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Research Article

Improvement of Clayey Soils by Combined Bamboo Strip and Flax Fiber Reinforcement

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A combined bamboo strips and flax fiber reinforcement method to reinforce clay is proposed in this paper, and in order to study the mechanical properties of bamboo strips and flax fiber-reinforced clay (BFRC), a series of tensile tests were carried out to obtain the relationship between the average tensile force and deformation of flax fiber and bamboo strip; after that, triaxial shear tests were carried out under the conditions of different confining pressures. In addition, the reinforcement mechanism of the bamboo strips and flax fiber-reinforced clay (BFRC) is analyzed. The test results show that the cohesion and internal friction angle of the bamboo strips and flax fiber-reinforced clay (BFRC) are improved compared with the pure clay. In the case of flax fiber-reinforced clay, the cohesion of reinforced clay is increased by 18.34% and the friction angle is only increased by 0.39%. In the case of bamboo strips and flax fiber-reinforced clay, the cohesion of reinforced clay is increased by 26.36% and the friction angle is only increased by 10.24%. The addition of bamboo strips improves the shear strength of the reinforced clay and effectively improves the deformation resistance of the flax fiber-reinforced clay (FRC). And it increases the internal friction angle and cohesion of the clay, although the increase in the strength is mainly reflected in the influence on the cohesion.

1. Introduction

Strength and ability to resist the deformation of the natural soil are often difficult to meet the engineering requires. The addition of a certain amount of fiber can improve the strength of the soil [1–4]. The fiber has the characteristics of tensile and crack resistance, and the dispersion degree of the fiber in the soil is very high so that the mechanical properties of the fiber-reinforced soil are close to isotropic, which can effectively make up for the deficiency of the traditional reinforced soil [5–7]. Thus, fiber reinforcement technology has been a hot topic in the research field of soil improvement [8–11]. In general, the researchers mainly carry out direct shear tests and triaxial compression tests on the shear strength behaviors of fiber-reinforced soil. In the direct shear test aspect, Garry and Ohashi [12] used direct shear tests to study the effect of different fiber angles on the working mechanism of fiber soil. Anagnostopoulos et al. [13] conducted a series of direct shear tests on unreinforced and reinforced clay to study the shear strength properties of polypropylene fiber-reinforced soil, and the test results showed that the addition of the fibers results in a substantial increase in the friction angle. On the contrary, cohesion does not change considerably with the change of fiber content. Similarly, Tang et al. [14] studied the strength properties of fiber-reinforced cement soil by the direct shear test. In the triaxial shear test aspect, Gray and Al-Refeai [15] reinforced the nondiscrete distribution fiber layer, and the stress-strain of the sand was triaxially tested. The test results showed that the fiber layer can avoid postpeak strength losses of the reinforced sand at larger axial strain. Ranjan et al. [16] conducted triaxial tests on the fiber-reinforced medium and coarse sand. The results showed that the peak strength of fiber soil increases with the increase of fiber content and the residual strength is higher than that of pure soil. The strength is linearly positively correlated with the amount of fiber in the range of volume percentage of less than 2%. Hamidi and Hooresfand [17] carried out triaxial tests on cement and polypropylene fiber-reinforced soil. And the results showed that the internal friction angle and cohesion increased when fiber was added. In addition, the effect of fiber content on the shear strength of cemented soil is greater at higher relative densities. The previous studies indicate that the shear strength of fiber-reinforced soil is related to the fiber type, reinforcement ratio, dimension, and other factors, and the effect of the reinforcement ratio is most significant [18, 19].

At the same time, due to the increasingly severe global energy and environmental problems, more and more attention has been paid to the research on the mechanical properties of soil improved by natural materials [20]. In research on the mechanical properties of soil reinforced by natural fiber, Prabaker and Sridhar [21] conducted triaxial consolidation undrained tests on sisal fiber to treat silty clay, and the results showed that sisal fiber can effectively increase the maximum deviatoric stress of clay. Vinod et al. [22] used coir to reinforce soft clay and carried out a triaxial unconsolidated undrained test. The test results showed that 1% is the optimum reinforcement ratio and the reinforcement effect is higher at a higher confining pressure. Adili et al. [23] pointed out that using papyrus as a reinforcement material, when the reinforcement ratio reaches 10%, the internal friction angle and cohesion of silt with sand can be maximized, thereby increasing the strength of the soil. Mohamed [24] studied the use of hay fibers to improve the properties of cohesive soils. Anggraini et al. [25] used coir fiber as the reinforcement material and considered that fiber content is the main influencing factor on the strength of reinforced soil. Qu and Sun [26] carried out a series of one-dimensional consolidation and triaxial tests on samples of unreinforced and reinforced Shanghai clayey soil with different percentages of randomly distributed wheat straw fibers, and the test results showed that the addition of wheat straw fiber leads to a significant increase in shear strength and friction angle of the soil and there is an optimum fiber content of 0.2–0.3% that makes this increase maximal. Ma et al. [27] put regenerated flax fiber into clay and investigated the shear performance of flax fiber-reinforced clay by unconsolidated and undrained triaxial tests, and the test results showed that the shear strength of the flax fiber-reinforced clay is significantly improved compared with that of the pure clay but the internal friction angle is small and the cohesion is obviously increased. In research on the mechanical properties of soil reinforced by natural bamboo material, Bergado et al. [28] investigated the reinforcement effect of bamboo as a reinforcement material by the direct shear test and pull out test, and the test result showed that the reinforcement effect of bamboo mesh is slightly better than that of the geogrid. Toh et al. [29] studied the reinforcement effect of geotextile-bamboo fascine mattress-reinforced soft soils in Malaysia. Huang et al. [30] investigated the strength characteristics of reinforced soil by using cement and bamboo chips by unconfined compression tests, and the test results showed that the strength and ductility characteristics of soil improvement are rather better when the bamboo chips are mixed. Ismanti and Yasufuku [31] added bamboo chips into cemented sand soil and investigated the effects of bamboo chips in cemented sand soil on permeability and mechanical properties by triaxial compression tests, and the test results showed that bamboo chips are able to improve the permeability value that affects the dilation behavior of cemented sand soil. Ma et al. [32] investigated the reinforcement mechanism and optimal reinforcement ratio of soil reinforced with bamboo slats, In terms of large-scale direct shear tests. Hegde and Sitharam [33] carried out laboratory plate load tests on the soft clay bed reinforced with natural (bamboo) and commercial (geosynthetics) reinforcement materials, and the test results showed that reinforcing the soil with 3D reinforcement system such as geocells and bamboo cells yields maximum benefit than the planar reinforcements such as geogrid and bamboo grids. In summary, these studies expand the sources and fields of reinforced material; however, there are relatively few researches on the behavior of bamboo strips and flax fiber-reinforced clay (BFRC) at present.

In this paper, the triaxial shear tests are carried out to study the deviator stress relationships of pure clay, flax fiber-reinforced clay (FRC), and bamboo strips and flax fiber-reinforced clay (BFRC) under the condition of different confining pressures. In addition, the reinforcement mechanism of the bamboo strips and flax fiber-reinforced clay (BFRC) is analyzed. The results can provide significant references to the application of the bamboo strips and flax fiber-reinforced clay (BFRC).

2. Test Process

2.1. Materials Tested. The clay used in the tests was taken from a foundation pit of Han Street located at Wuhan, with a depth of 9 m, which is unsaturated silty clay. Some physical properties of clay are listed in Table 1. The fiber used in the tests was flax fiber (Figure 1(a)), which was taken from the flax tree on the campus of Hubei University of Technology, and the bamboo strip, which was taken from the natural bamboo in Badong City, Hubei Province, China (Figure 1(b)). The specimens of flax fiber and bamboo strips were kept at a temperature of $20^{\circ}C \pm 2^{\circ}C$ and a relative humidity of $65\% \pm 15\%$ for 3 days to avoid the influence of water content on the tests results. The tensile tests were carried out at a loading speed of 0.1 mm/min. The curves of tensile force versus tensile elongation (ΔL) of flax fiber and bamboo strips are shown in Figure 2. The basic mechanical parameters of flax fiber and bamboo strips are listed in Table 2.

Figure 2(a) shows the relationship between the average tensile force and the deformation of flax fiber. It can be seen that the curve of flax fiber can be divided into three stages due to tensile failure, and the line between a and b points is a linear change stage, which is the elastic tension stage. At this stage, the tensile force and deformation present a linear relationship. With the increase of the tensile force, the deformation of flax fiber increases linearly, and the line between b and c points is the elastoplastic stage. At this stage, with a gradual increase in the tensile force, the deformation increases continuously. The c and d stages are the failure

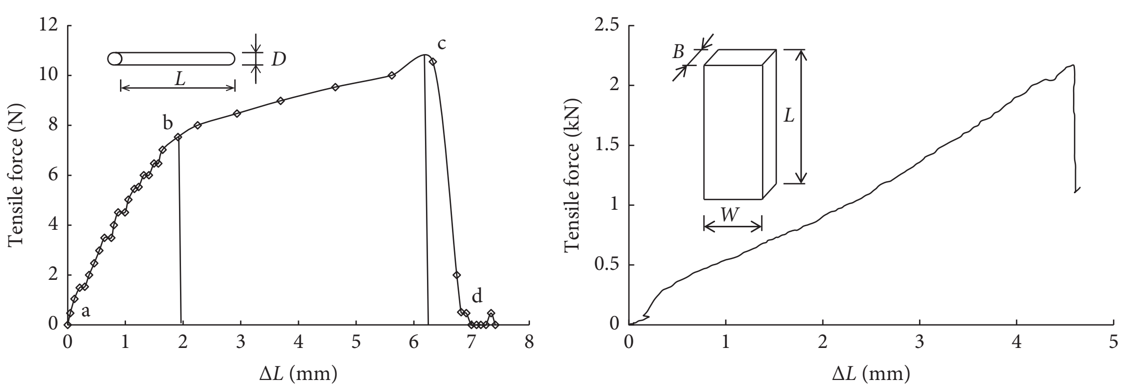
Table 1: Some physical properties of clay.

Natural density (kg·m^{-3})	Natural moisture content (%)	Liquid limit (%)	Plastic limit (%)	The mineral content of clay (%)		
				Kaolinite	Illite	Montmorillonite
2.03×10^{3}	21.90	38.95	20.43	58.34	23.46	18.20

(a)

(b)

Figure 1: Different materials used in tensile tests. (a) Flax fiber. (b) Bamboo strip.



(a)

(b)

Figure 2: Tensile force vs. deformation of (a) flax fiber and (b) bamboo strip.

Table 2: Parameters of flax fiber and bamboo strip.

Material	Dimension (mm)	Ultimate tensile strength (MPa)	Tensile modulus (GPa)
Flax fiber	200 $(L)\times0.35$ (D)	127.54	0.51
Bamboo strip	200 $(L)\times10$ $(W)\times1$ (B)	216.82	9.43

stage where a large displacement occurs and the tensile strength of the fiber obviously decreases, and at the end of this stage, the flax fibers break.

It can be seen from Figure 2(b) that the specimen exhibits an approximately linear change before the specimen fails. It can be seen that the bamboo strip is approximately an elastic reinforced material.

2.2. Triaxial Compression Tests. A TSZ-2 automatic triaxial instrument (manufactured by Nanjing Soil Instrument Factory Co., Ltd.) is employed in the test. The instrument consists of a triaxial device and a data acquisition system. The unsaturated clay was subjected to a triaxial test of reinforced soil under the condition of unconsolidated and undrained (UU), and the controlled loading speed of load was 0.50 mm/min. The reinforcing effect and mechanism of two natural materials mixed reinforced clay were studied by controlling the confining pressure.

According to the Chinese Test Methods of Soils for Highway Engineering requirements [34], the selected clay was dried and crushed to make disturbed testing samples, and the indoor compaction test of the sieved clay was carried out. The relationship curve between dry density and moisture content was obtained by experiments. The optimum moisture content was 15%, and the maximum dry density was 1.80 g·cm^{-3}, which is shown in Figure 3. The flax fiber and the bamboo strips were taken from the natural

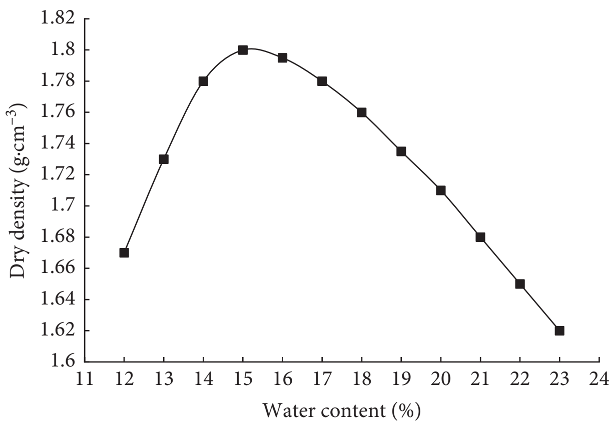


Figure 3: Relationship curve between dry density and water content.

state, and the diameter of the flax fibers is about 0.2 mm~0.4 mm. The fibers were cut with a length of 20 mm, and the size of the bamboo strips were selected as 10 mm × 54 mm × 3 mm. The treated dry clay and flax fiber required for each sample were divided into 5 parts, and 5 parts were mixed together after one by one mixing to ensure that the flax fiber is evenly dispersed in the clay. The moisture content of the sample was controlled at 15% by adding water, and then the flax fiber-reinforced clay was cured for 24 hours to make its moisture content stable. The flax fiber-reinforced clay weighing 175 g is used for the preparation of each sample, which was compacted in 5 layers by using a unified compaction hammer from the same height and compacted to a target dry density of 1.80 $g{\cdot}cm^{-3}$. Preparation of bamboo strips and flax fiber-reinforced clay samples is as follows: after the 4th layer compaction of flax fiber-reinforced clay, bamboo strips were inserted vertically, and four bamboo strips with definite size were placed at the position as shown in Figure 4. Then, the 5th layer of flax fiber-reinforced clay was added and compacted to the target dry density of 1.80 $g{\cdot}cm^{-3}$. The final size of the samples was 39.1 mm in diameter and 90 mm in height, which is shown in Figure 5. Three groups of specimens were subjected to triaxial tests under three confining pressures of 100 kPa, 200 kPa, and 300 kPa, respectively, and three groups of parallel tests were carried out. Thus, a total of 18 specimens should be tested by triaxial tests.

3. Results and Analysis

3.1. Relationship between the Deviator Stress ($\sigma_1 - \sigma_3$) and Axial Strain (ε_1). As it can be seen from Figure 6, (1) under the same confining pressure, the specimens with different reinforcement conditions are at the initial stage of deformation ($\varepsilon_1 \leq 1\%$), and the deviator stress ($\sigma_1 - \sigma_3$) under the same strain is basically the same. When the strain reaches a certain value, the deviator stress of the reinforced clay begins to present obvious differences due to the different reinforcement conditions, and the deviator stress of the bamboo strips and flax fiber-reinforced clay (BFRC) is much larger than that of the flax fiber-reinforced clay (FRC), which indicates that bamboo strips can further strengthen the shear strength of flax fiber-reinforced clay (FRC). The main reason is that the tensile stress of the reinforced material is small in the early stage of deformation, and only when the strain reaches a certain degree, the reinforced material is subjected to a large tensile stress. And bamboo strips and flax fiber can bear larger tensile stress than flax fiber. (2) When the axial strain is large, the deformation resistance and shear strength of the clay can be improved by using the flax fiber and bamboo strips. Taking Figure 7(b) as an example, under the confining pressure of 200 kPa, the peak deviator stress of pure clay is 136.3 kPa when the strain is 13%. However, the deviator stress of flax fiber-reinforced clay (FRC) and bamboo strips and flax fiber-reinforced clay (BFRC) at the corresponding strain is 224.5 kPa and 320.6 kPa, respectively, and the deviator stress is increased by 64.7% and 135.2%, respectively, but the corresponding peak deviator stress is not reached, which indicates that the addition of flax fiber and bamboo strips can further improve the shear strength and deformation resistance of clay.

In Figure 7, the following can be observed: (1) Regardless of the confining pressure, the stress-strain curves of clay with different reinforcement conditions show hardening regulation, but with the increase of confining pressure, the stress-strain curves become steeper and change from the weak hardening regulation to the strong hardening regulation. The results indicate that the influence of confining pressure on the shear strength of reinforced clay is very obvious, which is due to the fact that the lateral restraint effect of low confining pressure on the specimen is small, and the clay particles are loose, but when the confining pressure increases, the lateral restraint effect on the specimen is stronger, and the friction force between clay particles and reinforced material is increased. Therefore, the reinforcement effect of reinforced material is more obvious when the confining pressure is high. (2) As it can be seen from Figure 7(b), the addition of flax fiber can improve the shear characteristics of flax fiber-reinforced clay (FRC) compared with pure clay. As shown in Figure 7(c), after the bamboo strips are added to the flax fiber-reinforced clay (FRC), the deviator stress increases with the increase of axial strain, and there is no decreasing trend, which indicates that the addition of bamboo strips has a significant effect on the shear strength of the bamboo strips and flax fiber-reinforced clay (BFRC). (3) The peak of deviator stress increases with the increase of confining pressure, which is due to the fact that the contact between clay particles and reinforced materials is closer under higher confining pressure, and the reinforcement effect of the reinforced material is fully exerted so that the deformation resistance and critical fracture toughness of clay are enhanced.

Figure 8 shows the peak value of deviator stress of reinforced clay under different confining pressures. It can be seen that the peak value of deviator stress of the bamboo strips and flax-fiber reinforced clay (BFRC) are larger than those of flax fiber-reinforced clay (FRC) under the same confining pressure, which indicates that bamboo strips can further improve the strength and resistance to deformation of flax fiber-reinforced clay.

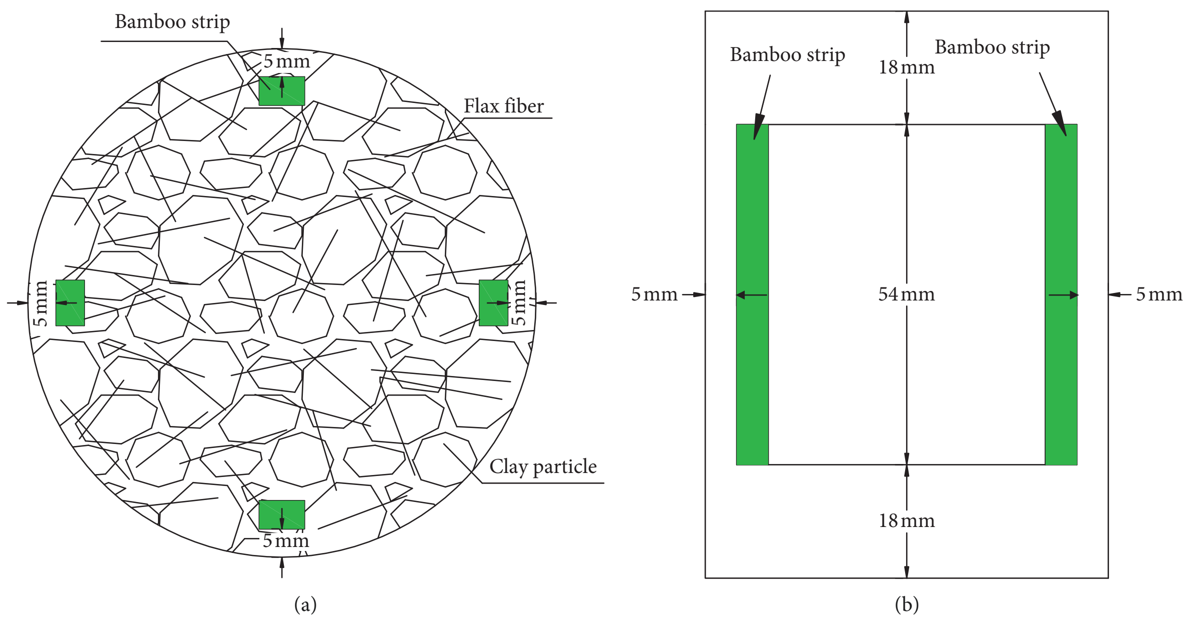


Figure 4: Arrangement of the bamboo strips and flax fiber composite reinforcement. (a) Cross section. (b) Vertical section.

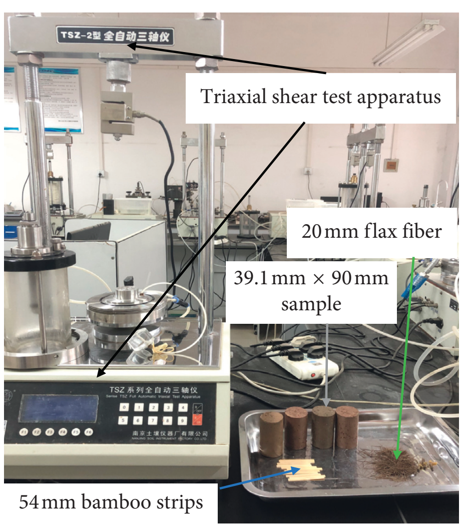


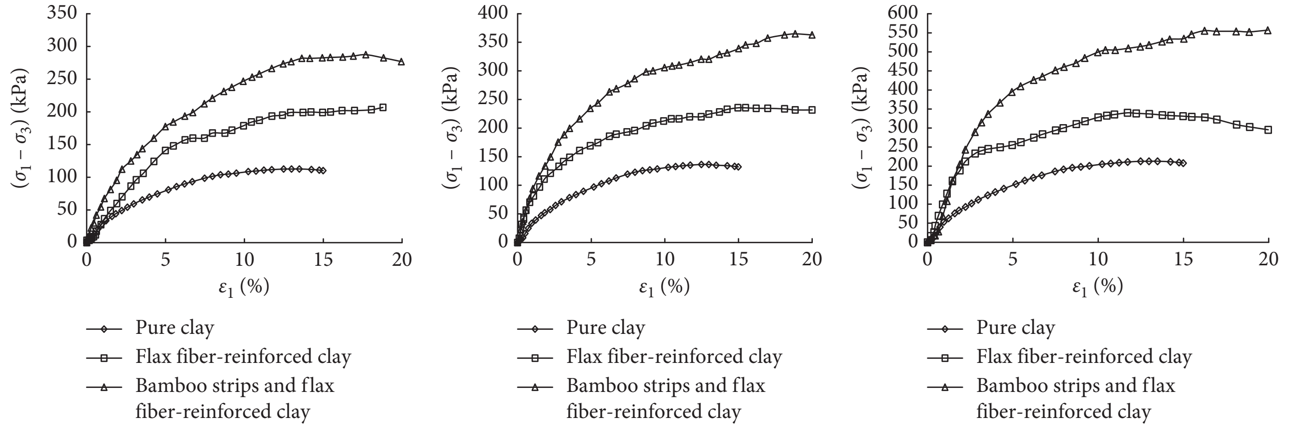
Figure 5: Samples preparation.

3.2. Shear Strength of Reinforced Clay. Under the confining pressure of 100 kPa, 200 kPa, and 300 kPa, according to the results of the whole test, the mean value was used to draw the Mohr stress circle envelope and the shear strength indexes of reinforced clay were obtained. Taking the bamboo strips and flax fiber-reinforced clay as an example, Figure 9 is the Mohr stress circle envelope of bamboo strips and flax fiber-reinforced clay.

The cohesion (c) and internal friction angle (φ) can be obtained by combining the whole test, as listed in Table 3. Table 3 shows the numerical relationship between the cohesion and the internal friction angle of the bamboo strips and flax fiber-reinforced clay (BFRC), as well as the flax fiber-reinforced clay (FRC). It can be seen from Table 3 that the cohesion and internal friction angle of the bamboo strips and flax fiber-reinforced clay (BFRC) are improved compared with the pure clay. In the case of flax fiber-reinforced clay, the cohesion of reinforced clay is increased by 18.34% and the friction angle is only increased by 0.39%. In the case of bamboo strips and flax fiber-reinforced clay, the cohesion of reinforced clay is increased by 26.36% and the friction angle is only increased by 10.24%. But the cohesion increases significantly and the internal friction angle increases inappreciably. The bamboo strips and flax fiber-reinforced clay (BFRC) further enhance the cohesion and internal friction angle of the clay on the basis of the flax fiber-reinforced clay (FRC). The cohesion increases the most, and the internal friction angle increases little, which illustrate that the effect of flax fiber reinforcement (FR) and bamboo strips and flax fiber composite reinforcement (BFR) is mainly reflected in the increase of cohesion.

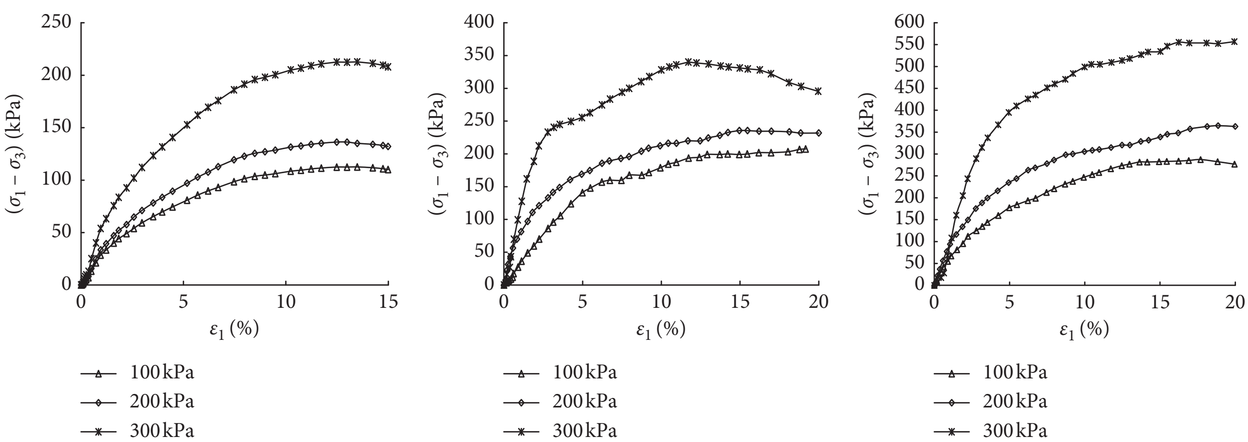
Based on the analysis of the above triaxial tests results, it can be seen that bamboo strips are beneficial to the strength of the flax fiber-reinforced clay. The addition of bamboo strips improves the mechanical properties of flax fiber-reinforced clay, and its shear strength parameters change by inserting bamboo strips, which causes an increment in the internal friction angle and cohesion of the flax fiber-reinforced clay. The value of the cohesion increases greatly, and the internal friction angle increases slightly, which indicate that the main influence of the bamboo strips is on the cohesion of reinforced clay.

3.3. Reinforcement Mechanism of the Bamboo Strips and Flax Fiber-Reinforced Clay. The reinforcement mechanism of the bamboo strips and flax fiber-reinforced clay can be explained by analyzing the state of the fiber and the bamboo strips in the reinforced clay. The fiber is three-dimensionally reinforced, but during the test, the samples were compacted so that the clay and fiber in the samples



(a) (b) (c)

Figure 6: Relationship between the deviator stress and axial strain of pure clay, flax fiber-reinforced clay (FRC), and bamboo strips and flax fiber-reinforced clay (BFRC). (a) 100 kPa. (b) 200 kPa. (c) 300 kPa.



(a) (b) (c)

Figure 7: Relationship between the deviator stress and axial strain of flax fiber-reinforced clay (FRC) and bamboo strips and flax fiber-reinforced clay (BFRC) under different confining pressures. (a) Pure clay. (b) Flax fiber-reinforced clay. (c) Bamboo strips and flax fiber-reinforced clay.

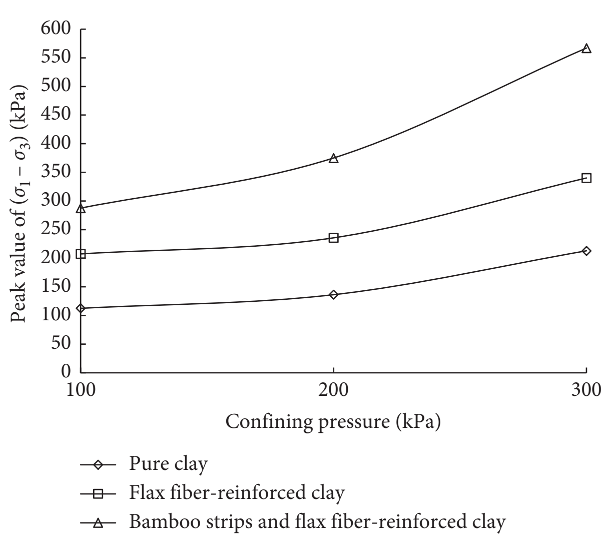


Figure 8: Peak value of $(\sigma_1 - \sigma_3)$ versus confining pressures.

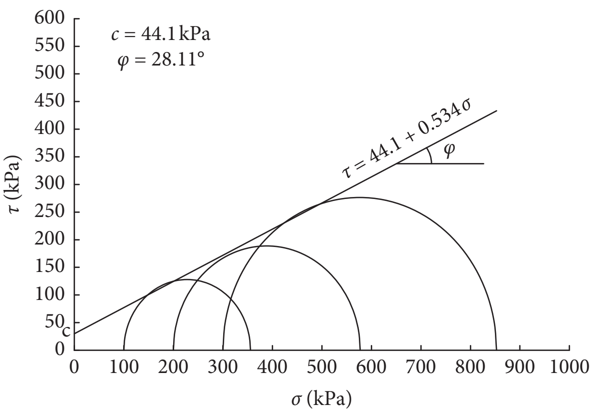


Figure 9: Mohr stress circle envelope of bamboo strips and flax fiber-reinforced clay.

Table 3: Shear strength parameters.

Materials	Shear strength parameters	
	C (kPa)	Φ (°)
Pure clay	34.9	25.5
Flax fiber-reinforced clay	41.3	25.6
Bamboo strips and flax fiber-reinforced clay	44.1	28.11

are compressed in the vertical direction, and the fiber exerts reinforcing effect in the horizontal direction; however, the effect in the vertical direction is very small. Adding bamboo strips to the flax fiber-reinforced clay makes up for this defect and enhances the resistance of the reinforced clay in the vertical direction. The vertical reinforcement generates passive resistance, which can effectively improve the shear strength and deformation resistance of the reinforced clay. The vertical reinforcement reduces the tensile stress of the reinforced clay in the horizontal direction, and the vertical reinforcement connects the horizontal reinforcement, forming a tightly connected structure in three-dimensional space. In addition, the surface of the bamboo strips is rough, and the bamboo strips have many deep lines in the direction of the grain. These lines can improve the mechanical interlocking force between the bamboo strips and flax fiber-reinforced clay (BFRC), thereby improving the shear resistance of the reinforced clay and improving the integrity of the bamboo strips and flax fiber-reinforced clay (BFRC). At the same time, bamboo strips are regarded as a naturally flexible material with a certain degree of toughness and strength that are not easily destroyed in the soil.

As shown in Figure 10, the bamboo strips and flax fiber-reinforced clay (BFRC) are formed by uniformly mixed flax fiber and clay inserted with bamboo strips. Compared with the flax fiber-reinforced clay (FRC), the bamboo strips are interspersed in the vertical direction, which improves the resistance of the reinforced clay in the vertical direction and reduces the tensile stress of the reinforced clay in the horizontal direction. Under vertical compression and loads, the reinforcement effect of flax fiber is mainly in the horizontal direction, and the reinforcement effect of the added bamboo strips is mainly in the vertical direction. Thus, the abovementioned composite reinforcement performs a horizontal-vertical reinforcing effect.

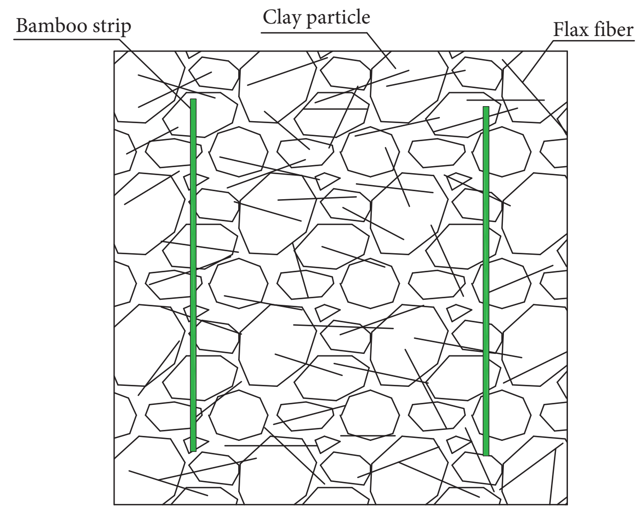


Figure 10: The reinforcement schematic diagram of the bamboo strips and flax fiber-reinforced clay (BFRC).

The shear strength of the clay is mainly derived from the frictional contact among the clay particles, namely, the effective stress. The addition of the reinforcement material is to increase the frictional resistance, enhance the contact between the soil particles and the reinforcing material and the clay particles, and improve the shear strength of the reinforced clay. The deformation of the clay will cause the tensile stress and compressive stress of the reinforced clay, and the pressure depends on the tensile and compressive stress of the clay in the direction of tensile stress and compressive stress. The addition of the reinforcement material to the clay changes the balance of the forces in the clay, causing the stress to redistribute at the location of the reinforcement material. When horizontally reinforced, the force of the reinforcement when shear strain occurs is shown in Figure 11.

The shear strain in the reinforced clay causes the tensile stress T_r to change, and two stress components along the cross-sectional direction and the vertical cross section are generated at the strain interface. The tangential component $T_r \sin\theta$ in the reinforced clay is directly resisting the shear force damage, and the normal component $T_r \cos\theta$ increases the frictional resistance of the reinforced clay interface $T_r \cos\theta \tan\varphi$.

The bamboo strips are inserted into the flax fiber-reinforced clay to form horizontal-vertical three-dimensional reinforced clay specimens. The force of the reinforcement materials when the reinforced clay is subjected to the shear strain is shown in Figure 12.

When the vertical reinforcement is applied, the tensile stress at the interface is composed of the horizontal reinforcement of the flax fiber and the tensile stress generated

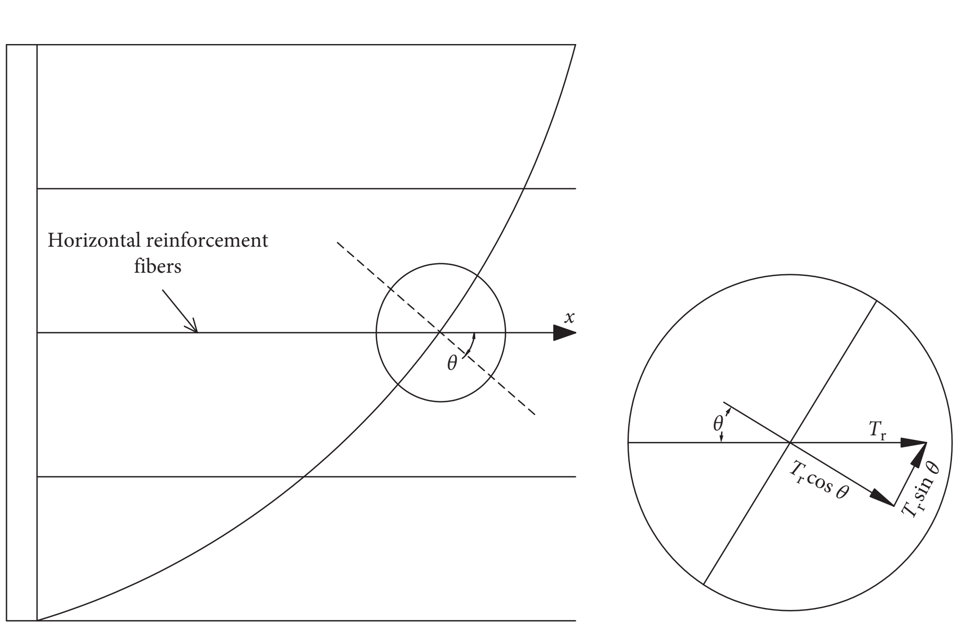


FIGURE 11: Schematic diagram of the horizontal reinforcement.

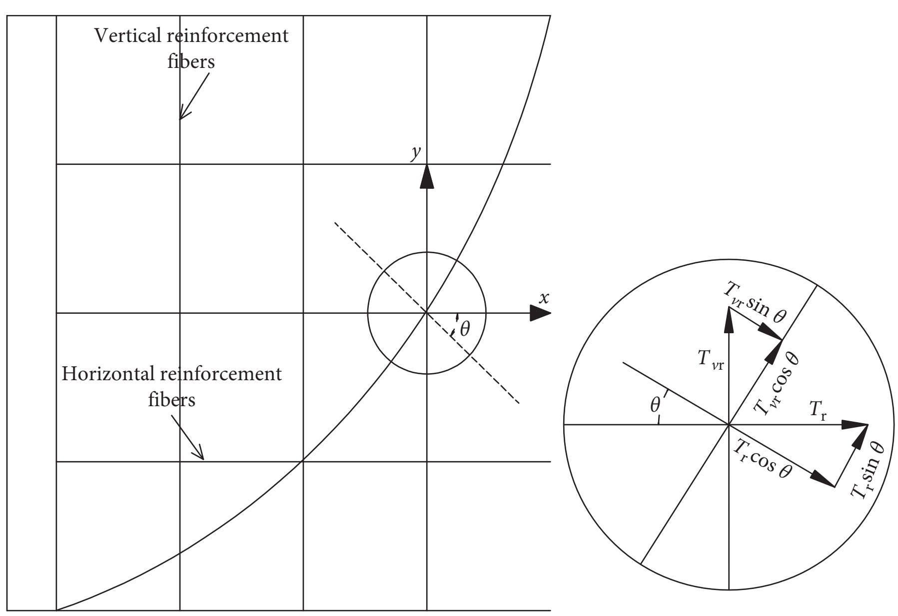


FIGURE 12: Schematic diagram of the horizontal-vertical reinforcement.

by the vertical reinforcement of the bamboo strips. The horizontal shear strain in the flax fiber-reinforced clay causes the tensile stress T_r to change. The tangential component in the reinforced clay is $T_r \sin\theta$, and the normal component is $T_r \cos\theta$. The vertical shear strain in the flax fiber-reinforced clay causes the tensile stress T_{vr} to change. The tangential component $T_{vr} \cos\theta$ in the reinforced clay is the normal component, and the tangential component $T_{vr} \sin\theta$ on the interface directly resists the shear failure of the shear force $T_r \sin\theta + T_{vr} \cos\theta$. The normal component increases the frictional resistance at the interface of the reinforced clay, and the magnitude is $(T_r \cos\theta + T_{vr} \sin\theta)\tan\varphi$. The horizontal-vertical reinforcement is better than separate horizontal reinforcement and vertical reinforcement because it fully exerts the reinforcement effect of the reinforcement in horizontal and vertical directions.

4. Conclusions

The study on the bamboo strips and flax fiber-reinforced clay (BFRC) can not only provide references to make full use of natural reinforced materials to improve the performance of clay but also maximize the value of materials by comprehensive utilization of various materials and reduce the engineering cost by taking local materials as well. From the comparison tests of the bamboo strips and flax fiber-reinforced clay (BFRC) and flax fiber-reinforced clay (FRC), the following conclusions can be drawn:

(1) Tensile tests results show that bamboo strip and flax fiber are similar to elastic materials and have strong tensile strength. They are ideal natural reinforcement materials and can be used for soil reinforcement.

(2) Bamboo strips and flax fiber can be used as reinforcement materials to improve the strength and deformation resistance of clay, and the reinforcement effect is more obvious when the axial strain is large.

(3) The surface of the bamboo strips is rough, and there are many deep lines in the direction of the bamboo strips. These lines can improve the mechanical interlocking force between the bamboo strips and the clay particles, thereby improving the shear resistance of the reinforcement, effectively improving the strength and deformation resistance of the flax fiber-reinforced clay (FRC). The cohesion and internal friction angle of the clay are increased, and the increase of this strength is mainly reflected in the influence on the cohesion. This study can provide significant references to the application of the bamboo strips and flax fiber-reinforced clay (BFRC).

(4) The influence of bamboo strips on the flax fiber-reinforced clay is mainly reflected in the enhancement of the vertical strength of the reinforcement and the improvement of its resistance to deformation. Bamboo strips and flax fiber can effectively exert the reinforcement effect of the materials, enhance the strength of the reinforced clay, play a vertical and horizontal reinforcement role, and improve the overall strength of the reinforced clay.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

Acknowledgments

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