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Study on the variation regularity of the strength index of Xigeda-soil-dam reinforced with bamboo along with the change of saturation

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Abstract. The Xigeda soil from Panxi region has a high strength in the state of nature. While meeting with water, this kind of soil is easy to produce swelling, disintegration, softening phenomenon. With the reinforcement of lime and bamboo can greatly improve the shear strength of the Xigeda-soil-dam. When the dam meet with water, the moisture content increased, the degree of saturation increased and the shear strength changed. To discuss the variation regularity of the strength changed alone with saturation, some triaxial tests are made in the laboratory to determinate the strength of 28d Xigeda soil reinforced with bamboo and from the respective saturation of 54.51%, 63.68%, 74.57%, 85.77% and 95.34%. It is found in this experiment that, with the increase of saturation, the Cohesion and Internal friction angle decreased approximately in logarithm function.

Key words. saturation, shear strength,Xigeda soil reinforced with bamboo, 3:7 lime earth.

1. Introduction

Xigeda soil, produced in Panzhihua Hongge Xigeda village, is widely distributed in Panxi area. And it belongs to the half diagenesis. It has a high strength in the dry state, but is easy to produce swelling, disintegration, softening phenomenon while meeting with water [1]. In 2004, the high fill soil slope reinforced with bamboo and lime is fully completed and put into use in Panzhihua University Stadium. The height of the dam is 40 meters (Including basis). And the maximum length of the arc is up to 179 meters. Compared with the original scheme, it saved about 50%

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investment in the construction. Over the past ten years, the dam has experienced several large earthquakes. But it still maintains the function efficaciously. Water is one of the main reasons causing landslide accident. The shear strength of soil will significantly decreases along with the increase of moisture content and the degree of saturation, which leads to a sharp decline in slope stability [2,3,4]. Therefore, in order to provide certain reference for dam monitoring and warning. The triaxial test is made to explore the influence law of saturation on the shear strength index of three-seven-xigeda soil reinforced with bamboo.

2. Speciment preparation

The samples in the experiment are taken from the dam in the above Panzhihua University Stadium. According to the volume ratio, the inverse proportion of lime is 75%, and Xigeda soil is accounted for 25% in the configuration of specimen. The reinforcing bamboo is made of Bambusa in Panxi area. The size of Bamboo is 50mm*10mm.

It is arranged in a network of 300mm*500mm with one layout by every 350mm in height. It is ensured that the test specimen and the practical engineering material have the same rate of compaction density and Moisture content. The size is reduced by 17.5 times to preparate the sample. The samples are maintained in the constant temperature moisture curing box for 28d [5]. The triaxial specimen fabric reinforcement is shown in Figure 1.

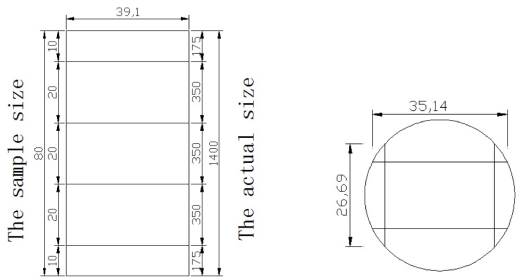

Fig. 1. Triaxial specimen fabric reinforcement

The ways to saturate the sample are respectively in immersion saturation and pumping gas saturation. The samples are divided into five groups according to the saturation. The first group of samples select natural saturation (Take the average saturation calculated by density, moisture content, specific gravity as its saturation). The second, the three and the forth group of samples saturate in immersion saturation, whose saturation is respectively 63.68%, 74.57%, 85.77%. The fifth groups use vacuum pumping gas saturation whose saturation is 95.34%[6,7,8].

3. Test and analysis

The test is taken on the three-seven-xigeda soil reinforced with bamboo under no drainage and no consolidation condition in the automatic three axial compression systems (TSZ). The principle of selecting the strain failure point: if the test result has a peak point within 15% (δ_1-δ_3), take the peak point as the failure point. if the test results has no peak point within 15% (δ_1-δ_3), take the strain corresponding point at 15% as the failure point [4]. The experimental results are shown in Figure 2-6:

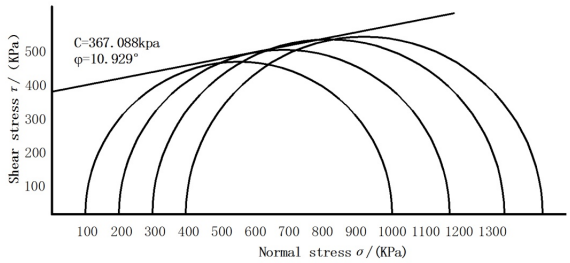

Fig. 2. The strength envelope about reinforced three-seven lime when the saturation is 54.51%.

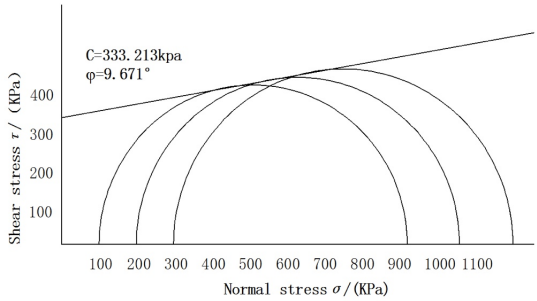

Fig. 3. The strength envelope about reinforced three-seven lime when the saturation is 63.68%.

Based on the experimental results, it is found that: on one hand, due to the confining pressure in the chamber, the dowel bar is not closely contact with the specimen. On the other hand the friction between the pressure chamber and dowel sleeve is obvious. This causes that the axial strain increases at the beginning period, but the principal stress did not change in the front several sample groups, which can be shown in Figure 2 and 4. In the following sample groups, the experimental scheme is improved by taking pressure in advance. After the dowel bar, the samples and the pressure sensor are in good contact, the data is resending to zero and then the test is officially started .The experimental results are shown in Figure 10. From test results shown above, the following conclusions can be drawn: After the 28d maintaining

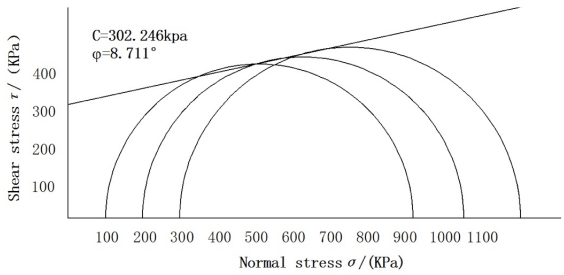

Fig. 4. The strength envelope about reinforced three-seven lime when the saturation is 74.57%.

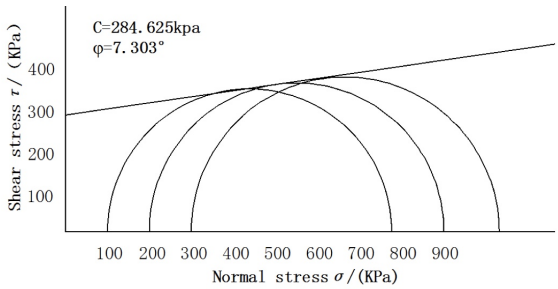

Fig. 5. The strength envelope about reinforced three-seven lime when the saturation is 85.77%.

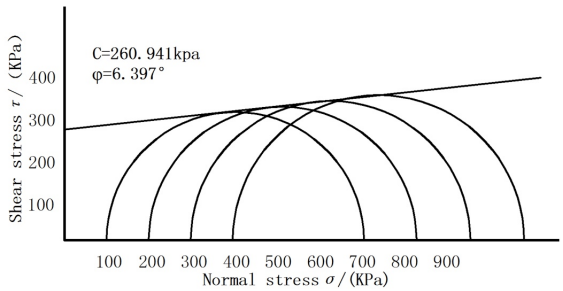

Fig. 6. The strength envelope about reinforced three-seven lime when the saturation is 95.43%.

Table 1. C, φ values of three-seven lime reinforced with bamboo corresponding different saturation

Order	$Sr(\%)$	$C/(\text{Kpa})$	$\varphi(^\circ)$
1	54.51	367.088	10.929
2	63.68	333.213	9.671
3	74.57	302.246	8.711
4	85.77	284.625	7.303
5	95.34	260.941	6.397

of Xigeda soil reinforced with bamboo, its cohesion values(C) have changed a lot, but which is still large .The internal friction angle decreases gradually, but without obvious and big change and its value is also very small.

4. Conclusion

To format a new dam structure reinforced with lime and bamboo in Xigeda soil is a new technology. The retaining wall above the sports field in Panzhihua University has been used in practice to verify its superiority. This project won the second prize in 2009 for annual science and technology progress meeting in Panzhihua. Through taking triaxial test indoor on models, this paper is to simulate and evaluate the shear strength loss of the dam when the fault occurred in the drainage measures and soil soaking saturation increases. The conclusions can be drawn as follows.

In the state of optimum water content, the compacting dam reinforced with lime and bamboo and with the maximum compaction density can have a saturation of 54.51%, when the strength development last for twenty eight days. At this point, the cohesion value(C) is 367.088kpa, and the internal friction angle value is 10.929°.

With the immersion time increasing, the saturation increases, the shear strength decreases gradually in Xigeda soil reinforced with lime and bamboo. Cohesion values(C) have decreased rapidly, but is still large. When the soil reaches complete saturation (Exceed 95%), the cohesion value(C) is still as high as 260.941kpa. The internal friction angle value gradually decreases. When the saturation of the soil is 54.51%, the value is 10.929 degrees. But when the saturation reaches 95.34%, the value becomes down to 6.397 degrees [9]. The shear intensity parameters with corresponding different saturation are shown in Table1.

Through the experiment, with the increase of saturation, the Cohesion and Internal friction angle decreases approximately in logarithm function. The experimental results are shown in Figure 7 and 8.

The experimental data can provide important reference for the long-term monitoring and analysis on shear strength and stability of the Xigeda retaining wall reinforced with high filling, lime and bamboo in the Panzhihua University stadium, when it is in the most unfavorable immersion state.

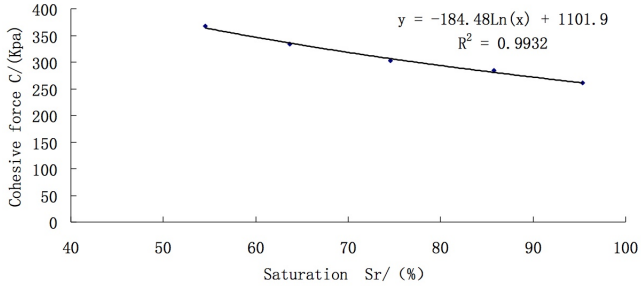

Fig. 7. Relationship between Degree of saturation and the Cohesion(C)

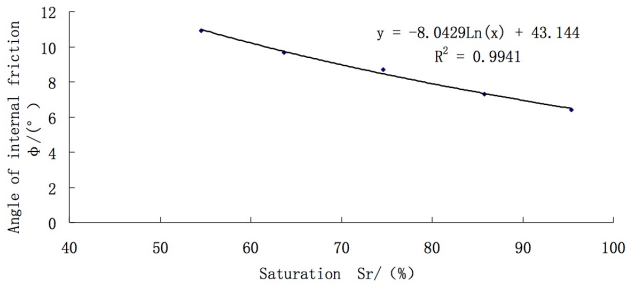

Fig. 8. Relationship between Degree of saturation and Internal friction angle(φ)

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