 0.1kPa/sec. Pore-water pressure was monitored 2mm above the boundary of the upper and the lower shear box, i.e., close to the shear zone. In the undrained test, shear resistance of the sample increased monotonically until it reached to the failure line. Pore pressure increased during this period gradually and effective stress decreased from 500kPa to about 320kPa. When shear resistance reached to the failure line, rotation side of the sample box begun to rotate. With the onset of the rotation, pore pressure increased rapidly and shear resistance of the sample decreased along the failure line to a steady-state value of about 80kPa. For the drained test, no excess pore-water pressure built up during shear loading and effective pressure was constant at 500kPa during the whole period of the run. When shear resistance of the sample reached to the failure line at about 400kPa, sample box begun to rotate and the shear resistant decreased to a steady state value at around 350kPa. Preliminary observation of the texture of the shear zone of the sample after the tests showed that preferred alignment of sand grains was developed for both types of the experiments. In the case of the drained experiments, weakly aligned sand grains were distributed for the whole section of the sample across the shear plane. On the contrary, un-drained sample showed a well developed preferred alignment of the grains only within a shear zone.