MODEL TESTS FOR SLOPE FAILURE

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1. INTRODUCTION

The mechanisms of slope failures due to rainfall are complex interactions between hydrology, geology and geomorphology of the area concerned. The pattern of precipitation such as successive light rainfall followed by heavy rainfall, and presence of fractured rock zone in the catchment are considered to be the main accelerating factors for slope failures. Seepage of rainwater during or after heavy rain causes increase of the pore water pressure on emerging to the weathered layer of the slope.

This paper presents a 1 g model test where by the insight of the above phenomenas are quantitatively evaluated. To be observed are the variations of pore water pressure at the base of the slope.

2. INVESTIGATED SOIL SAMPLE

The physical properties of the *haido* sample are shown in Table 1.

Table 1 Physical properties of the investigated sample

Natural water content, Wn (%)	41.5
Specific Gravity, Gs	2.497
Consistency	N.P
Gravel (%)	0.3
Sand (%)	14.3
Silt (%)	69.4
Clay (%)	16.0
Uniformity Coefficient, U_c	9.1
Coeff. of Curvature, U_c'	0.9
Largest Particle size, (mm)	4.76
Type of soil	VH_1

3 MODEL TEST METHOD

3.1 *Test apparatus and test procedure*

The apparatus introduced by *Mshana et al* (1990) was improved by fixing three porous stone bars (size 60×5 cm). The porous stones had a two-fold purpose. Firstly, at the infiltration stage they can be used to saturate the soil layer (ρ_t = 1.40 g/cm^3) by supplying water at a constant head through the base inorder to minimize entrapment of air in the pore spaces of the soil layer. Secondly, at the failure stage they can be used as piping points.

3.2 *Simulation models*

Two models MD-1 and MD-2 were used in the simulation process (Table 2). Both models were saturated by suppling water through the porous stones at a constant head. To minimize air entrapment in the soil layer the head was raised in two steps 5 cm each. Slope MD-1 was piped to failure direct after saturation, while slope MD-2 was drained (by inclining at 20 degrees) to steady state before piping. Model MD-2 is practically related to the dewatering of slopes after stop of rainfall. Its main objective was to check the effect of hysteresis in the building up of the pore

Table 2 Simulation models

MODEL	INFILTRATION TEST	FAILURE TEST
MD-1	Saturation from the base(*) $\theta = 0°$	Piping $\theta = 20°$ H=10.6 cm
MD-2	Saturation from the base(*) $\theta = 0°$	Piping(**) $\theta = 20°$ H=22.6 cm

NOTE:
(*)-Saturated in 2 steps: H=5 cm & 10cm
(**)-After dewatering (θ =20°) to steady state. Piping was carried in steps of 4 cm from the soil surface (i.e H=10.6, 18.6, 22.6 cm)

water pressure. In both models the slopes were piped to failure through the middle porous stone (Figure 1).

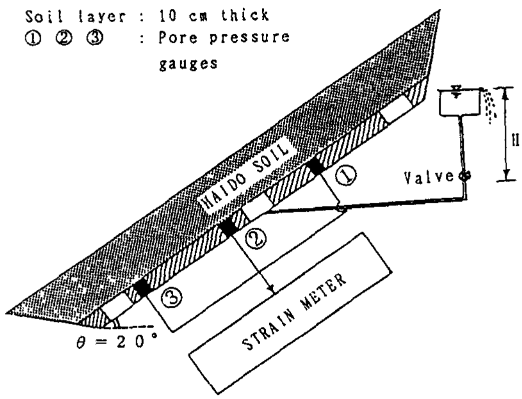

Fig. 1 Schematic diagram of the Failure test

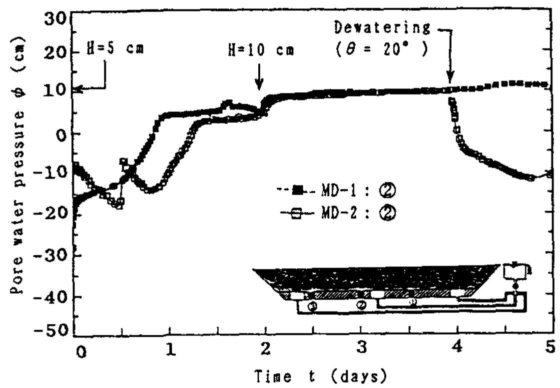

Fig. 2 Measured pore water pressure during infiltration and dewatering

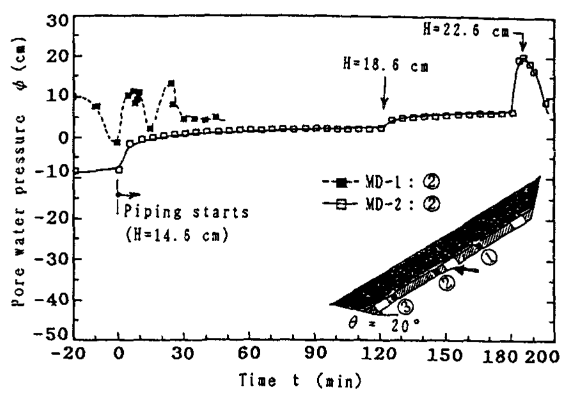

Fig. 3 Measured pore water pressure during piping

4. RESULTS AND DISCUSSION

As shown in Figure 2 the pore pressure in slope MD-2 reduced by 22 cm in the dewatering stage. On the otherhand, the hysteresis process raised the piping head at failure to 22.6 cm as compared to 14.6 cm in model MD-1 (Figure 3). In model MD-1 the first crack appeared at the toe of the slope in the second minute of piping. This was followed by fine cracks at the top of the middle porous stone (i.e piping region) in 13th second. The cracks enlarged and extended to cover the whole width of the slope surface. Total failure was reached after 23 minutes of piping. Model MD-2 was piped in steps, by increasing the piping head by 4 cm in each step. No failure was observed in the first two piping heads, H=14.6 cm and H= 18.6 cm, which took 2 hours and 1 hour respectively. The first cracks occured around the piping region during piping step 3 (H=22.6 cm) after 3 hours 6 minutes of piping. Total failure was reached after a total piping time of 3 hours 20 minutes (or 20 minutes of piping step 3, H=22.6 cm). Although the piping heads and time of failures were different the final patterns showed a close resemblance.

5. CONCLUSIONS

Effect of soil hysteresis in the building up of the pore water pressure have been presented. From the above results we can conclude that, dewatering of a saturated slope has a reinforcing effect to its stability.

REFERENCES

Mshana, et al (1990). *Study on infiltration behaviors of unsaturated slopes by using laboratory and numerical models.* JSCE-Seibu pp.394-395.