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Experimental study of rainfall-induced landslides by means of ring-shear test.

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Rainfall-induced landslides are the most often occurring landslides in steep slopes, especially on the ones without or only with bare vegetation. Those slope slips are due to quick decrease in the effective normal stress as response to the raise of the ground water level. Rainfall-induced landslides appear not only during the usual rainfall seasons, but also during or after random rainstorms.

A new method for soil shear resistance testing is proposed. It is intended to represent real slope conditions and raise of the pore water pressure in fully saturated specimens in a ring shear apparatus, thus simulating situations of rainfall-induced landslides.

Methodology. A highly developed ring-shear apparatus DPRI5 is used to conduct series of tests with sand samples. The ring-shear test has many advantages to the direct shear and the triaxial test. In the particular testing it is the application of combinations of normal and shear stresses that are kept constant during application of backpressure and precise observation and recording of PWP and shear displacement that give uniqueness and a new aspect of the tests.

Test procedures. A sample is closed in the shear box and fully saturated. Tests are usually conducted with BD value ≥ 0.95 (Sassa, 1988). Except from the first conventional undrained test, in all other tests the sample is consolidated to the desired normal stress and then a certain shear stress is applied in slow rate not to trigger a failure. Then pore water pressure by means of backpressure is applied. For all test the speed of PWP increment is 25kPa/h. A test finishes when a final failure is observed due to enough PWP generation and effective normal stress decrease.

Silica sand 7 and 8 are tested in 2 series. Table 1 shows the results of a series of tests with SS8. An undrained test is done as a starting point for determination of the approximate range of normal and shear stress for the following tests.

According to some preliminary results when a failure is triggered by excess PWP, a higher value for PWP is reached than in undrained test for approximately the same combination of total normal stress and shear stress at failure. Also overconsolidated samples tend to have increased stability and their failure is delayed until higher PWP is obtained. That tendency though showed abnormality for overconsolidation to higher normal stress. Other differences are observed in the creep-like displacement and dilation before failure. Such variations show that more tests of that kind with various combinations and samples will distribute to finding specific individualities of the different soil materials in aspect of their stability during heavy rainfalls.

Table 1. Results from a series conducted with SS8

	Overconsolidation (kPa)	Total normal stress (kPa)	Initial shear stress (kPa)	Effective normal stress at failure (kPa)	Shear stress at failure (kPa)	PWP at failure (kPa)	Time to failure (min)	Failure line (deg)
Undr.	-	97	0	49.5	45	49.5	55	42
1	-	100	40	38	40	61.5	145	47
2	-	98	48	43	44.6	55.5	117	43.5
3	-	97	59	64	62.5	33.5	75	41
4	141	97	59	59.5	60	38	87	42
5	187	96	61	54.5	58.9	44	99	43
6	-	149.5	79.5	74.5	77.5	79	189	43
7	-	149.5	89.5	88.4	87.4	62.7	153	44
8	-	149	100	85	100	65.5	164	45
9	200	149	90	43	87	107.5	264	60.8
10	250	148.5	90	78.5	88	71.5	175	43.8