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A Study on Classification of Soils for Preparation of Soil Blends to Obtain Maximum Dry Density and Optimum Moisture Content

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ABSTRACT

Foundation Design is a necessary evil, because without foundation, without proper sub grade soil no structure exists. The geological formation of earth in the world is very diversified and one place is not matching with the other place. Here we are introducing a concept of soil blends, which replaces the existing unwanted loose and less bearing capacity soils with soil blends. This gives good sub base to support the structure. The availability of soils with good safe bearing capacity and less settlement property is very less. The use of soil stabilization methods like use of cement, chemicals and by using fly ash are costly and not justifiable. So here an attempt is made to obtain a mixture of soils commonly known as soil blends, which replaces unwanted, loose un stabilized soil. The method is safe and cheap compared to any other method, avoiding any environmental effect to the soil strata which is existing. Here four different soils of varying origin and type are taken and blends are prepared and tested for optimum moisture content and dry density. These vales are compared with the places where soils of required density and optimum moisture content are obtained by field tests.
Key Words: Soil Stabilization, Soil Blends, Optimum Moisture Content, Dry Density

INTRODUCTION AND METHODOLOGY

Soil is a composite material, as we know it contains three phase. It contains solid particles, water and air. Voids are containing with air or water. In our discussion we are interested to obtain a Soil Blend (mixture of different soils) to obtain a maximum density. This can be done by designing aggregate and a binder. First we take four soil samples A, B, C and D. we define the preliminary properties which are required for soil classification. This can be done by taking the soil individually, Two combinations (70:30) & (30:70), and three combinations ABC (20:20:60) by altering the proportions and four combinations ABCD (25:25:25:25) (See Table 12)The soil is classified based on liquid and plastic limit by using plasticity chart(Table 12).

Results and Tabulations:

Table 1: Specific Gravity (G)

Soil Type	Mean Value
Individual Soil	2.3007
Two Combination Soil	2.3259
Three Combination Soil	2.3474
Four Combination Soil	2.2990
Average	2.3182

Table 2: Water Content (w)

Soil Type	Mean Value
Individual Soil	2.2529
Two Combination Soil	2.8595
Three Combination Soil	2.7473
Four combination Soil	2.4450
Average	2.5762

Table 3: Coefficient of Uniformity (Cu)

Soil Type	Mean Value
Individual Soil	3.0913
Two Combination Soil	2.7650

Three Combination Soil	2.8011
Four combination Soil	2.8
Average	2.864

Table4: Coefficient of Curvature (Cc)

Soil Type	Mean Value
Individual Soil	1.2107
Two Combination Soil	1.3710
Three Combination Soil	1.2716
Four combination Soil	1.4286
Average	1.3205

Table 5: Plastic Limit (WL)

Soil Type	Mean Value
Individual Soil	18.0120
Two Combination Soil	15.0865
Three Combination Soil	17.3953
Four combination Soil	17.77
Average	17.0650

Table 6: Liquid Limit (LL)

Soil Type	Mean Value
Individual Soil	23.7089
Two Combination Soil	24.9262
Three Combination Soil	25.6217
Four combination Soil	22.3833
Average	24.1593

Table 7: Flow Index (I_F)

Soil Type	Mean Value
Individual Soil	15.5041
Two Combination Soil	17.1483
Three Combination Soil	15.2682
Four combination Soil	18.933
Average	16.7134

Table 8: Plasticity Index (I_P)

Soil Type	Mean Value
Individual Soil	4.2734
Two Combination Soil	7.3808
Three Combination Soil	5.9740
Four combination Soil	4.6133
Average	5.5595

Table 9: Toughness Index (I_T)

Soil Type	Mean Value
Individual Soil	0.2627
Two Combination Soil	0.3672
Three Combination Soil	0.4186
Four combination Soil	0.2437
Average	0.3230

Table 10: Consistency Index (CI)

Soil Type	Mean Value
Individual Soil	4.0854
Two Combination Soil	2.5793
Three Combination Soil	3.2749
Four combination Soil	4.3219

Average	3.5654

Table 11: Liquidity Index (LI)

Soil Type	Mean Value
Individual Soil	-2.8679
Two Combination Soil	-2.0146
Three Combination Soil	-2.2329
Four combination Soil	-3.3219
Average	-2.6093

Table 12: Classification by using Plasticity Chart

Soil	Classification	Name of soil
A	ML	Low Compressible Silt
B	CL	Low Compressible Soil
C	MI & OI	Medium compressible silt with organic matter
D	CL & ML	Low compressible clay and silt
AB(70:30)	CL & ML	Low compressible clay and silt
AB(30:70)	CL	Low compressible Clay
AC (70:30)	CL	Low compressible Clay
AC(30:70)	CL	Low compressible Clay
AD(70:30)	CL	Low compressible Clay
AD(30:70)	CL	Low compressible Clay
BC(70:30)	CL	Low compressible Clay
BC(30:70)	CI	Medium compressible clay
BD(70:30)	ML	Medium compressible silt
BD(30:70)	CL	Low Compressible clay
CD(70:30)	CI	Medium compressible clay
CD(30:70)	CL	Low compressible clay
ABC(20:20:60)	CL	Low compressible clay
ABC(20:60:20)	CL	Low compressible clay
ABC(60:20:20)	ML & OL	Low compressible silt with organic matter
ABD(20:20:60)	CL	Low compressible clay
ABD(20:60:20)	CL & ML	Low compressible clay and silt
ABD(60:20:20)	CL	Low compressible clay
BCD(20:20:60)	CL	Low compressible clay
BCD(20:60:20)	ML & OL	Low compressible silt with organic matter
BCD(60:20:20)	ML & OL	Low compressible silt with organic matter
ACD(20:20:60)	CL	Low compressible clay
ACD(20:60:20)	CL	Low compressible clay
ACD(60:20:20)	CL	Low compressible clay
ABCD(25:25:25:25)	CL & ML	Low compressible clay and silt

C Represents clay: M Represents silt: O Represents organic matter: L Represents soil with low compressibility: I Represents soil with medium compressibility.

Table 13: Dry Density (Yd)

Soil Type	Mean Value
Individual Soil	1.8644
Two Combination Soil	1.8452
Three Combination Soil	1.8548
Four combination Soil	1.8925
Average	1.8642

Table 14: RESULTS OF DRY DENSITY

Test	Dry Density (Y_d) g/cm^3
Compaction (Experimental)	1.8925
Core Cutter(Natural Ground)	1.8078
Sand Replacement (Natural Ground)	1.7706

DISCUSSION

Soil A is low compressible silt, soil B is low compressible clay, soil C is Medium compressible silt with organic matter and soil D is low compressible clay and silt. When we have two combinations Low compressible clay property is dominated and in three combinations also low compressible clay property is dominating and when we take four combination low compressible clay and silt property, the combination is exhibiting. So from this we come to a conclusion that usually the clay content dominates in the soil property.
When the dry density is tested for the individual and combination and its mean value is evaluated and we get 1.8925g/cm$^{3.}$ When we test the required density from good natural ground and also required maximum dry density from the lab experiments for earthen embankments, pavement sub grades and for other applications it is almost same as we obtain. For natural ground we obtain the maximum dry density as 1.8078 and 1.7706 g/cm^3 which is almost same as we obtain from the Blended Soil approach.

CONCLUSION

From the above tables and the results we can come to a conclusion that by using more than two types of different soil origin and combine them in a proper proportion according to the soil classification we can achieve a required density of soil which can be used for a particular task.

This method can be demonstrated byconsidering more different types of soil so that the available soil at site can be taken as ingredients and a soil blend can be designed for our requirement. This method is economical and it requires no further money to use at the site.The design soil can be used as sub grade or as foundation soil or as earthen embankment soil material.

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