Experiment for effects of preferential flow and entrapped air on slope failure

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Although many previous studies examined the mechanism that slope failure s concentrated around the rainfall peak, and the process that collapsed soil quickly tuned into debris flow, to date there is no widely used theory for describing these phenomena. Recent studies proposed possible explanation about the process of slope failure induced debris flow. Several processes explain drastic decline of safety factor with the increase of rainfall intensity have been proposed. According to filed observation for the landslide scars, a number of studies suggested that the preferential flow through soil pipe might effect on drastic decline of safety factor with the increase of rainfall intensity. Several studies confirmed that the preferential flow through soil pipe gave an impact on the redistribution of pore water pressure in soil layer. Also, other studies suggested that the drastic decline of safety factor can be influenced by the extra pore water pressure due to entrapped air in the soil layer.
Therefore, we conducted the artificial hillslope experiment to test the influence of the preferential flow thorough soil pipe and entrapped air on slope failure . Figure shows our experimental model. We set manometers in each 20 cm along the soil layer to monitor positive soil pore water pressure distribution at the bottom of soil layer. To examine the effect of entrapped air on slope failure occurrence, we used two ways, rainfall simulator and upper water tank, to supply water to the soil layer. Steel wire netting and cloth was attached between the soil layer and upper water tank to support the sand. For several cases, we didn’t use rainfall simulator, since we assumed that the if water was supplied only at the upper end of the hillslope, the pore air in soil layer easily went out. While, once the surface layer of hillslope was saturated, pore air might be entrapped in the soil layer. To enhance the saturation of surface layer, in several cases, we put shallow fine sand layer at the surface of hillslope.
To simulate soil pipes, we set the artificial soil pipe made by polyvinyl chloride tube, which was made holes (φ4 mm) in each 2 cm. To test the effect of water pressure in soil pipe, the upper end of the artificial soil pipe was connected to another water tank to control the water pressure in the upper end of the artificial soil pipe. Further, we attached gate valve at the intermediate of soil pipe to disturb water flow in soil pipe. So, we changed water levels in both upper water tank and water tank connected with soil pipe and monitor pore water pressure and displacement of hillslope. We found that slope failure occurred just after the increase of water pressure in soil pipe, indicating that water pressure in soil pipe strongly controlled slope failure occurrence and movement. Moreover, the effect of entrapped air was not obvious.

Keywords: slope failure, soil pipe, pore water pressure

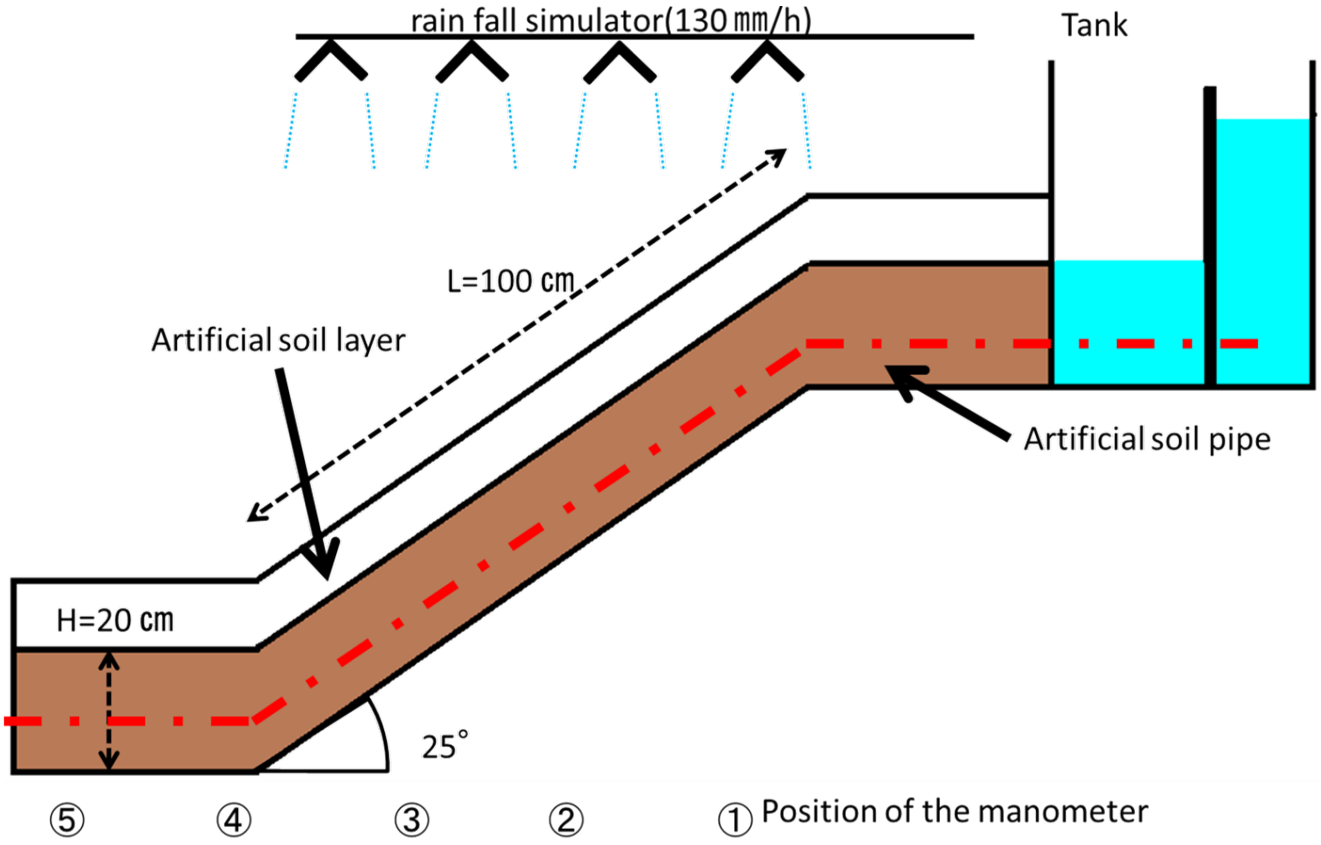

Figure experimental equipment

