

## **Landslide process and types of groundwater- and rainfall-induced landslide in a flume experiment**

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Most of the landslide cases in Taiwan were induced by rainfall or earthquake events. The landslide cases which were only induced by groundwater were very rare. The groundwater-induced deep landslide with landslide depth of 15-20 m and landslide volume of around 220000 m<sup>3</sup> occurred at 3.1K of Highway No. 3 on Apr. 25, 2010 in Taiwan. The groundwater-induced landslide is a fast-moving dip-slope landslide. The purpose of this study is to understand the landslide processes and types of groundwater- and rainfall-induced landslide in the flume landslide experiments. The landslide experiments were carried out in the flume with the length, width, and height of 1.5 m, 0.3 m, and 0.3 m, respectively. The research proceeded 18 flume landslide experiments and observed the processes and types under different setting conditions, including soil deposited height (5 cm and 10 cm), channel slope (4.4°, 8.7°, and 13.0°), groundwater discharge (51.3 and 31.7 cm<sup>3</sup>/sec), rainfall intensity (0.093 and 0.037 mm/sec), soil diameter (0.5 and 0.9 mm). The research also measured the water content and pore pressure by using ECH<sub>2</sub>O Dielectric Aquameter sensors and TML KPC-200KPB sensors, and recorded the experiment processes by two Video cameras from side and top views.

Some conclusions can be made based on the results of the flume landslide experiments. The porosity of soil decides the development speed of wet wave in the soil. The pile soil deposition with a high porosity of soil or a large soil diameter is hard to from landslide because the development speed of wet wave in the soil is fast but the water content in the soil is low than the threshold of water content to induce the landslide. The height of pile soil deposition decides the wetness and landslide types of pile soil deposition. The height of pile soil deposition gets higher, the pile soil deposition is harder to be totally wet, the seriousness of landslide gets lighter and the total sediment yield gets less. The slope of channel gets steeper, the development speed of wet wave in the soil get faster, the landslide gets more serious, and the total sediment yield from the pile soil deposition gets larger. As the rainfall and groundwater infiltrates to the pile soil deposition at the same time, i.e. two landslide-induced factors, the infiltration from rainfall water is hard to from the wet wave from up to down in the pile soil deposition. The infiltration from groundwater which forms the wet wave from upslope to downslope in the pile soil deposition dominates the process and types of landslide. The landsliding process in the groundwater-induced experiments starts from the liquefaction in the hillslope toe, and the liquefaction leads to the following soil erosion from the down soil layer. The continued soil erosion from the down soil layer sinks the soil layer and the cracks appear at the surface of the soil layer.