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AN EXPERIMENTAL INVESTIGATION ON THE UTILIZATION OF WASTE MATERIALS TEND WITH MARINE CLAY

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Abstract: The marine clay properties are changes significantly from wet and dry soil.It is called as expansive clay, due to changes of moisture content in the marine clay swell and shrinkage occurs. Acquire an increasing a number of various waste materials is becoming a bigger problem to the environmentalists. Fly ash is the one of waste material which is produced from thethermal power plants.From the point of this, to stabilize the properties of marine clay and decrease the quantity of industrial waste.The present experimental study has been taken into consideration. In this thesis observed the sequel of quarry dust and fly ash on the properties of marine clay. The observation were made from the experimental data is, obtained optimum value at exact 20% of quarry dust and 20% of fly ash. Static plate load test was conducted on obtained optimum percentages. The defamation and load bearing capacity of treated marine clay has been increased by 41.80% and 669% compared to untreated marine clay foundation bed.
Key words: Marine clay, UCS, MDD&OMC, Plate Load Test.

1. GENERAL

At the nearer of coastal areas the state of soil is very soft and saturated. The very soft and saturated soil is called as marine clay. The total length of the coastal line of India exceeds 7000km and entire length covered with marine clay deposit, with low density, high deformation, high compressibility and less shear strength. To avoid or minimize such situations it is necessary to treat the marine clay with additives.

2. REVIEW OF LITERATURE

Mohd et al (2018), studies the comparison between two additive Lime and Cement for treating peat soil in term of stabilization. The experiment results showed that the addition of additives had improved the strength characteristics of peat soil. In addition, the mixture of lime with peat soil yield higher result in shear strength compared to cement.

Marto et al 2018, investigates the suitability of possible uses of RBT to treat marine clay. Laboratory tests included Standard proctor tests and Atterberg limits tests. For all mix designs of soft clay-RBT, MDD was gradually increasing and OMC was sharply reducing with further increments of both sizes of RBT.

Husam 2018, the main objective of this research is the concentrating on compression ratio (CR), the Rebound (Swelling) ratio (RR) and the stiffness during the modulus of elasticity (Es) for treated and natural soils procreation from consolidation test. The results from laboratory tests shows high ability on the enhancing in terms of reduction in plasticity index (greatly increased workability), reduction in compression ratio (CR), reduction in the Rebound (Swelling) ratio (RR), increase in the modulus of elasticity (Es). The change in moisture-density relationships resulting in lower maximum dry densities, higher optimum water content, and less variation of dry density from the maximum over a much wider range of water contents.

3. IDENTIFIED MATERIALS AND ITS PROPERTIES

3.1 Marine Clay

The marine clay was collected from the coastal area (Kakinada), which is excavated at a depth 0.4 to 0.8m below the ground level. The following table shows the physical properties of marine clay.

Grain size distribution	Grave: 0 (%)	Sand: 10(%)	Silt: 19(%)	Clay: 71(%)
Atterberg limits	Liquid limit: 73.56 (%)	Plastic Limit: 27.45(%)	Plasticity Index: 46.11(%)	
Soil Classification CH	Compaction MDD: 1.397 (g/cc) OMC: 33.45 (%)	CBR: 1.06 (%)	UCC:72.3 (kN/m2)	
Shear Strength parameters	Cohesion (c) :123(kN/m2)	Angle of internal friction (Φ):2 degree.	Free Swell: 73.54 (%)	Specific Gravity(G): 2.41

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3.2 Fly Ash:

The ignition of powdered coal in thermal power plants make fly ash. Fly ash make thus having both ceramic and pozzolanic actions. This was collected from the Dr. Narla Tata Rao thermal power plant, Vijayawada. The following table shows the physical properties of fly ash.

Grain size distribution	Grave: 0 (%)	Sand: 17(%)	Silt: 76(%)	Clay: 7(%)
Atterberg limits	Liquid limit: NP	Plastic Limit: NP	Plasticity Index: NP	
Soil Classification ML	Compaction MDD: 1.59(g/cc) OMC: 20 (%)	CBR: 6.12 (%)		
Shear Strength parameters	Cohesion (c) :8(kN/m2)	Angle of internal friction (Φ):8 degree.	Free Swell: ---	Specific Gravity(G): 2.15

3.3 Quarry Dust:

The quarry dust is collected from the Padmavathi crusher unit situated at yeleswaram approximately 40 km away from Kakinada. The following table shows the physical properties of the quarry dust.

Grain size distribution	Grave: 14.60(%)	Sand: 85.04(%)	Fines: 0.35(%)
Atterberg limits	Liquid limit: NP	Plastic Limit: NP	Plasticity Index: NP
Soil Classification SW	Compaction MDD: 2.04 (g/cc) OMC: 12.4(%)	Specific Gravity(G): 2.90	
Shear Strength parameters	Cohesion (c) :0.5(t/m2)	Angle of internal friction (Φ):18 degree.	

3.4 Geotextile

The geo-textiles –GWF-40-220 was collected from theGARWARE –WALL ROPES Ltd, Pune, India. The geotextile having a tensile strength of woven geo-textile is 60.00kN/m for warp and 45.0kN/m for weft. This geo-textile used as a separator between foundation soil bed and the gravel cushion.

3.5 Gravel

The gravel was collected from the Surampalem, East Godavari District, A.P, and India. in this investigation the gravel is used in a sub-base course in all model foundation beds. The properties of gravel were presented below.

Grain size distribution	Grave: 60(%)	Sand: 30(%)	Fines: 30(%)
Atterberg limits	Liquid limit: 23(%)	Plastic Limit: 17(%)	Plasticity Index:6(%)
Soil Classification GW	Compaction MDD: 12.4 (g/cc) OMC: 1.97(%)	Specific Gravity(G): 2.80	CBR: 7.78 (%)
Shear Strength parameters	Cohesion (c) :0.5(t/m2)	Angle of internal friction (Φ):18 degree.	

4. Experiment and Result

4.1 Static Plate Load Test:

4.1.1 Construction Procedure

Setup the loading frame at the center of the steel tank. 4.75mm micron sieve passed marine clay is used for the foundation bed in this investigation. At exact OMC&MDD, the marine clay is compacted at achieving every 2cm thickness, finally stopped the compaction at 20cm thickness. For the Marine Clay + Fly Ash mix, the moisture content w.r.t OMC of same mix was taken and the needed quantity of ash mixes with it. For the Marine Clay+ Fly Ash+ Quarry Dust mix, the moisture content w.r.t the OMC of the same mix was taken. For the Marine Clay+ Fly Ash+ Quarry Dustmixes, the weights of the dry mixes w.r.t the MDD of the same mix were taken and compacted at OMC of the same mix. Set the thickness of the treated marine clay of 20cm. set a gravel cushion of 10cm.These tests were conducted on soil foundation systems in a circular steel tank of diameter 60cm. The loading was done through a circular metal Plate of diameter layed on the model foundation soil bed system. The steel tank was placed on the pedestal of the compression testing machine. Two dial gauges of least count 0.01mm were arranged for obtaining deformations. A 5ton capacity hydraulic jack was placed on the loading.

Author Conducting Static Plate Load Test

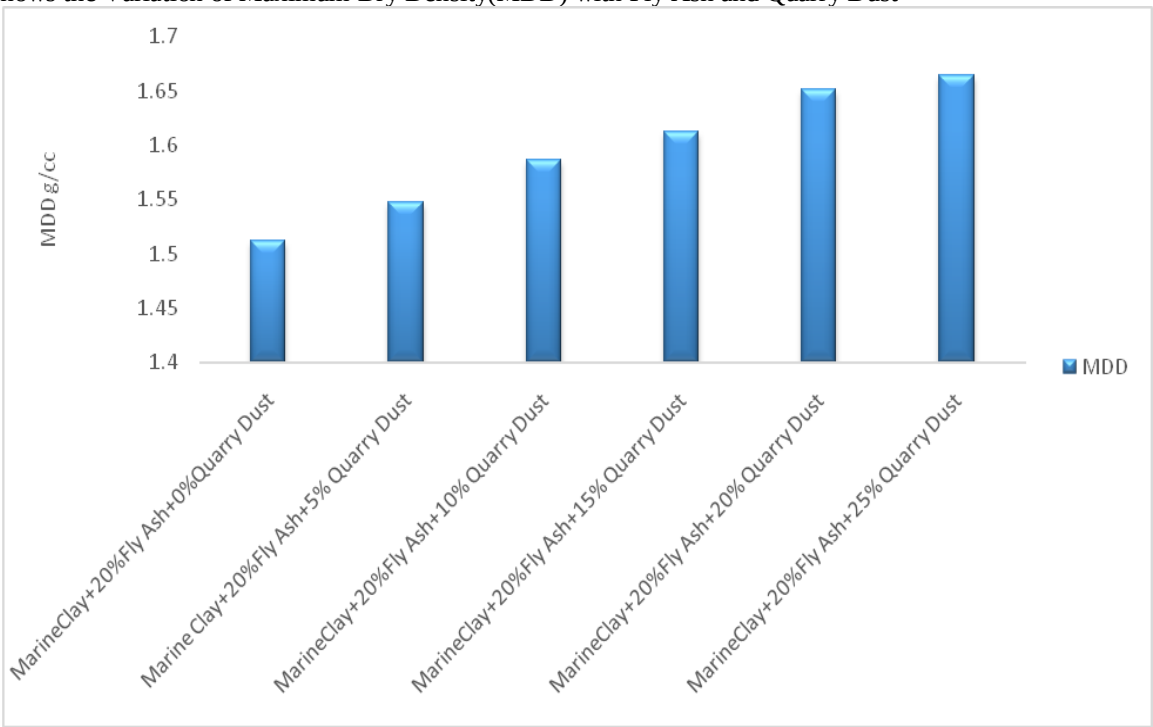
Construction Details of Untreated and Treated Marine Clay Sub Grade Model Foundation Beds

Sl.No	Foundation Soil Bed	Cushion
1	Untreated marine clay	……..
2	Untreated marine clay	Gravel
3	20% fly ash treated marine clay with 20% quarry dust	Gravel
4	Optimum fly ash treated marine clay with 20% quarry dust using Geotextile as separator and reinforcement	Gravel

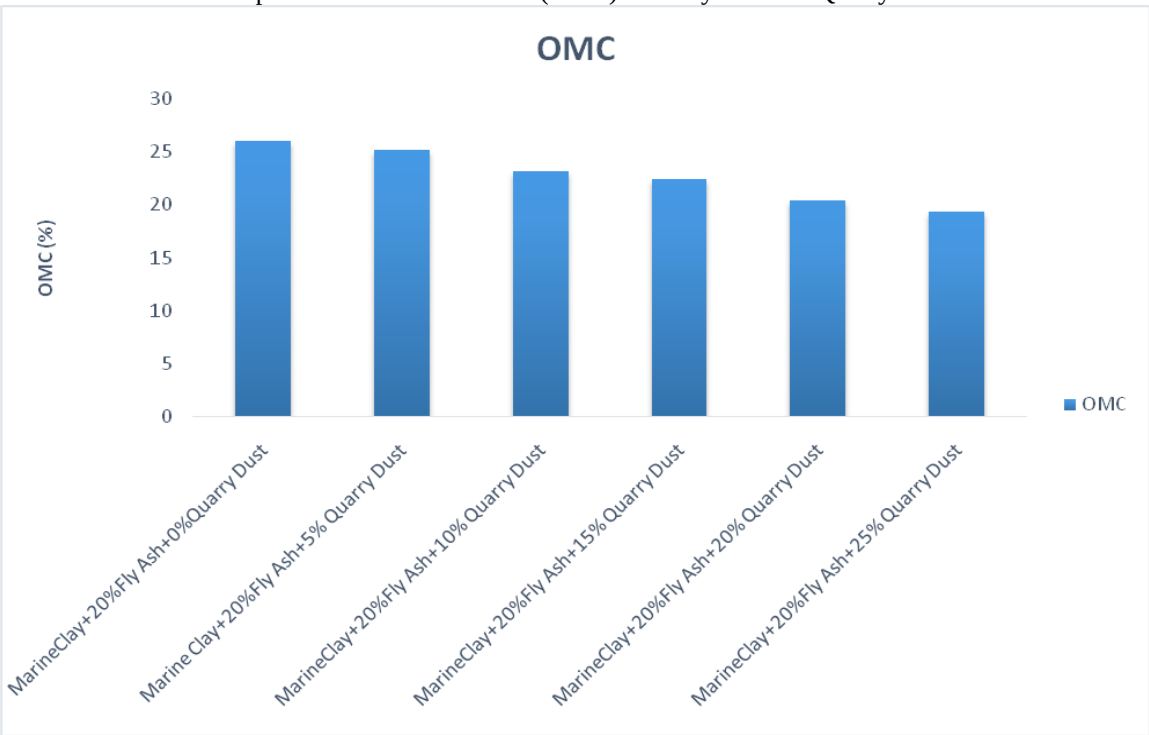
OMC and MDD values of 20% Fly Ash Treated Marine Clay with Quarry Dust

Mix Proportion	0.M.C (w)%	M.D.D (Ɣd) g/cc
MarineClay+20%Fly Ash+0%Quarry Dust	26.04	1.512
Marine Clay+20%Fly Ash+5% Quarry Dust	25.16	1.548
MarineClay+20%Fly Ash+10% Quarry Dust	23.12	1.587
MarineClay+20%Fly Ash+15% Quarry Dust	22.45	1.613
MarineClay+20%Fly Ash+20% Quarry Dust	20.39	1.652
MarineClay+20%Fly Ash+25% Quarry Dust	19.34	1.664

Graph: Shows the Variation of Maximum Dry Density(MDD) with Fly Ash and Quarry Dust



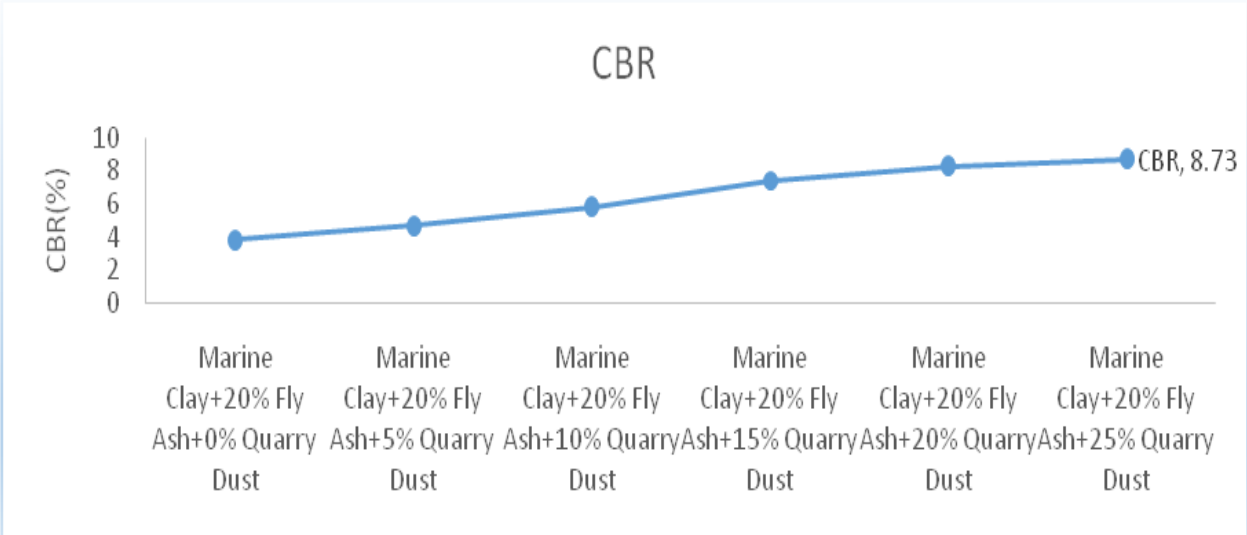
Graph: Shows the Variation of Optimum Moisture Content (OMC) with Fly Ash and Quarry Dust



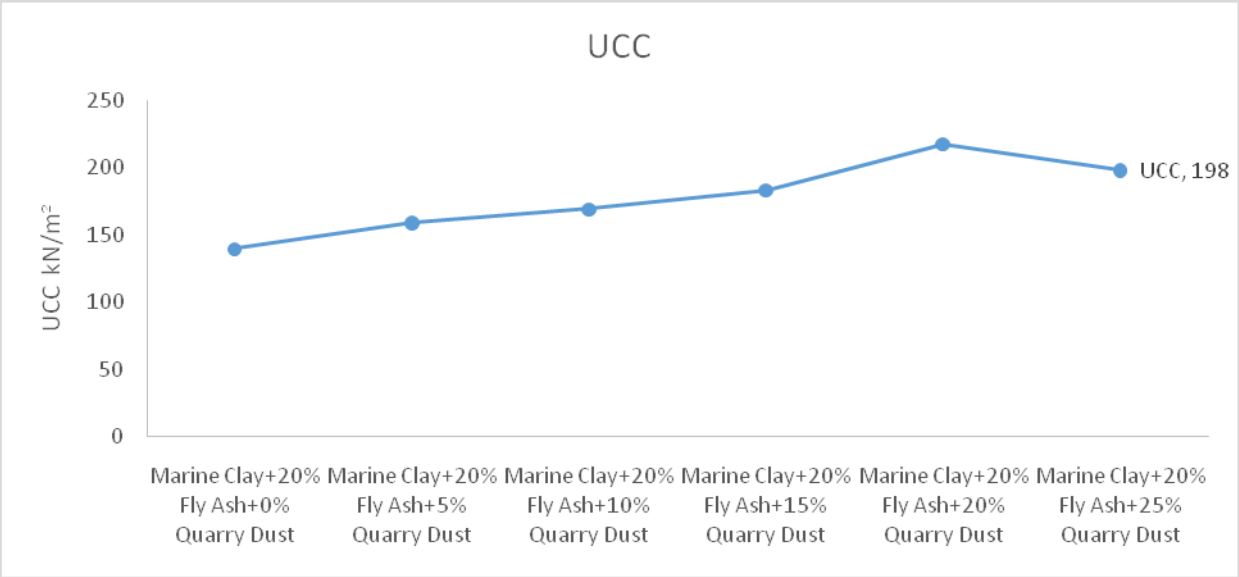
CBR Values of 20%Fly Ash Treated Marine Clay with Different Percentages of Quarry Dust

Mix Proportion	C.B.R	UCC (kN/m2)	Cohesion	Angle of internal friction (φ)
Marine Clay+20% Fly Ash+0% Quarry Dust	3.81	140	72	5.5
Marine Clay+20% Fly Ash+5% Quarry Dust	4.70	159	64	7
Marine Clay+20% Fly Ash+10% Quarry Dust	5.82	169	56	8.5
Marine Clay+20% Fly Ash+15% Quarry Dust	7.39	183	44	9
Marine Clay+20% Fly Ash+20% Quarry Dust	8.29	217	37	12
Marine Clay+20% Fly Ash+25% Quarry Dust	8.73	198	30	14.5

Graph: Shows the Variation of California Bearing Ratio (CBR) with Fly Ash and Quarry Dust



Graph: Shows the Variation of Un-Confined Compressive Strength (UCS) with Fly Ash and Quarry Dust



The optimum percentages of are presented in the following

Additives	Optimum Percentage (%)
Fly Ash + Quarry Dust	40

Table Laboratory Static Plate Load Test Results of Untreated and Treated Marine Clay Model Foundation Bed at OMC.

Sl.No	Foundation Bed	Cushion	Load Bearng Capacity	Settlement (mm)
			OMC	OMC
1	Marine Clay	----	168.00	3.23
2	Untreated marine clay	Gravel	549.82	2.84
3	Treated marine clay (20%Fly Ash +20% Quarry Dust)	Gravel	1313.47	1.88
4	Treated marine clay (20%Fly Ash+20%Quarry Dust) and Geotextile provided as reinforcement & separator between Foundation Bed and Gravel Cushion.	Gravel	2031.31	1.38

5. CONCLUSION

It was noticed that when the marine clay was treated with "20% Fly Ash+20% Quarry Dust" the liquidity limit and plasticity index of marine clay has been decreased by 17.51%, 38.64% and 36.39%, 79.61% respectively when compared with untreated marine clay.

It was noticed that when the marine clay was treated with "20% Fly Ash+20% Quarry Dust" the free swell is decreased by 53.95% and 75.205% respectively when compared with untreated marine clay.

It was noticed that when the marine clay was treated with "20% Fly Ash+20%Quarry Dust" the CBR values are increased by 256.4% and 669.87% respectively when compared with untreated marine clay.

It was noticed that when the marine clay was treated with "20% Fly Ash+20%Quarry Dust" the UCC values are increased by 18% and 41.23% respectively when compared with untreated marine clay.

It was noticed from laboratory plate load test that the total deformations at ultimate load carrying capacity of treated model foundation bed has decreased by 41.79% at OMC when compared to the untreated marine clay.

It was noticed from laboratory plate load test that ultimate load bearing capacity of the treated marine clay has increased by 668.18% when compared to the un treated marine clay at OMC when compared to the untreated marine clay.

Scope of Further Work

The following areas are identified as the scope of further work in this direction, based on the experience of present work.

Similar work can be done using other additives and also admixtures to arrive the optimum combination used in construction of foundation beds on marine clay.
The reinforcement Technique can be adopted for higher load bearing capacity of the foundation beds.
The technique can also be done with a combination of chemicals like potassium chloride, ferric chloride, calcium chloride etc.

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