MECHANICAL BEHAVIOUR OF RICE HUSK ASH AND CEMENT–STABILIZED PEAT UNDER DIFFERENT CURING PERIODS.

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The problematic nature of peat due to its high organic content, substantial compressibility, and low shear strength, frequently requires stabilization to make it appropriate for construction. This research focuses on enhancing peat soil properties for construction purposes, particularly focusing on areas in Sri Lanka where peatlands present significant challenges for infrastructure development. With involvement in sustainable and cost-effective solutions, the study investigates the efficacy of using Rice Husk Ash (RHA) and cement as stabilizers for natural peatlands. In fact, this approach offers a solution for traditional stabilizers while harnessing the beneficial properties of RHA – a waste product, to enhance the peat stabilization process. This method aims not only to improve the mechanical properties of peat but also to provide an alternative to traditional stabilizers like lime or cement, which are linked to higher carbon dioxide emissions.

The suitable mix proportions of RHA and Portland composite cement (PCC) and their effects on peat's Unconfined Compressive Strength (UCS) were obtained from laboratory experiments, under different curing conditions and curing periods. The prepared samples were subjected to UCS tests to determine the stabilized peat's peak strength and stress-strain behavior. The strength and stiffness of the stabilized peat were calculated using observed test results and analyzed by comparing it with the properties of natural peat.

The findings suggest that a specific mix proportion of RHA and PCC, under a defined curing period, significantly enhances the UCS, shear strength, and stiffness of peat. The optimal curing condition was identified as submerging in water with a 1.25 kN/m^2 surcharge load and maintaining *in-situ* conditions, where stabilized samples were cured at low temperatures. It is evident from the study that different mix proportions resulted in varying strength gain variations across different curing periods, including 7 days, 28 days, 45 days, 60 days, and 80 days. In conclusion, mixing peat with 10% PCC + 10% RHA and curing for 60 days under submerged curing with a surcharge would yield optimum strength and stiffness.

After evaluating the mechanical properties, Scanning Electron Microscope (SEM) images were taken to identify the behavior of the microstructure. The microstructure reveals a hollow, perforated cellular structure, along with a minor network of fibrous elements. Voids between peat soil particles have filled with C-H-S bonds. This observation suggests that while RHA may offer certain benefits as a secondary stabilizing material, excessive reliance on it may not be conducive to achieving the desired strength properties in stabilized peat soil. However, there is a possibility of partially replacing cement with RHA which would result in the strength and stiffness gain up to anticipated levels. By demonstrating the positive impact of these materials on peat stabilization, the research contributes to the field of geotechnical engineering, offering a viable solution for construction on peatlands.

Keywords: Curing period, Peat, Portland-Composite Cement, Rice husk ash

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MECHANICAL BEHAVIOUR OF RICE HUSK ASH (RHA), CEMENT–STABILIZED PEAT UNDER DIFFERENT CURING PERIODS

Background

- Low Shear Strength
- Organic content (30-40%)
- Moisture content > 300%
- High compressibility
- High secondary consolidation settlement

Peat Soil

- Shear Failure
- Settlements of the foundation

Peat Ground Improvement Using Stabilizer

Deep mixing with traditional industrial binders (Cement, Lime, Fly ash) or non-traditional waste material (Rice husk ash) or combination of those two

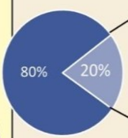
Stabilized Peat
Suitable for construction

Methodology

Selecting Mix proportion

20% of RHA and 80% of peat achieve maximum strength under submerged curing condition with surcharge load, for RHA stabilized peat.

Peat Vs Stabilizers



Rice Husk Ash	Cement
20%	0%
15%	5%
10%	10%
5%	15%
0%	20%

Sample preparation

Peat Soil Collect from Kerawalapitiya

Moisture C. - 300%
Shear Strength - 3.65 kPa
Void Ratio - 5.3

Sample size - (h-200 mm, d-50 mm)
sample - 3 layers, 25 blows/layer
Surcharge - 1.25 kPa
Curing condition - Fully submerged

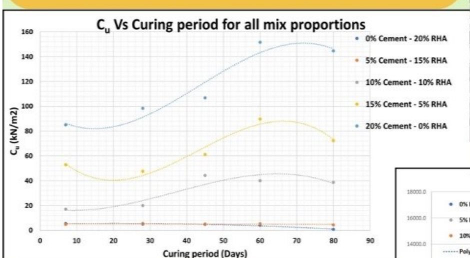
Cement - Portland Composite Cement

Rice Husk Ash -
Burning Temp.: 600-700˚C
Silicate Content: 94.8%

Testing & Analyzing

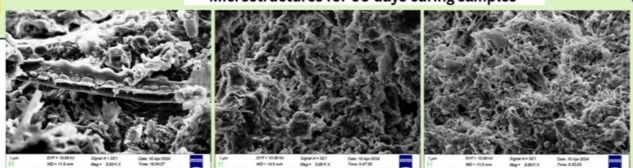
Stress - Strain relationships for cured samples were observed from Triaxial apparatus & calculated undrained shear strength parameters

Results & Conclusion

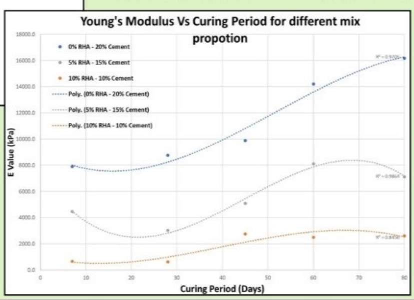


- Shear strength & stiffness of the RHA + Cement stabilized peat soil is influenced by the curing period.
- Higher Cement percentage & lower RHA percentage can be used effectively for stabilization

Microstructures for 60 days curing samples



20% RHA and 0% Cement | 10% RHA and 10% Cement | 0% RHA and 20% Cement



Suggested mix proportion :
10% Cement + 10% RHA

Suggested curing period :
60 days in fully submerged condition

These Mix Proportions, curing periods and curing conditions are depended on initial peat properties.