Simulation of ground water level in the weathered granite region -Effect of clay veins-

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1.INTRODUCTION Numerous clay veins can generally be observed in a failed slope and/or surrounding outcrop. According to Kitagawa et al. (1989), the clay veins consist of illite, smectite, interstratified minerals of illite and smectite, kaolinite, and halloysite. The clay veins found in a failed slope, however, generally consist mainly of smectite and/or interstratified minerals. Smectite characteristically swells with water, and thus the materials in the veins are impermeable. Kitagawa (1996) infers that the clay veins in a slope have a significant effect on its failure. As the typical examples, some regions where many slope failures occurred are selected to make a comparison between the directions (strikes) of failed slopes and clay veins observed on the slope surfaces and/or their outcrop. The directions of clay veins and strikes of the failed slope are nearly same. It is indicated from geological and mineralogical investigations that the slope failures during rainfall occur easily along the boundary between host granite and the veins. In particular, the ground water level will rises remarkably due to the presence of clay veins in the slope. In fact, Aoyama et al (1999) also suggested that in the slope with clay veins, the water table reaches higher level at a faster rare during the rainfall. In this study, the variation of ground water level in the slope with clay veins and without clay veins during rainfall was simulated, based on the heavy rainfall of June 29, 1999, and the slope failure that occurred in Doi, Imuro, Asakita-ku, Hiroshima on that day was chosen for the study. The variation in the safety factor of the slope was also simulated, based on the rainfall data. 2. METHOD OF SIMULATION The variation of ground water level was simulated by the seepage analysis method. The safety factor was determined by the Janbu method. The rainfall date of June 29, 1999 for Kure-city, Hiroshima Prefecture recorded every 10 min hour 10 am to 6 pm was used for the simulation. The data shows; 10mm/min. rainfall for two hours, and the total amount of the rainfall was 184mm from 10am to 6pm. Two major clay veins were observed in the failed slope at Doi, Imuro, Asakita-Ku, Hiroshima. 3. RESULTS 3.1 Seepage analysis method As a result, the ground water level is remarkably higher in the slope with clay veins than in these without clay veins. It is understood from this result that because the clay veins prevent the ground water flow, the ground water level rises quickly during a heavy rainfall. The slope with clay veins is easily saturated with ground water compared to the slope without clay veins. Therefore it is inferred that the slope failure is highly possible to occur immediately after a heavy rainfall. 3.2 Safety factor of the slope On the relationship between safety factor of the slope and the rainfall duration, the safety factor of the slope without clay veins is much higher than 1, and dose not change with the rainfall times. On the other hand, the safety factor of the slope with clay comes down to a value less than 1 after the rainfall. In other words, the slope with clay veins fails easily during heavy rainfall. 4. CONCLUSION The effect of clay veins on the slope failure at Doi, Imuro, Asakita-ku, Hiroshima was studied by simulating the geological factors and rainfall data. The results obtained are as follows; 1)The water table in the slope with clay veins becomes remarkably higher than in the slopes without clay veins during a rainfall. 2)The variation of ground water level in the slope with clay veins is remarkable. 3)Clay veins prevent the ground water flow. 4)The safety factor of a slope without clay veins remains almost unchanged with time during rainfall, whereas the safety factor of a slope with clay veins falls below 1 during rainfall. 5)Based on these results, it can be said that clay veins in a slope strongly affect the stability of a slope, especially in a weathered granite region.