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Sliding surface liquefaction and rapid and long runout shallow disrupted slides under extreme weather condition

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Extreme weather condition, especially heavy localized rainfall events frequency apparently increased in many countries, possibly as one of the consequences of global climate change. On July 16, 2010, extreme rainfall attacked western Japan and it caused very intense rainfall in 5 km x 3 km area of Shobara city, Hiroshima prefecture, Japan. This rainfall induced hundreds of shallow disrupted slides and many of those became debris flows. Authors took soil samples from landslide sites induced by similar heavy rainfall phenomena which took place in Hiroshima city (1999), Minamata city (2004), Hofu city (2009), San Vicente volcano, El Salvador, Central America (2009).

Authors have constructed pore pressure control system for the undrained ring shear apparatus. Above-mentioned sampled weathered sandy soils were consolidated by smaller stress corresponding to the site condition, and saturated by overnight circulating de-aired water. Normal stress and shear stress corresponding the slope condition was given, then, pore pressure (back pressure) was raised artificially at constant rate. When the effective stress reached the failure line, suddenly measured pore pressure monitored at about 2 mm above the shear plane, quickly increased. This sudden change abruptly reduced the mobilized shear resistance and accelerated the shear displacement. Stress condition soon reached the steady state and remained there thereafter. The reason of the excess pore pressure generation was the negative dilatancy, following a slight positive dilatancy. Most of the negative dilatancy could be explained by collapse of loose soil skelton as well as grain crushing during deformation and shearing.