# Precast Stabilized Peat Columns to Reinforce Peat Soil Deposits

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## ABSTRACT

This article describes laboratory research on precast columns made of peat soil and ordinary Portland cement, with and without polypropylene fibers. The columns used in this study unlike the usual in situ or in place columns used previously, that are formed inside prepared holes in the ground, are formed outside the hole, and then inserted into the ground holes.

The process of making precast stabilized peat columns includes mixing peat soil with a specified amount of cement, (with or without polypropylene fibers) at their optimum moisture (found from compaction tests) contents. The mixture is then compacted into molds and left to dry. As the stabilized columns dry out, they gain strength. When drying is complete, they are taken out of their molds and inserted in the pre-drilled holes.

In this laboratory study, long precast columns (L/D > 4) were used to reinforce undisturbed peat soil samples. The strength evaluation for the precast stabilized columns was done through consolidated undrained triaxial tests. The undisturbed peat soil in the study has been used as control sample.

The results of the study obtained from shear strength parameters, stress-strain curves and undrained modulus prove that precast stabilized peat columns can be used to reinforce and strengthen weak deposits of peat soil. Their production requires relatively small amounts of cement compared with the usual in situ columns but provides higher strength values, and therefore provides more load-bearing capacity. Since the production process does not waste much of the materials involved and does not use any fill materials the columns can also be considered environmentally friendly.

KEYWORDS: undisturbed peat samples, precast stabilized peat columns, compaction, consolidated undrained, principal stresses, shear strength parameters, undrained modulus

# INTRODUCTION

Peat and organic soil represent the extreme forms of soft soil. They are susceptible to instability such as localized sinking and slip failure, and massive and long-term settlement when subject to even moderate load increase (Jarret, 1995). Access to these surficial deposits is usually very difficult as the water table will be at, near or above the ground surface with low shear strength ranging from 5 to 20 kPa (Huat, 2004). The modification of soil properties to improved states of load-bearing capacity may be done in a number of ways, including the following (Bowles, 1978):

Compaction, usually most economical.

Preloading, primarily to reduce future settlement but may also be used to increase shear strength.

Drainage, used to speed up settlements under preloading but may also increase shear strength.

Densification using vibratory equipment, particularly in sand, silty sand and gravelly sand despite relative density below 50 to 60 percent.

Grouting, both to reduce voids and to stiffen soil.

Chemical stabilization, to stiffen soil.

Use of geotextiles, primarily as reinforcement but sometimes in other beneficial modes.

Sometimes it may be possible to combine different methods to provide a suitable foundation for the imposed loads. Hebib and Farrell (2003) provide a technique of surface stabilization combined with stabilized cement columns for foundation load support. Black and colleagues (2007) in their study used a reinforced stone column that not only transfers loads to the lower and stronger layer but receives lateral support from the weak soil along the way. Rahman and colleagues (2004) in their laboratory study increased the shear strength of undrained plain peat soil by almost 36% using drainage methods.

In this laboratory research, oven-dried 100 mm long precast stabilized columns made of peat, ordinary Portland cement, and polypropylene fibers have been inserted in undisturbed plain peat soil samples prepared for consolidation un-drained (CU) triaxial tests. Triaxial, consolidated undrained tests have been conducted on the undisturbed peat samples as control samples as well as a combination of undisturbed plain peat samples having precast stabilized column made of different amount of cement with and without polypropylene fibers. The results indicate that installing precast stabilized peat columns in plain undisturbed peat soil improves the shear strength of the peat soil.

# TEST MATERIALS

Peat soil samples used for the study were collected as disturbed and undisturbed according to AASHTO T86-70 and ASTM D42069 (Bowles, 1978; Engineering and Design Laboratory Testing, 1980) from Kampung, Jawa in the western part of Malaysia. Table 1 presents the properties of the in situ (field) peat soil. The stabilizing agent used for the columns was ordinary Portland cement and polypropylene fibers (Figure 1). Polypropylene fibers were used as additive to increase the strength values of the columns as well as increasing the columns' intactness and uniformity as described by Kalantai and Huat (2008).Table 2 presents the main components of the ordinary Portland cement and Table 3 presents the specifications for the fibers used in the research.

**Table 1:** Properties of the peat soil

| Properties | Standard Specifications * | Values |
|---|---|---|
| Depth of sampling | | 5 – 100 Cm. |
| Moisture Content | ASTM D2216 | 198 - 417 % |
| In situ (natural) bulk density | | 10.23–10.4 kN/m$^3$ |
| Classification | ASTM D5715 | Fibrous |
| Liquid Limit | BS 1337 | 160 % |
| Plastic Index | ASTM D424-59 | N.P. |
| PH | BS 1337 | 6.81 |
| Organic content | ASTM D2974 | 80.23 % |
| Wopt | A ASHTO T 180-D | 130 % |
| γd(max) | AASHTO T 180-D | 4.89 kN/m3 |
| Permeability (Undisturbed) | ASTM D2434-68 | 4.9 x 10 -4 (cm/sec) |
| eo (initial void ratio) | BS 1337, ASTM D2435-70 | 12.55 |
| Cc (compression index) | BS 1337, ASTM D2435-70 | 4.163 |
| Cr (recompression index) | BS 1337, ASTM D2435-70 | 0.307 |
| UCS (Undisturbed) | ASTM 2166-6, AASHTO T208-706 | 28.5 kPa |

*Bowles (1975) and BS 1337

**Table 2:** Main components of ordinary Portland cement (Nevile, 1999)

| Name of Component | Oxide | Abbreviation |
|---|---|---|
| Tricalcium Silicate | 3CaO SiO2 | C3S |
| Dicalcium Silicate | 2CaO SiO2 | C2S |
| Tricalcium Aluminate | 3CaO Al2O3 | C3A |
| TetracalciumAluminate Ferrite | 4CaSO4, Al2O3, Fe2O3 | C4AF |
| Calsium Sulphate | CaSO42H2O or CaSO4 | Gypsum |

**Table 3:** Polypropylene fibers specifications (Polypropylene fibers, 2005)

| Property | Specification |
|---|---|
| Color | Natural |
| Specific gravity | 0.91 gr/cm$^3$ |
| Fiber Length | 12mm |
| Fiber Diameter | 18 micron – nominal |
| Tensile strength | 300 – 440 MPa. |
| Elastic modulus | 6000 – 9000 (N/mm$^2$) |
| Water absorption | None |
| Softening point | 160ºC |

**Figure 1:** About 50 grams of the type of polypropylene fibers used in the research.

## EXPERIMENTAL PROGRAM

In order to examine the effect of precast stabilized peat columns on the shear strength parameters of peat soil, index property tests on the plain peat soil were conducted. The tests included: sieve analysis (Figure 2), water content, liquid limit, plastic limit, organic content, fiber content, compaction, unconfined compressive strength, permeability, and Rowe consolidation cell. Consolidated undrained triaxial tests were conducted on the plain peat soil as well as precast peat columns made of peat soil plus different amounts of ordinary Portland cement (OPC) as well as peat soil plus OPC and optimum dosage (amount that gives the maximum strength values for stabilized soil) of polypropylene fiber, as presented by Kalantari and Huat, (2008). A mixture of peat soil, OPC, and polypropylene fibers used to make dried stabilized peat columns were at their optimum moisture contents. Therefore in this research the two types of frequent laboratory tests that were conducted were compaction and triaxial tests.

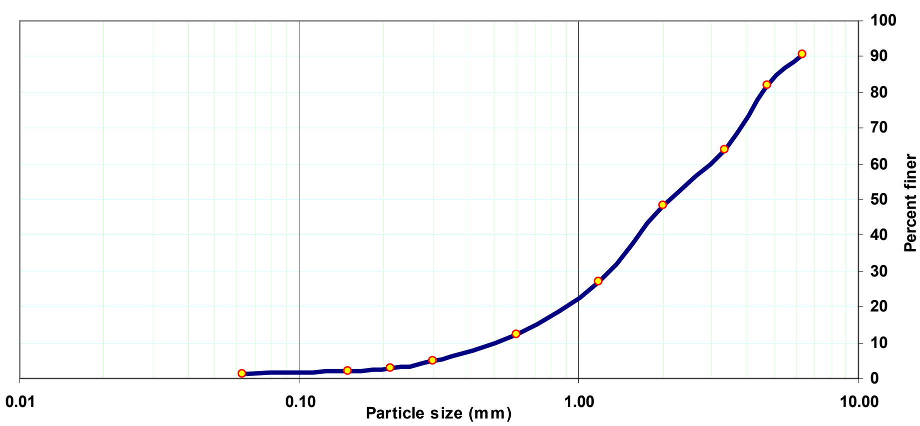


**Figure 2:** Particle size distribution for the peat soil.

The experimental program in this research consists of:

***a*** - Finding index properties of plain peat soil either in disturbed or undisturbed states according to the specified standard listed in Table 1.

***b*** - Compaction tests for the stabilized peat soils.

***c*** - Molding the columns.

***d*** - Drying the precast columns.

***e*** - Conducting consolidated undrained triaxial tests on the undisturbed peat soil, and precast stabilized peat columns inserted in the undisturbed peat samples.

## Dosage amount of Ordinary Portland Cement and polypropylene fibers used to make precast peat columns

In order to investigate the effect of precast stabilized peat columns on the shear strength values of plain peat soil, a total of four different dosages of ordinary Portland cement were chosen. These dosage amounts were, 5, 15, 30, and 50%. The 5 and 15% OPC are considered lower dosages, and the other two are considered higher dosages. In this laboratory research, 5% ordinary Portland cement means 5 g of OPC in dry form has been added to 100 g of the wet peat soil (weight of dry peat soil + weight of water in the peat soil), and also 50% OPC means 50 g of ordinary Portland cement powder has been added for each 100 g of wet soil.

Polypropylene fibers used in this study had a constant value of 0.15%. This amount means that for each 100 g of wet peat soil (weight of dry peat + weight of water in the peat soil), 0.15 g of polypropylene fibers has been added. The value of 0.15% was used in research carried out by Kalantari and Huat (2008) on the stabilization of peat soil using cement and polypropylene fibers; it was found to be the optimum dosage amount to give the maximum strength values in unconfined compressive strength as well as CBR tests.

# COMPACTION PROCESS

Modified compaction tests were used, specified by AASHTO T 180-D procedures (Bowles, 1978), to find optimum moisture contents ($W_{opt}$)for the plain peat soil, and also for the mixture of peat soil plus 5, 15, 30, and 50% ordinary Portland cement, as well as peat soil with the same amount of OPC including 0.15% polypropylene fibers.

Prior to the laboratory compaction tests, the wet natural peat soil with water content of 198 to 417% (natural water content of peat soil) was reduced to around 50%. Reducing moisture content of the natural peat soil was first done by leaving the natural peat soil in the oven at a low temperature of 60˚C for more than five days. In order to release the confined moisture inside the peat soil samples, every day the soil sample was taken out of the oven and mixed, and then replaced back inside the oven.

This gradual drying of natural peat soil samples procedure has been used instead of the usual method of complete drying of peat soil to prevent the possible change of peat soil texture upon complete drying inside the oven. Figure 3 shows the gradual moisture reduction process of the peat soil, and the reduced-moisture content peat soil prior to use in compaction tests.

**(a)** **(b)**

**Figure 3: (a)** Gradual moisture content reduction or half drying of peat soil procedure in the oven for compaction tests, **(b)** Reduced moisture content samples to be used for compaction tests.

For each set of compaction tests, the moisture-density curve was drowned and from its result the optimum moisture content ($w_{opt}$) and maximum dry density ($\gamma_{d(max)}$) were detected. For the following triaxial tests the optimum moisture content values found in the compaction tests were used. The number of points used to construct the compaction curves throughout the experimental compaction work ranged from three to eight points.

Prior to the compaction tests process, the specified amount of peat, cement and fibers were mixed in an electric dough mixer to achieve uniformity for at least ten minutes. The compaction process was also done with the help of an electric compacting machine, and this insured more uniform compaction for all different mixtures of stabilized peat soil samples.

## PREPARATION OF PEAT SOIL SAMPLES WITH PRECAST STABILIZED COLUMNS INSIDE

Each set of columns made of specified amounts of peat soil, ordinary Portland cement, with or without polypropylene fibers, had optimum moisture content, found from moisture-dry density curves. Column dimensions consisted of 16.67 mm diameter, and 100 mm length. The area ratio of the columns with respect to samples used for triaxial tests (area of the column/ area of the peat soil sample) was 0.11 and is accordance with the most commonly used pile spacing specified by several building codes described by Bowles (1983). The code suggests the optimal spacing is in the order of 2.5 to 3.5 D (D is the diameter of the pile or column) and in this research the column spacing was 3.0 (50/16.67). Length divided by the diameter ratio of the columns in this research was 6 (100/16.67) and since the L/D ratio was greater than 4 (L/D > 4), the columns were considered to be the long type of columns (Alwi, 2008).

After the mixture of stabilized peat soil had been prepared, the mixture was placed in non-reusable molds made of plastic sheet cover and tapes in a form of plastic tubes (Figure 4).Each mixture of peat soil was placed in five layers, and each layer of stabilized peat was given 56 blows with a metal rod weighing 384 grams while inside its mold. Then the prepared samples with their molds were subjected to the drying process. In order to prevent possible cracking in the prepared samples owing to the high temperature of drying, the prepared column samples were placed inside an oven with a temperature of 75˚C for three days to be dried by gradual drying processes.

**Figure 4:** Non-reusable molds (plastic tubes) for columns made of plastic sheet cover and tape

## PREPARATION OF SAMPLES FOR TRIAXIAL TESTS

Undisturbed peat soil samples were placed inside the standard steel mold of triaxial tests with each sample with length and diameter dimensions of 100 mm and 50 mm respectively covered with rubber membrane. Using a thin wall (0.25 mm) metal tube cutter of the same size as the column diameter (Figure 5a) a hole was made at the center of the undisturbed peat soil. The precast stabilized peat column was then inserted in to the hole as depicted in Figure 5b and Figure 6. Finally, undisturbed peat samples along with the columns at their center were placed in the triaxial cell for actual consolidated undrained tests.

**Figure 5: (a)** Thin-walled metal tube cutters used to make hole at the center of undisturbed peat soils. **(b)** Precast stabilized peat column to be inserted in the center of triaxial undisturbed peat soil sample.

**Figure 6:** Triaxial undisturbed sample with the precast stabilized peat column placed at its center.

## CONSOLIDATED UNDRAINED TRIAXIAL TESTS

Consolidated undrained (CU) triaxial tests were conducted on three types of samples. The first type included plain undisturbed peat samples. In the second and third types, the undisturbed peats were tested with precast stabilized columns were at their center. For the second type of samples tested, the precast columns consisted of 5, 15, 30, and 50% of ordinary Portland cement (OPC) plus peat soil, and for the third type of samples that were subjected to CU tests the precast columns comprised 5, 15, 30, and 50% of OPC, with each sample having 0.15% of polypropylene fibers as well. Therefore, the second type of column had only peat and OPC, and no additive (polypropylene fibers) while the third type of test included columns with OPC and additives.

All consolidated undrained test samples were conducted by computerized programs using GDSLAB v 2.2.7 and in accordance with ASTM International (2004). For all samples, the consolidation pressure of 50 kPa was used. Confining pressure used to fail the samples was, 50, 100, and 150 kPa respectively. The strain rate of 0.24% per minute was used to shear the samples. The numbers of samples for each set of tests used in the experiment varied from two to four. The total time length for each single sample to be tested was from 24 to 30 hrs.

## SOAKING COLUMNS TEST AND RESULTS OBTAINED

In order to test the columns, at their weakest condition possible, that is when they were 100% saturated. Test has been conducted on columns made of peat soil, 50% cement, and 0.15% polypropylene fibers. Reason to choose columns with 50% cement, and 0.15% polypropylene fibers was, because this type of stabilized samples showed maximum strength values, and therefore it was chosen as control sample for soaking test.

Procedure includes submerging the long precast stabilized peat column samples with the mentioned specified amount of peat, ordinary Portland cement, and polypropylene fibers in water for 4 days. The submerged samples were weighted every 24 hours for possible weight increases. According to the obtained result, they reached their 98.9% of their constant weight or 100% of their saturation condition during the first 24 hours. Therefore, it was assumed that all samples containing lower dosages of cement (5 and 15%), as well as higher containing dosages of cement (30 and 50%) were 100% saturated, before being failed under stress deviator stresses. Since, they were in saturation condition while in triaxial cell for at least 24 hours, before being subjected to failure.

## Results of Compaction Tests

In order to find the moisture-density relation, modified compaction tests according to AASHTO T 180-D ( Bowles, 1978) were conducted on plain peat soils as well as a mixture of peat and different amounts of ordinary Portland cement with and without polypropylene fibers. From moisture-density curves, optimum moisture content (OMC) was found for each set of peat soil mixtures.

Moisture-density relation curves for 5, 15, 30, and 50% cement mixed with peat soil, as well as 5, 15, 30, and 50% cement with peat soil plus 0.15% of polypropylene fibers, are shown in Figures 7(a), and 7(b) respectively. The compaction curve for the plain peat soil sample has also been presented as a control measure sample in both figures.

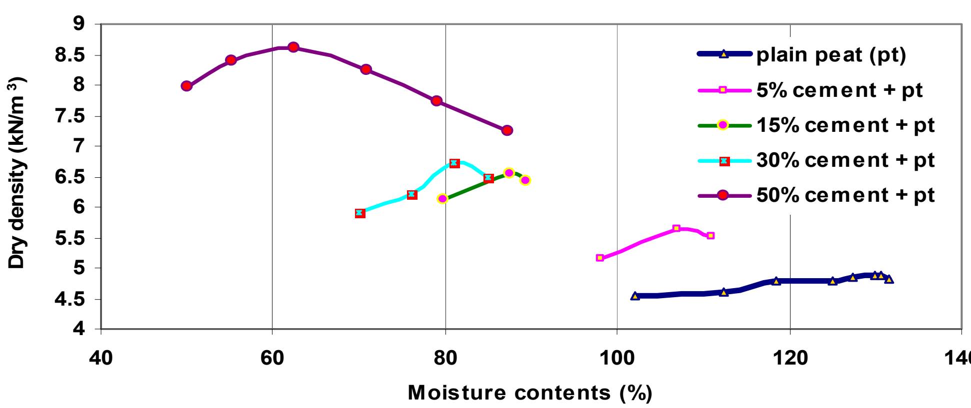


**Figure 7*a*:** Moisture-density relationship curves: (*a*) for plain peat soil, and peat soil plus different amounts of cement (*b* in the next page)

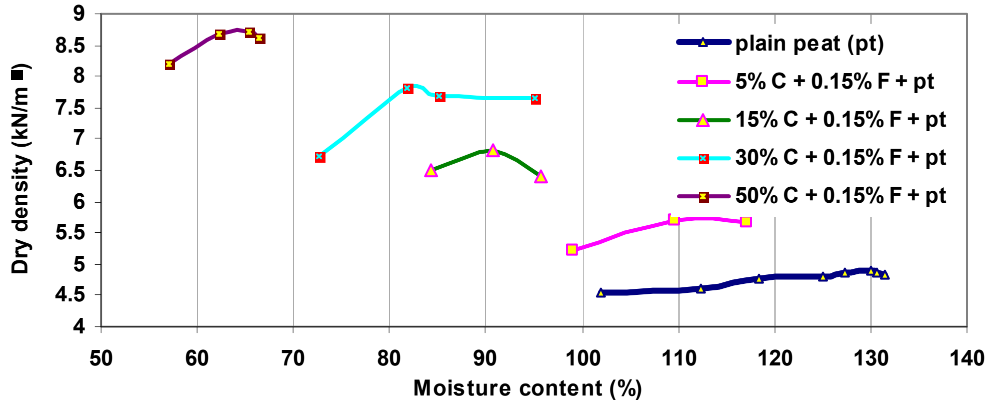


**Figure 7*b*:** Moisture-density relationship curves: (*b*) for plain peat soil, and peat soil plus different amounts of cement plus 0.15% of polypropylene.

A comparison of results shown in Figure 7 shows that, as the cement content of the mixture is increased, the optimum moisture content (OMC) decreases, and dry density increases. As polypropylene contents are introduced to each set of peat soil mixture, the OMC decreases and dry density of the mix increases. The decrease in OMC and increase of dry density for the mixtures containing polypropylene fibers are slight when compared with mixtures without fibers.

## Results of Consolidated Undrained Tests

In order to find the effect of precast stabilized columns on the undisturbed peat samples, consolidated undrained (CU) triaxial tests were conducted on undisturbed peat soil, as well as column mixtures of peat soil and 5, 15, 30, 50% ordinary Portland cement. CU tests were also conducted for undisturbed peat soil samples with columns containing 5, 15, 30, and 50% cement plus 0.15% polypropylene fibers.

For each set of samples, the stress path method using **p** (Eq.2), and **q** (Eq.3) values was used to construct $\mathbf{k_f}$ line (Figure 8). From $k_f$ line, and its equation (Eq.1), total shear strength parameters, cohesion ($\mathbf{C_{cu}}$) from equation 4, and friction angle ($\boldsymbol{\varphi_{cu}}$) from equation 5 for the consolidated undrained samples were calculated.

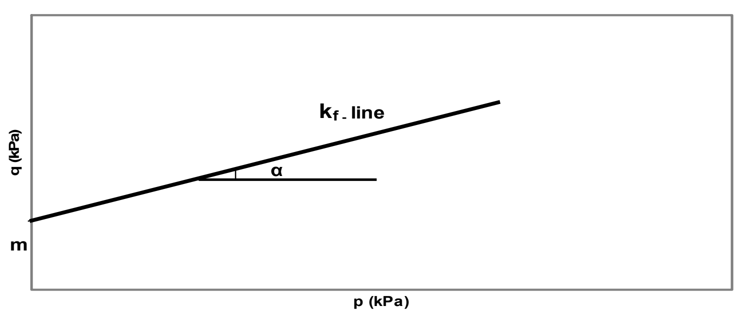


**Figure 8:** Constructing $k_f$ line, from p versus q values for each set of CU triaxial test samples

$$q = m + p \tan \alpha \quad (1)$$

$$p = (\sigma_1 + \sigma_3)/2 \quad (2)$$

$$q = (\sigma_1 - \sigma_3)/2 \quad (3)$$

$$C_{cu} = m/\cos \alpha \quad (4)$$

$$\varphi_{cu} = \sin^{-1} (\tan \alpha) \quad (5)$$

$\boldsymbol{\sigma_1}$ (major principal stress) is used in equation 2, and 3 is the deviator stress plus the constant confining stress during the shear failure of the sample, and $\boldsymbol{\sigma_3}$ (minor principal stress) is the confining stress used during the shear failure for each sample. Value for **m** used in equation 1 is measured along q axis, and where the $k_f$ line intersects the vertical axis as is shown in Figure 8. Angle $\boldsymbol{\alpha}$ is the angle of $k_f$ line with the horizontal axis.

After calculation of total shear strength parameters, the effective shear strength parameters ($\mathbf{C'_{cu}}$ from equation 12 and $\boldsymbol{\varphi'_{cu}}$ from equation 13) for each set of samples were calculated in the same manner as described for total shear strength parameters, except, in this case, the $\mathbf{k'_f}$ line that is represented by equation 7 was constructed instead of $\mathbf{k_f}$ line, taking the pore pressure (**u**) measurements at the time of failure of each sample into account. By use of equations 8 and 9, values for effective major ($\boldsymbol{\sigma'_1}$) and minor ($\boldsymbol{\sigma'_3}$) principal stresses were calculated respectively. For each sample that was tested points **p′** from equation 10 and **q′** from equation 11 were calculated.

$$q' = m' + p' \tan \alpha' \quad (7)$$

$$\sigma'_1 = \sigma_1 - u \quad (8)$$

$$\sigma'_3 = \sigma_3 - u \quad (9)$$

$$p' = (\sigma'_1 + \sigma'_3)/2 \quad (10)$$

$$q' = (\sigma'_1 - \sigma'_3)/2 \quad (11)$$

$$C'_{cu} = m'/\cos \alpha' \quad (12)$$

$$\varphi'_{cu} = \sin^{-1} (\tan \alpha') \quad (13)$$

$\boldsymbol{\alpha'}$**,** in equations 12 and 13 is the angle of $k'_f$ line with the horizontal axis obtained from plotting p′ versus q′ values. The value for **m′** is determined where the $k'_f$ line intersects the q′ or vertical axis.

**Table 4:** Consolidated undrained shear strength parameter values for undisturbed plain peat, and different types of precast stabilized peat column within the undisturbed peat soil.

| Sample types | Total stress $C_u$ (kPa) | Total stress $\varphi_u$ (deg.) | Effective stress $C'_u$ (kPa) | Effective stress $\varphi'_u$ (deg.) | $R^2$ (%) |
|---|---|---|---|---|---|
| Plain undisturbed peat | 5.03 | 13.31 | 0 | 36.64 | 99*, 97** |
| **Undisturbed peat with precast stabilized column made of:** | | | | | |
| Peat + 5% cement | 24.4 | 4.6 | 9.44 | 16.8 | 100,100 |
| Peat + 15% cement | 13.13 | 12.6 | 6.3 | 35.6 | 100,100 |
| Peat + 30% cement | 2.42 | 20.52 | 23.8 | 20.95 | 100,100 |
| Peat + 50% cement | 35.7 | 4.9 | 0 | 42.82 | 80, 89 |
| Peat + 5% cement + 0.15% fibers | 9.43 | 16.8 | 16.85 | 19.63 | 100,100 |
| Peat + 15% cement + 0.15% fibers | 0.45 | 26.9 | 12.93 | 39.9 | 100,100 |
| Peat + 30% cement + 0.15% fibers | 25.8 | 16.97 | 26 | 27.92 | 100,100 |
| Peat + 50% cement + 0.15% fibers | 80.6 | 1.7 | 44.6 | 24.3 | 100,100 |

*$R^2$ for total stress parameters

**$R^2$ for effective stress parameters

Results shown in Table 4 show that precast stabilized long peat columns (L/D > 4) made of different percentages of cement and peat improve the shear strength of plain undisturbed peat soil samples. As the cement content for the columns is increased, the shear strength values of the samples are improved as well. Addition of 0.15% of polypropylene fibers to the mixtures of peat and cement would add to the total as well as effective consolidated undrained shear strength parameter values further.

Figure 9 shows stress deviators versus strain values for plain peat soil, and different types of precast stabilized peat columns installed in the plain undisturbed peat soil. The consolidation pressure used to consolidate the samples as well as the confining pressure at the time of failure for all samples that their stress-strain results are shown in Figure 10, during the consolidated undrained tests were 50 kPa.

Figure 9 shows that the lowest maximum stress deviator is for the plain peat, and the highest is for the peat soil plus 50% cement and fiber, and values for maximum deviator stress for the other types of undisturbed peat soil with different types of columns fall between these two values. As the cement contents in the columns are increased the maximum deviator stress values for them are increased as well. The results in Figure 9 show that addition of 0.15% polypropylene fibers to the mixture of peat soil and ordinary Portland cement in construction of precast columns provides more resistance against imposed loads.

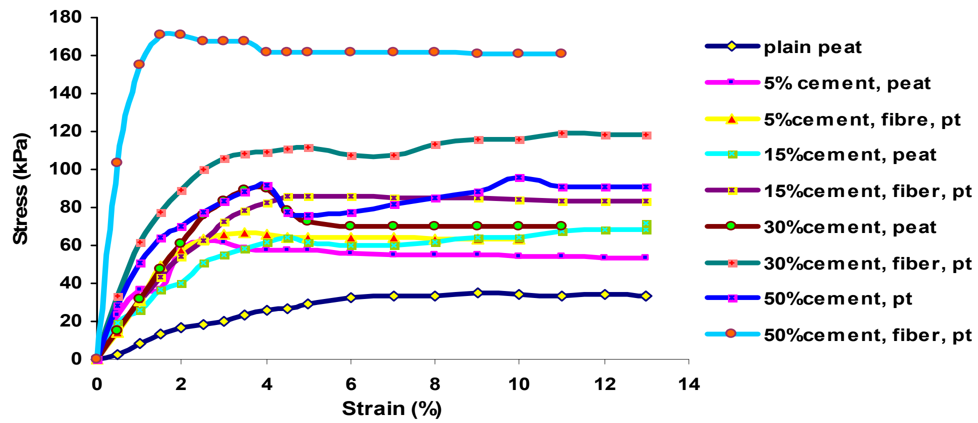


**Figure 9:** Stress-strain curves for undisturbed peat and different types of columns used to strengthen peat soil samples obtained from CU tests.

In order to study the strength values between the different types of precast stabilized peat columns used to strengthen undisturbed peat soil, undrained modulus ($E_u$) values were found from the initial tangent line of stress-strain curves shown in Figure 9. The results for undrained modulus for different types of columns used in the research are shown in Figure 10.

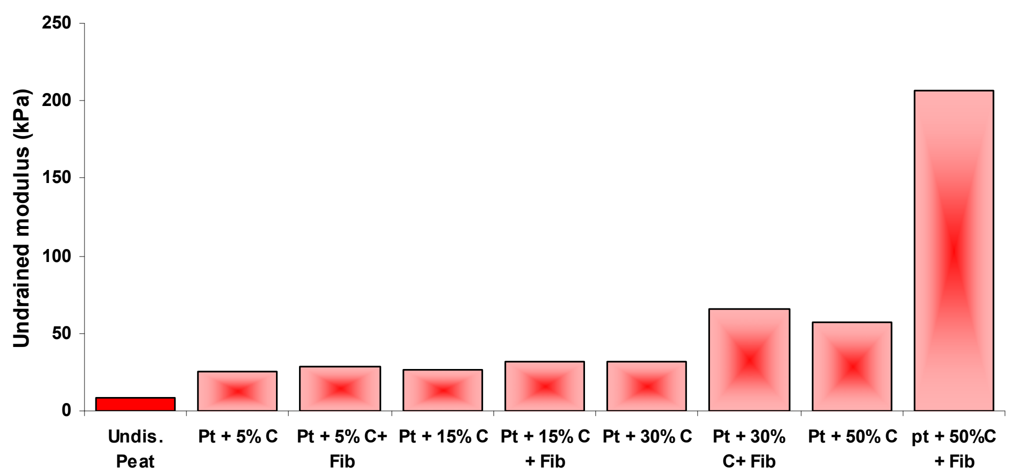


**Figure 10:** Undrained modulus for undisturbed peat and different types of dried stabilized peat columns used to strengthen peat soil samples.

The results presented in Figure 10 indicate that dried stabilized peat columns do increase the undrained modulus of the plain peat soil. Also, as the cement content in the mixture of peat and ordinary Portland cement is increased, the value for $E_u$ is increased, too. Addition of polypropylene fibers to the mixture increases the undrained modulus of the samples even further. The effect of polypropylene fibers is more profound in columns containing higher amounts of ordinary Portland cement (30 and 50%).

# CONCLUSION

Peat soil is one the softest soils and is unable to resist construction loads imposed upon it. Different methods have been proposed to stabilize or strengthen peat soil deposits. One of the common methods presented in the literature to strengthen peat soil deposit, is to use in situ or in place columns (columns made inside the ground and in the peat soil layers on the field). These types of columns are usually made of 100% cement (cement columns) but, to lessen the amount of cement, some kind of filler material such as sand and in situ peat soils has also been used to strengthen the peat columns.

In this research a new type of column is introduced. It is made of a mixture of in situ peat soil (peat from the drilled hole), ordinary Portland cement, with or without additives (in this study polypropylene fibers were used as an additive). The mixtures are mixed at their optimum moisture content and are compacted in a mold outside the drilled holes (unlike the in situ (in place) columns that are formed inside the drilled hole), dried and finally the dried precast columns are inserted in the drilled holes inside the ground on the field.

In this laboratory-scale research, precast stabilized peat columns were tested for their strength effects on the undisturbed peat soil samples. The strength test that was conducted for this purpose was the consolidated undrained triaxial test. Various amounts of ordinary Portland cement along with polypropylene fibers were used to stabilize the precast peat columns.

The results obtained from shear strength parameters, stress-strain curves, and undrained modulus values show that precast stabilized peat columns used in the study are effective to improve load-bearing capacity of undisturbed peat soil. As the cement content in the mixtures is increased the strength values for the columns are increased as well. Polypropylene fibers when used in the mixtures of peat soil and ordinary Portland cement columns contribute more strength and uniformity to the stabilized columns.

Precast stabilized peat columns are environmentally friendly products too, since most of their ingredients come from the natural peat soils that are drilled out of the ground to form holes for the columns, and therefore do not produce much waste material; nor do they need extra fill materials (such as sand) except ordinary Portland cement and the usual additives (in this study, polypropylene was used as an additive).

The concept of precast stabilized peat columns can be used to produce short stabilized peat columns (L/D< 4) as well as precast stabilized piles to reinforce deep peat deposits, since they are more suitable for carrying larger loads than the long precast stabilized peat columns used in this research.

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