PREDICTION OF CALIFORNIA BEARING RATIO (SOAKED) AND UNCONFINED COMPRESSIVE STRENGTH VALUES WITH INDEX PROPERTIES OF DIFFERENT STABILISED SOILS OF MEDAK DISTRICT REGION OF TELANAGANA STATE

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Abstract

Thickness of the Pavement Affects the Subgrade Strength in The Design of Flexible Pavements. California Bearing Ratio (CBR) Is One of The Methods to Determine the Subgrade Strength. The Conventional Soaked CBR Testing Method Is Expensive, Laborious and Time Consuming, So Here an Attempt Was Made for Correlating CBR Values as Well as UCS (Unconfined Compressive Strength) With the Index Properties of Soils Stabilised with Stone Dust, Ordinary Portland Cement (OPC) And Portland Slag Cement (PSG) Like LL, PL, PI, OMC, And MDD. Correlation Co-Efficient (R^2) Value of Index Properties with Soaked CBR Is Determined. In This Study Thirty (31) Number of Soil Samples (Having 44<LL<84) Were Collected from Different Parts of Medak District Region (Telangana). Different Laboratory Tests Including Atterberg Limits, Specific Gravity, Gradation Analysis, Soaked CBR, UCS and Compaction Were Performed on These Samples and Various Linear Relationships Were Established Between Index Properties and Soaked CBR As Well as UCS Of the Samples Using Statistical Software (SPSS) And Microsoft Excel. Simple And Multiple Linear Regression Analysis Was Performed and No of Predictive Equations Were Developed for Estimating the Soaked CBR And UCS Value from The Index Properties of Soil with A Maximum R^2 Value Of 0.99.

Keywords: Correlation Coefficient (R^2), Regression Analysis, Soaked CBR Value, Unconfined Compressive Strength

DOI Number: 10.14704/nq.2022.20.6.NQ22744 **NeuroQuantology 2022; 20(6):7434-7447**

1. Introduction.

Soil Is Diverse in Formation and Character Therefore Accurate Prediction of Its Engineering Behaviour Is of Research Interest in Civil Engineering Area. The Engineering Behaviour of Soils Varies from Place to Place and Also with Time. Many Attempts Are Made to Predict CBR Values and UCS From the Index Properties of Stabilized Soils. Hence Determining of Factors That Influence the Soil Strength and Studying Their Relationship with California Bearing Ratio Value and Unconfined Compressive Strength on Representative Sample Maybe Considered as Good Insight of Soil Behaviour

The Unique Nature of Soil Properties as It Appears Naturally Is That Being Divergent Spatially and Seasonally Beyond the Designer's Control. Geotechnical Engineers Usually Attempt to Develop Empirical Equations Specific to A Certain Region and Soil Type. However, These Empirical Equations Are More Reliable for The Type of Soil Where the Correlation Is Origin. Hence, It Is Important to Develop Empirical Equations That Best Fit for The Local Area That We Can Access.

Presently India's Infrastructure Is Growing Rapidly. Large Number of New Urban and Lightly Trafficked Roads Are Being Constructed or Planned. The CBR Or California Bearing Ratio Is the Well-Known, Common and Trustful Test Currently Used in Road Construction. The Test Is Being Used for Many Years and Is Familiar to Organisations Involved in The Interpretation of Results, Consequent Road Design and Construction.

California Bearing Ratio Mainly Comes Under the Use of Civil Engineers Particularly for Those

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Working in Pavement Construction to Determine Stiffness Modulus and Shear Strength of Sub-Grade. It Shows Comparison of Strength of Subgrade Material to The Strength of Standard Crushed Rock Referred In %Age Values. This Method Was Basically Developed at California Division of Highways In 1930s To Give an Assessment of The Relative Stability of Fine Crushed Rock Base Material.

The CBR Values Are Used by The Engineers to Design the Thickness of Pavement Layer to Be Laid on The Top of The Sub-Grade. The Lower CBR Value Sub-Grade Will Have More Thickness of Pavement as Compared to The Sub-Grade That Has Higher CBR Value. In This Method the Soil Sample Is Compacted in A Standard Mould and Then a Plunger Is Allowed to Penetrate in To the Soil at A Specified Penetration Rate. Load Vs Penetration Curve Is Plotted from The Result of Penetration and Then Compared with The Bearing Resistance of Standard Crushed Rock.

2.Materials and methods

2.1 Soil

Here Thirty two (32) number of disturbed soil sample were collected from the different parts of Sangareddy district of Telangana, India. Those were tested in VNR VJIET laboratory Bachupally, Hyderabad. The collected sample were Black Cotton soils. All samples Were collected from one meter below the ground by using hand operated sampler.

Commonly un stabilized black cotton soil is not used in any construction purposes because of it was poor in strength so among those samples one of the black cotton soil and remaining red soil is stabilised with stone dust and two types cements i.e. (OPC&PSG).This stabilized data (engineering &index properties of soils) was collected from some of my friends and an attempt was made to develop some predictive Empherical formulas to predict the soaked CBR,UCS of soils with respect to their index properties like LL,PL,PI,OMC,MDD by using statistical software SPSS as well as Microsoft excel.

2.2 Methodology

Primarily, in order to address the intended objectives of the study, basic theories and descriptions of CBR test in general and in relation to soil index property of subgrade soil is reviewed. Subsequently, previous works of different researchers with regard to prediction of CBR,UCS value from basic soil index properties were assessed.

In order to have satisfactory data for utilizing the correlations, laboratory tests were conducted by the researcher on samples collected from different localities of Sangareddy, so as to get records of test results of CBR, UCS values along with the associated soil indicates particularly the grain size analysis, Atterberg limits, moisture-density relationships. Then, discussions on sample collection and summary of laboratory test results were presented. Statistical regression analyses of test results were carried out and correlations were developed and also analysed to fit the test results. Under the discussions of the obtained results the suitability of the developed correlations were examined. Finally, a generalized conclusion and recommendation were made.

2.3 Experimental procedure.

2.3.1 Soaked California bearing ratio test (CBR):

In this study, the soaked CBR test is performed as per [10]. As per mentioned IS code procedure heavily compacted soil sample should immersed (along with weights to produce a surcharge equal to the weight of base material and pavement to the nearest 2.5 kg) in a tank of water allowing free access of water to the top and bottom of the specimen. At the end of soaking period mould taken out of the water and allowed to drain 15 minutes and then penetration test was conducted.

2.3.2 UConfined Compressive Sytrenth (UCS)

The UCS test is performed to determine the shear strength characteristics of the soil according [14]. Generally UCS sample is prepared by taking 5kg of soil passing through 4.75µm sieve in a mould. The sample is taken in a tray and suitable water is added according to OMC of that soil and mixed thoroughly. The sample is compacted by using the hammer and 56 evenly distributed blows are given in five equal layers falling at a height of 56cm. The collar is removed and is trimmed off by using the spatula. The sample is extracted using the sample extractor and the extra portion is removed using the knife. The height and diameter of the sample obtained is 7.5cm and 3.5cm. About 15 of such samples are obtained for each soil. These specimens are properly sealed till the testing. Proper care is taken to avoid any moisture loss between the preparation and the subsequent testing of the specimen. The UCS test is conducted for 3 of the specimen to obtain the strength characteristics of the soil. The average of the 2 closer results has been considered as the UCS strength and the undrained cohesion values (Cu) have been obtained

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2.3.3 Standard proctor test:

As per [14] the standard proctor test conducted to determine the Optimum Moisture Content (OMC) and Maximum Dry density (MDD) of the soils. It's values are shown in Table 3.

2.3.4 Specific Gravity

Soil Specific Gravity (G) was determined as per guide lines of IS 2720-part 3 As per [13]. The average value of three samples has been taken as the specific gravity of soil. The specific gravity of fine grained soils are determined by density bottle method and which are reported at 27ºc in 100 ml volume.

2.3.5 Grain Size Analysis

Grain size distribution was done by using wet sieve analysis and hydrometer analysis as per guide lines of IS2720 part 4.

2.3.6 Atterberg Limits:

Liquid limit test:

As per [12] liquid limit test was conducted and it's values are shown in Table 2.

Plastic limit test:

As per [12] plastic limit test was conducted on the soil mixed with distilled water by rolling on a glass plate until it is about 3mm diameter and it's values are shown in Table 2.

Plasticity index (PI):

PI=liquid limit(LL)-plastic limit(PL)

2.3.7 Hydrometer analysis:

As per [11] the oven dried sample has been made through 75µm sieve and 50g of soil was taken for testing procedure.

2.3.8 Regression analysis:

The regression analysis is done based on the results obtained from each soil. The results of thirty soils are utilised to fit a best curve with the help of regression analysis. Here soaked CBR value will be Considered as dependent were as LL, PL, PI, OMC, MDD are independent.

3.0 Results and Discussions

3.1 Basic soil Properties

Table1. Results of sieve analysis

Sample number	Clay (%)	Gravel (%)	Sand (%)	Silt (%)	Soil classification
1	9.5	0.9	6.75	82.85	Fine grained
2	30.5	0.8	25.6	43.1	Fine grained
3	18	3.2	26.7	52.1	Fine grained
4	16.5	0	5.85	77.65	Fine grained
5	18	0.3	5.9	75.8	Fine grained
6	16.5	3.35	17.45	62.7	Fine grained
7	17.5	0.35	5.25	76.9	Fine grained
8	8.5	0.6	6.45	84.45	Fine grained
9	20.3	1.8	25.75	52.15	Fine grained
10	12	0	5.3	82.7	Fine grained
11	29.5	1.6	25.4	43.5	Fine grained
12	17	2.4	11.8	68.8	Fine grained
13	14	0.6	10.65	74.75	Fine grained
14	22	1.2	28.55	48.25	Fine grained
15	11.5	0.25	5.05	83.2	Fine grained
16	15	0.9	17.8	66.3	Fine grained
17	26	0	23.4	50.6	Fine grained
18	16	0.2	7.2	76.6	Fine grained
19	14.5	0.2	7.4	77.9	Fine grained
20	20	5.95	12.9	61.15	Fine grained
21	13.5	0.7	5.15	80.65	Fine grained
22	11.5	0	28.7	59.8	Fine grained
23	24.5	0.2	27	48.3	Fine grained
24	26.5	0.4	23	50.1	Fine grained
25	30.0	0	22.8	47.2	Fine grained
26	9.5	0	29.6	60.9	Fine grained
27	30	4.2	23.3	42.5	Fine grained
28	54	0.1	25.2	20.7	Fine grained
29	34.5	0.8	25.1	39.6	Fine grained
30	23.8	0	24	52.2	Fine grained

Table 2. Results of consistency limits

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Sample number	Liquid limit (%)	Plastic limit (%)	Plasticity index (%)	Soil classification
1	72	39.6	32.4	MH
2	62.3	31.0	31.25	CH
3	45.6	24	21.6	MH
4	71.6	41.2	30.4	MH
5	71.4	38.9	32.5	MH
6	81.2	44.7	36.46	MH
7	60	32.6	27.4	MH
8	73.2	41.4	31.8	CI
9	44.9	25.1	19.8	MH
10	73	40.8	32.2	CH
11	53	27.47	25.53	CH
12	71.7	37.91	33.79	MH
13	53.5	30.3	23.2	CI
14	48.1	21.6	26.5	MH
15	54.2	31.1	23.1	MH
16	71.4	40.4	31	MH
17	81.6	43.2	38.4	MH
18	83.4	46.2	37.2	MH
19	79.6	45.1	34.5	MH
20	76.2	40.7	35.5	MH
21	77.2	46.6	30.6	MH
22	55	31.3	23.7	MH
23	48.8	27.2	21.6	CI
24	46.1	26.16	19.94	CH
25	55.7	29.3	26.4	CH
26	49.5	30.7	18.8	MI
27	63.8	31.25	32.55	CH
28	73.2	30.43	42.77	CH
29	50.6	27	23.6	CH
30	49.2	23.15	26.05	CI

Table 3.Results of compaction characteristics:

Sample Number	Optimum Moisture Content (%)	Maximum Dry Density (%)	Laboratary Soaked CBR Value (%)
1	28	1.4	4.82
2	15.5	1.53	4.57
3	14	1.81	4.09
4	29	1.39	4.82
5	28	1.38	4.82
6	29	1.31	5.05
7	15	1.56	4.57
8	27.5	1.38	4.82
9	14	1.79	4.09
10	28	1.37	4.82
11	14.5	1.66	4.33
12	27	1.41	4.82
13	16	1.65	4.33
14	14	1.8	4.09
15	17.5	1.63	4.33
16	26	1.41	4.82
17	27.5	1.31	5.05
18	28.5	1.33	5.29
19	29	1.34	5.05
20	27.5	1.41	4.81
21	28	1.35	5.05
22	14	1.65	4.33
23	14.5	1.65	4.09
24	15	1.78	4.09
25	19	1.64	4.33
26	21	1.6	4.57
27	21.5	1.41	4.82
28	20	1.66	4.33
29	18	1.31	5.05
30	18.5	1.79	4.09

Table 4.Adopted soil data

Property Name	Value	
	BC soil	Red soil
Specific gravity	2.6	2.58
Gravel (%)	0	0
Sand (%)	5	20
Silt (%)	33	45
Clay (%)	62	35
Liquid limit(%)	62	38.2
Plastic limit (%)	37.3	16.2
Plasticity index (%)	24.7	22.4
Classification	CH	CI
Optimum moisture content (%)	19.8	16
Maximum dry density (g/cc)	1.48	1.8
UCS (kg/cm^2)	1.74	2.07
CBR (%)	3.74	4.6

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Table 5. LL, PL, PI, OMC, MDD, CBR and UCS Results for stone dust (SD) stabilized BC soil

S.NO	SD	LL	PL	PI	OMC	MDD	CBR	UCS
1	5	44	22.2	21.8	24.7	1.481	3.8	4.4
2	7.5	43	21.4	21.6	26.9	1.486	4.3	4.8
3	10	41	19.04	21.96	26.6	1.495	4.8	5.2
4	12.5	39	18.18	20.82	23.8	1.529	5.7	6
5	15	37	17.64	19.36	21.6	1.546	6.7	6.8

Table 6.LL, PL, PI, OMC, MDD, CBR and UCS Results for stone dust (SD) stabilized Red soil

S.NO	SD%	LL	PL	PI	OMC	MDD	CBR	UCS
1	5	42	18.18	23.82	14.7	1.87	6.7	4.6
2	7.5	40	17.6	22.4	15.3	1.877	8.1	5
3	10	38	16.66	21.34	14.1	1.897	9.6	5.5
4	12.5	36	15.38	20.62	16.4	1.914	11.5	6.2
5	15	32	13.33	18.67	16.5	1.936	12.5	7.1

Table 7. LL, PL, PI, OMC, MDD, CBR and UCS Results for cement (OPC) stabilized BC soil

S.NO	OPC%	LL	PL	PI	OMC	MDD	CBR	UCS
1	3	63.8	40.6	23.2	25.3	1.471	21.19	4.2
2	5	65	42.2	23	26.3	1.459	28.42	6.7
3	7.5	67.7	44.8	22.9	26.4	1.447	33.23	7.3
4	10	70.2	49	21.2	29.9	1.44	39.5	9.2

Table 8. LL, PL, PI, OMC, MDD, CBR and UCS Results for cement (PSC) stabilized BC soil

S.NO	PSC%	LL	PL	PI	OMC	MDD	CBR	UCS
1	3	63.1	38.6	24.5	28.6	1.461	18.3	3.6
2	5	64.5	41	23.5	28.3	1.449	20.7	4.4
3	7.5	65.7	43.4	22.3	26.4	1.436	24.57	5.6
4	10	68.2	46.4	21.8	32.9	1.428	29.87	7.5

Table 9.LL, PL, PI, OMC, MDD, CBR and UCS Results for cement (OPC) stabilized Red soil

S.NO	OPC%	LL	PL	PI	OMC	MDD	CBR	UCS
1	3	44.6	18.8	25.8	15.4	1.779	32.73	5.2
2	5	46.9	23.9	23	15	1.764	35.17	6.7
3	7.5	50.2	28.6	21.6	17.3	1.748	40.46	8.4
4	10	55.4	34.2	21.2	17.9	1.739	42.4	10.2

Table 10 LL, PL, PI, OMC, MDD, CBR and UCS Results for cement (PSC) stabilized Red soil

S.NO	PSC%	LL	PL	PI	OMC	MDD	CBR	UCS
1	3	42.7	17.4	25.3	17.4	1.763	29.39	4.8
2	5	44.6	22.2	22.4	15.9	1.757	31.7	6.2
3	7.5	48	26.6	21.4	16.8	1.734	35.2	8.2
4	10	52.1	33.2	18.9	19	1.726	39.9	9.9

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3.2 PRAPOSED EQUATIONS FOR PREDECTING THE SOAKED CBR VALUE, UN CONFINED COMPRESSIVE STRENGTH WITH INDEX PROPERTIES OF DIFFERENT SOILS

Here number of predictive equations were developed to predict the laboratory soaked CBR value with index properties of soil by using statistical software IBM SPSS and Microsoft excel on doing both multiple and linear regression analysis.

proposed equations for predicting the soaked CBR value with index properties of virgin black cotton soils

1).CBR $_{(soaked)}$ = -2.060*MDD+7.744 with an R^2 value of 0.943

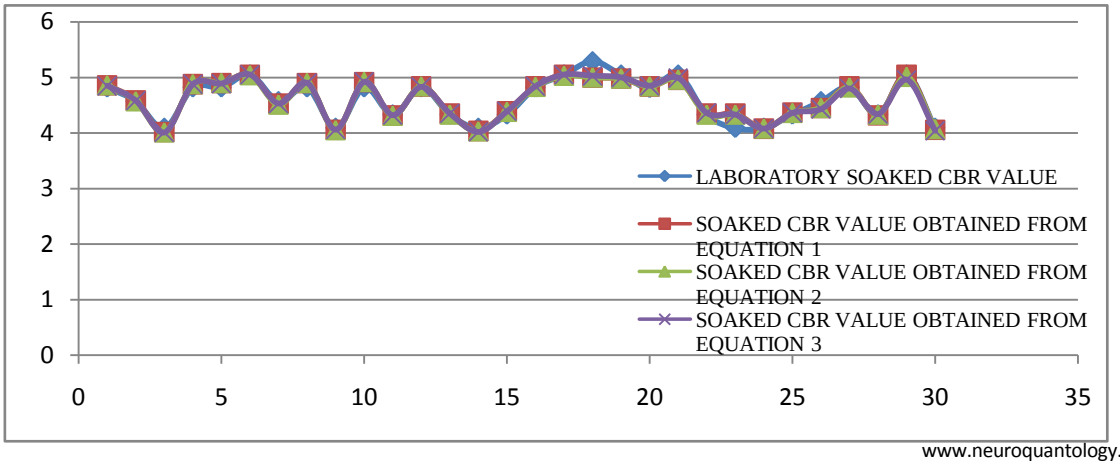
2). CBR $_{(soaked)}$ = 0.003*OMC-1.961*MDD+7.521 with an R^2 value of 0.944

3).$CBR_{(soaked)}$=-0.002*OMC-1.865*MDD+0.001*LL+0.005*PL+7.251 with an R^2 value of 0.947

Table 11. Experimental and predicted soaked CBR values of virgin soils.

Sample Number	Laboratory Soaked CBR Value	Soaked CBR Value Obtained from Equation 1	Soaked CBR Value Obtained from Equation 2	Soaked CBR Value Obtained from Equation 3
1	4.82	4.86	4.86	4.85
2	4.57	4.59	4.57	4.58
3	4.09	4.02	4.01	4.01
4	4.82	4.88	4.88	4.88
5	4.82	4.90	4.90	4.89
6	5.05	5.05	5.04	5.05
7	4.57	4.53	4.51	4.53
8	4.82	4.90	4.90	4.90
9	4.09	4.06	4.05	4.06
10	4.82	4.92	4.92	4.92
11	4.33	4.32	4.31	4.32
12	4.82	4.84	4.84	4.83
13	4.33	4.35	4.33	4.35
14	4.09	4.04	4.03	4.02
15	4.33	4.39	4.38	4.39
16	4.82	4.84	4.83	4.84
17	5.05	5.05	5.03	5.05
18	5.29	5.00	5.00	5.03
19	5.05	4.98	4.98	5.00
20	4.81	4.84	4.84	4.85
21	5.05	4.96	4.96	4.99
22	4.33	4.35	4.33	4.36
23	4.09	4.35	4.33	4.33
24	4.09	4.08	4.08	4.08
25	4.33	4.37	4.36	4.36
26	4.57	4.45	4.45	4.43
27	4.82	4.84	4.82	4.80
28	4.33	4.32	4.33	4.34
29	5.05	5.05	5.01	4.96
30	4.09	4.06	4.07	4.04

3.2.1 Comparison graph between experimental and predicted soaked CBR values:



eISSN 1303-5150

Proposed equations for predicting the soaked CBR and UCS value with index properties of black cotton soil stabilized with stone dust

1).CBR $_{(soaked)}$ =0.288*SD+2.180 with an R^2 value of 0.972

2). CBR $_{(soaked)}$ = -0.358*PL-0.624*PI-4.5*MDD+32.073 with an R^2 value of 0.999

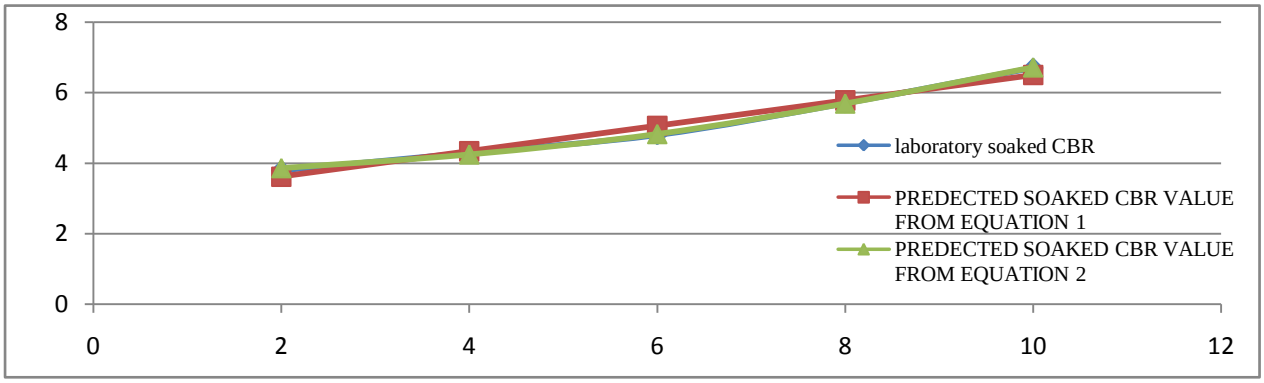
3). UCS =0.240*SD+3.040 with an R^2 value of 0.970

4).UCS = -0.266*PL-0.459*PI+0.612*MDD+19.432 with an R^2 value of 0.98

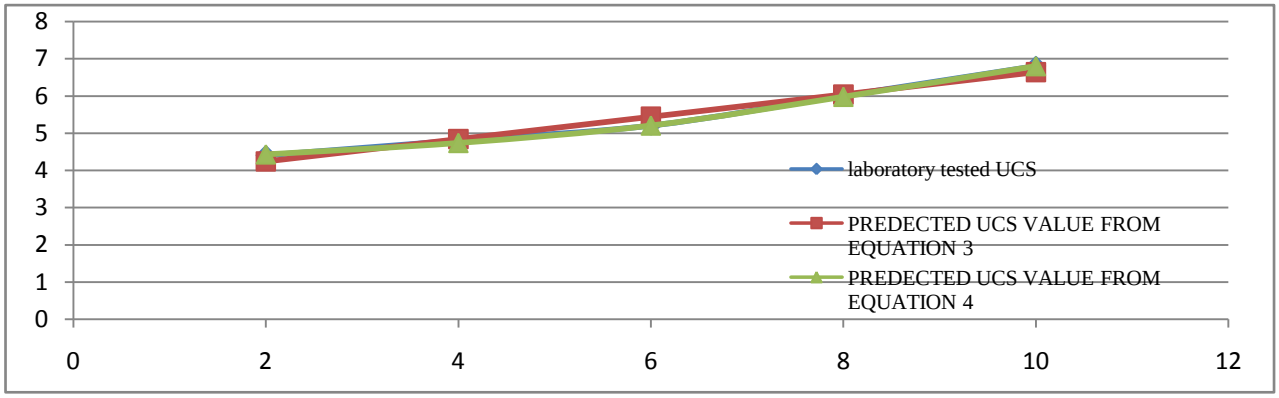
Table 12. Experimental and predicted soaked CBR and UCS values of black cotton soil stabilized with stone dust

Laboratory Soaked CBR Value	Predected Soaked CBR Value From Equation 1	Predected Soaked CBR Value From Equation 2	Laboratory Tested UCS Value	Predected UCS Value From Equation 3	Predected UCS Value From Equation 4
3.8	3.62	3.86	4.4	4.24	4.43
4.3	4.34	4.25	4.8	4.84	4.73
4.8	5.06	4.83	5.2	5.44	5.20
5.7	5.78	5.69	6	6.04	5.98
6.7	6.50	6.72	6.8	6.64	6.80

3.2.2Comparison graph between experimental and predicted soaked CBR values:



4.2.3 Comparison graph between experimental and predicted UCS values:



Proposed equations for predicting the soaked CBR and UCS value with index properties of black cotton soil stabilized with stone ordinary Portland cement (opc)

1) CBR $_{(soaked)}$ =2.527*OPC+14.473 with an R^2 value of 0.986
2) CBR $_{(soaked)}$ = 1.240*OMC-0.869*LL-586.077*MDD+907.391 with an R^2 value of 0.99
3) UCS =0.656*OPC+2.665 with an R^2 value of 0.934
4) UCS = -297.717*MDD-1.160*LL-1.598*PI+553.229 with an R^2 value of 0.99

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Table 13. Experimental and predicted soaked CBR and UCS values of black cotton soil stabilized with ordinary Portland cement (opc)

Laboratory Soaked CBR Value	Predected Soaked CBR Value From Equation 1	Predected Soaked CBR Value From Equation 2	Laboratory Tested UCS Value	Predected UcCSValue From Equation 3	Predected UCS Value From Equation 4
21.19	22.05	21.20	4.2	4.63	4.21
28.42	27.11	28.43	6.7	5.95	6.71
33.23	33.43	33.24	7.3	7.59	7.31
39.5	39.74	39.51	9.2	9.23	9.21

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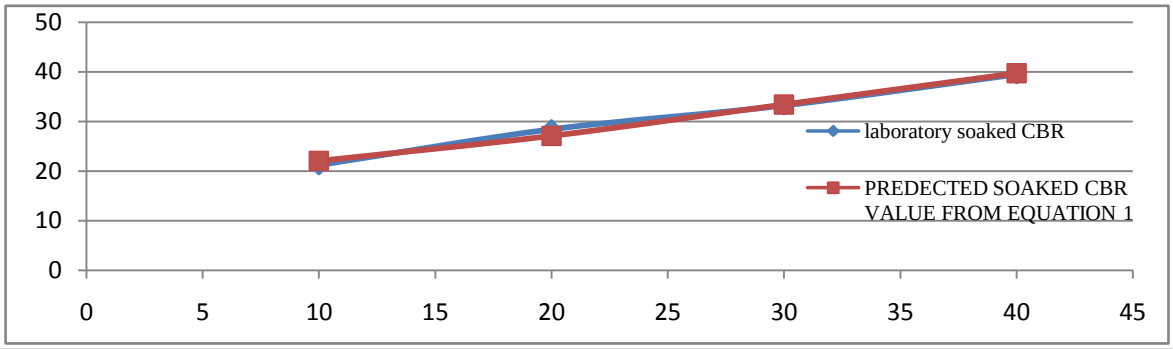
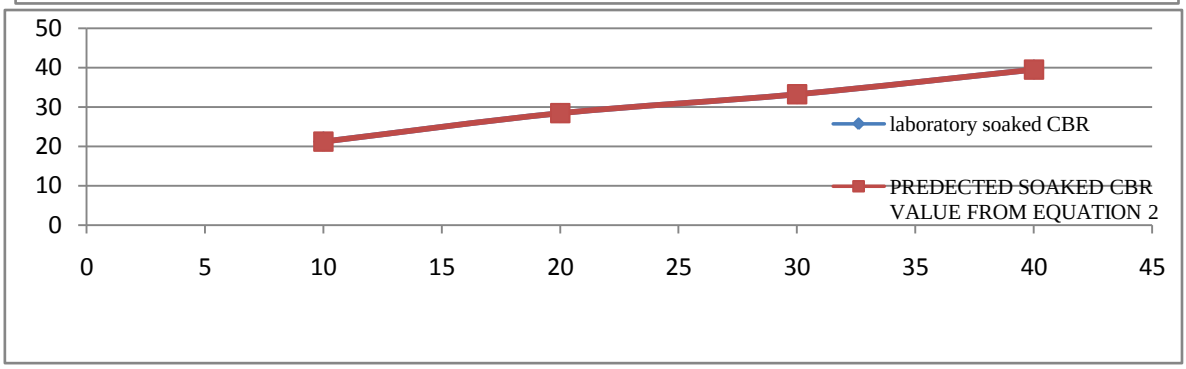
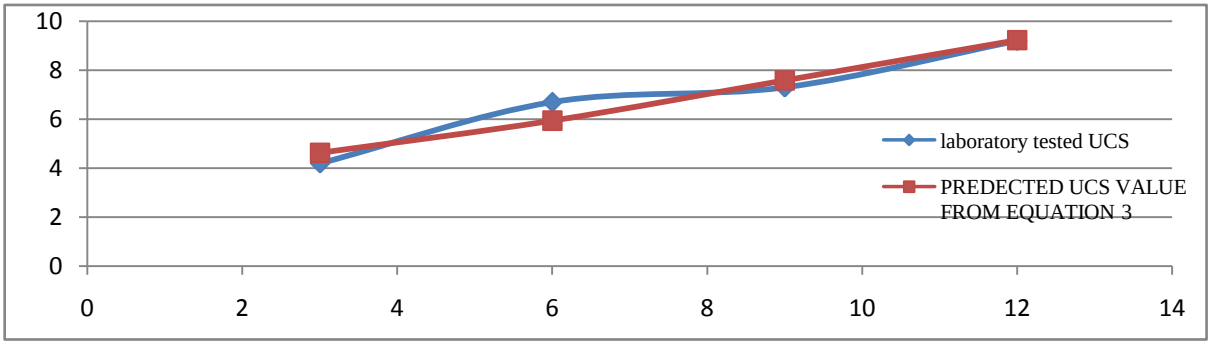
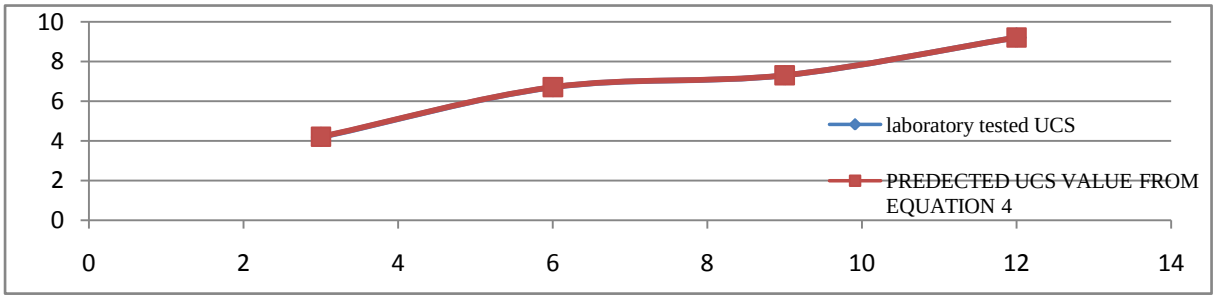
3.4.4 Comparison graph between experimental and predicted soaked CBR values:





3.4.5 Comparison graph between experimental and predicted UCS values:





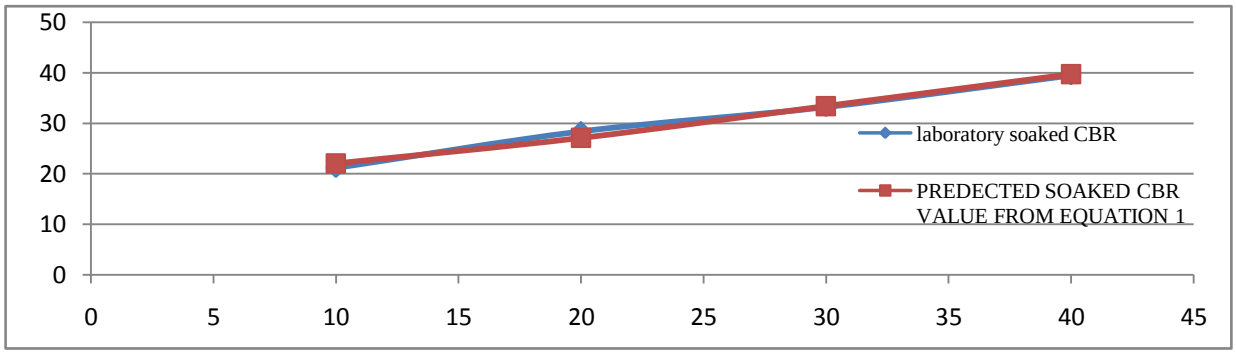
Proposed equations for predicting the soaked CBR and UCS value with index properties of black cotton soil stabilized with Portland slag cement (psc)

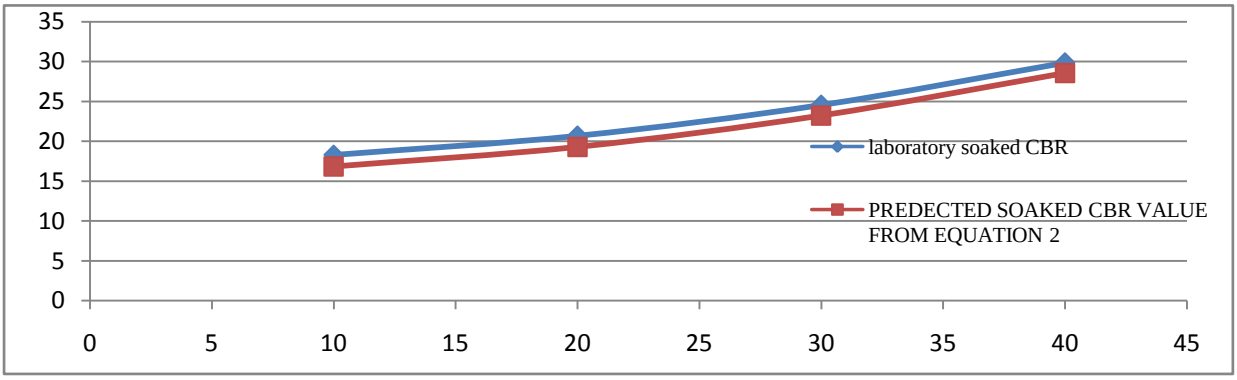
1) $CBR_{(soaked)}$ = 1.650*PSC+12.839with an R^2 value of 0.986
2) $CBR_{(soaked)}$ = 1.239*OMC-27.674*PI+2070.225*MDD-2365.185 with an R^2 value of 0.99
3) UCS =0.552*PSC+1.755 with an R^2 value of 0.978
4) UCS = 0.414*OMC-8.448*PI+626.966*MDD-717.270 with an R^2 value of 1.0

Table 14. Experimental and predicted soaked CBR and UCS values of black cotton soil soil stabilized with Portland slag cement (psc)

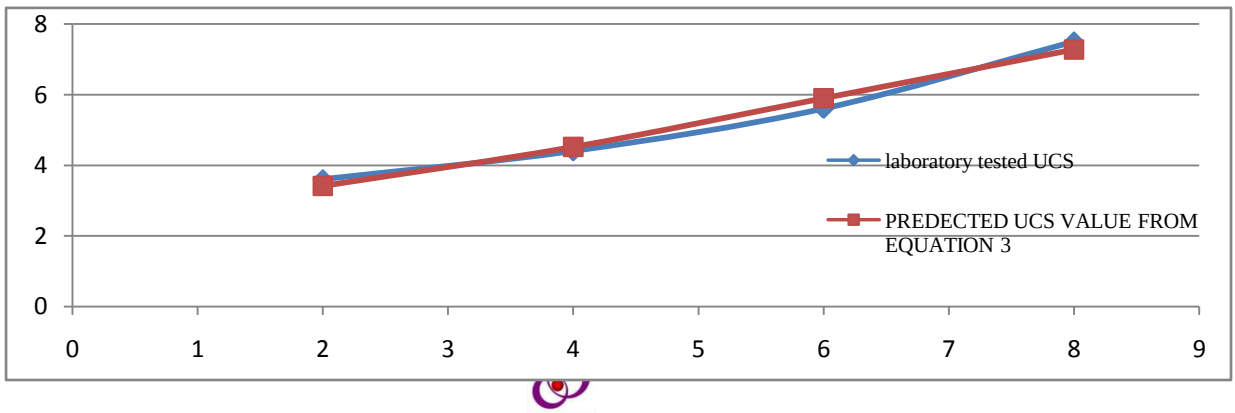
Laboratory Soaked CBR Value	Predected Soaked CBR Value From Equation 1	Predected Soaked CBR Value From Equation 2	Laboratory Tested UCS Value	Predected UCS Value From Equation 3	Predected UCS Value From Equation 4
18.3	17.79	16.84	3.6	3.41	3.59
20.7	21.09	19.30	4.4	4.52	4.39
24.57	25.21	23.24	5.6	5.90	5.59
29.87	29.34	28.57	7.5	7.28	7.49

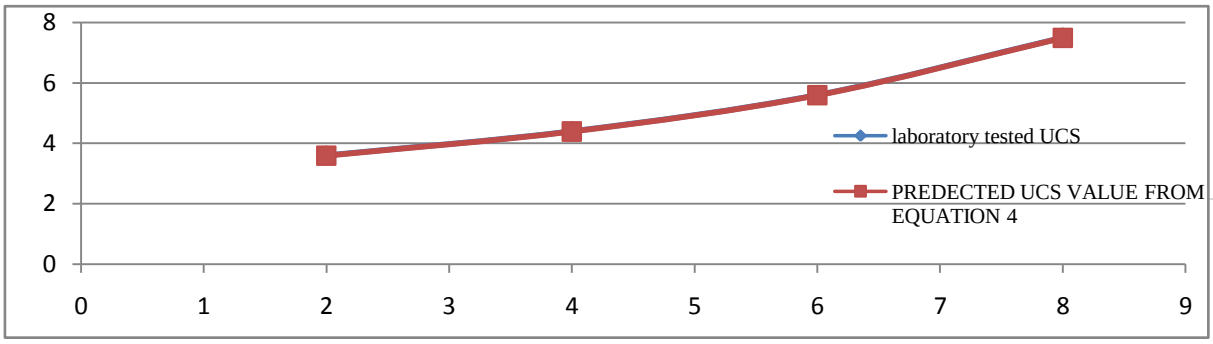
3.4.6 Comparison graph between experimental and predicted soaked CBR values:





3.4.7 Comparison graph between experimental and predicted UCS values:





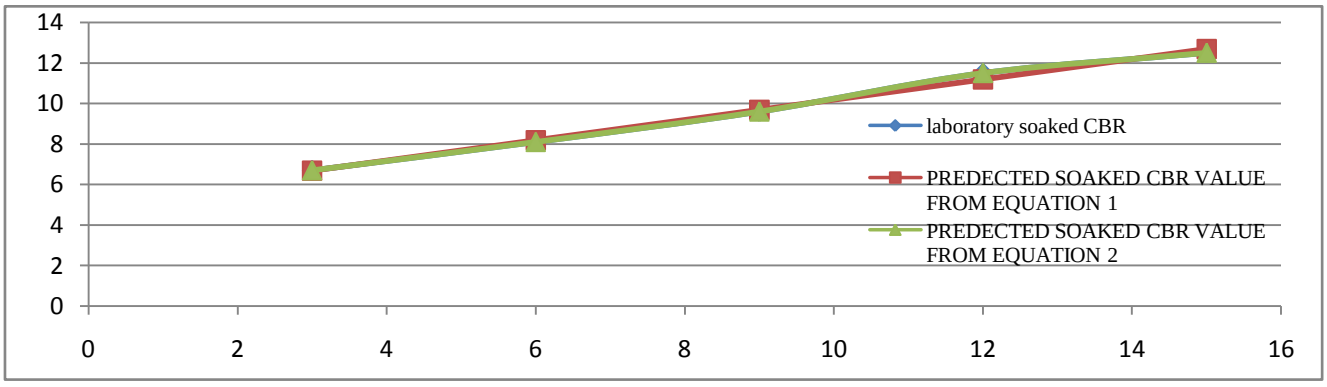
Proposed equations for predicting the soaked CBR and UCS value with index properties of red soil stabilized with stone dust

1) $CBR_{(soaked)}$ = 0.600*SD+3.680with an R^2 value of 0.993
2) $CBR_{(soaked)}$ = 0.520*OMC-0.804*PI+1.987*PL+156.967*MDD-311.441with an R^2 value of 0.999
3) UCS = 0.248*SD+3.200with an R^2 value of 0.974
4) UCS = 0.065*OMC-0.111*PI-0.168*PL-15.054*MDD-18.786 with an R^2 value of 0.99

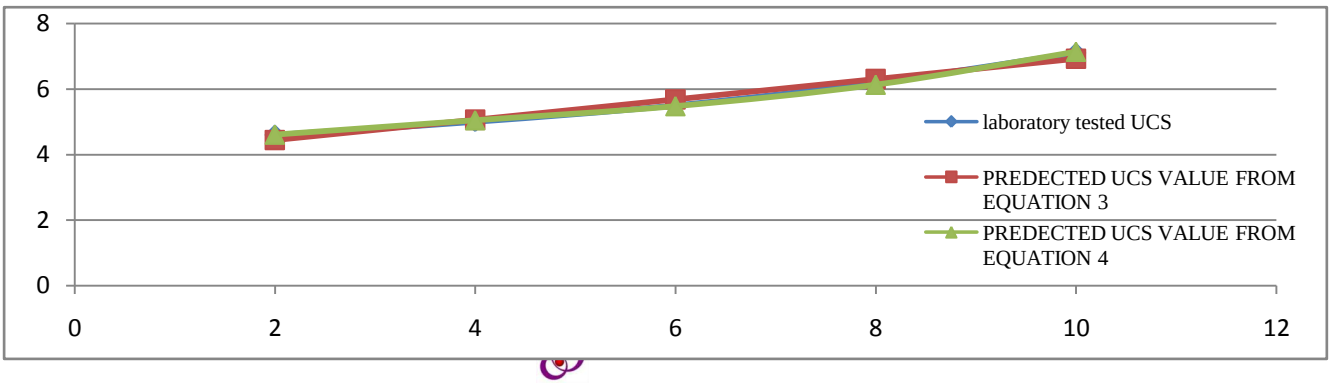
Table 15. Experimental and predicted soaked CBR and UCS values of Red soil stabilized with stone dust

Laboratory Soaked CBR Value	Predected Soaked CBR Value From Equation 1	Predected Soaked CBR Value From Equation 2	Laboratory Tested UCS Value	Predected UCS Value From Equation 3	Predected UCS Value From Equation 4
6.7	6.68	6.70	4.6	4.44	4.61
8.1	8.18	8.10	5	5.06	5.05
9.6	9.68	9.60	5.5	5.68	5.48
11.5	11.18	11.50	6.2	6.30	6.13
12.5	12.68	12.50	7.1	6.92	7.14

3.4.8 Comparison graph between experimental and predicted CBR values:



3.4.9 Comparison graph between experimental and predicted UCS values:



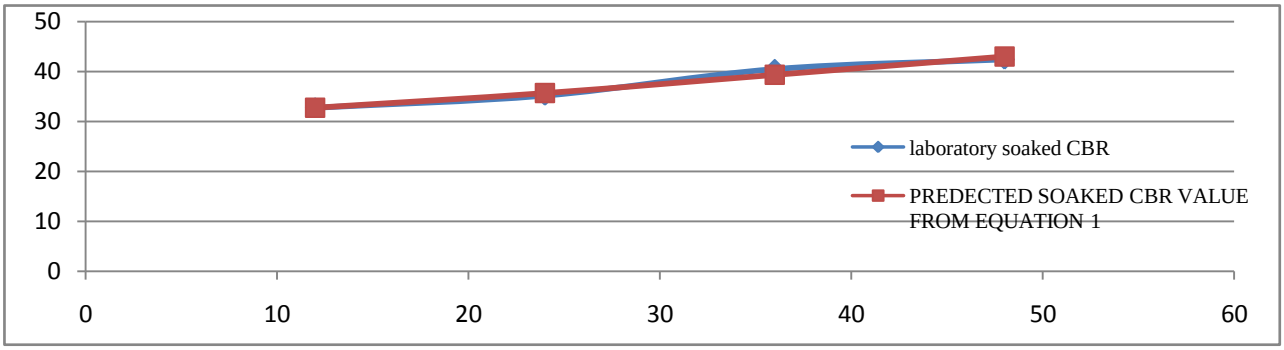
proposed equations for predicting the soaked CBR and UCS value with index properties of red soil stabilized with ordinary Portland cement (opc)

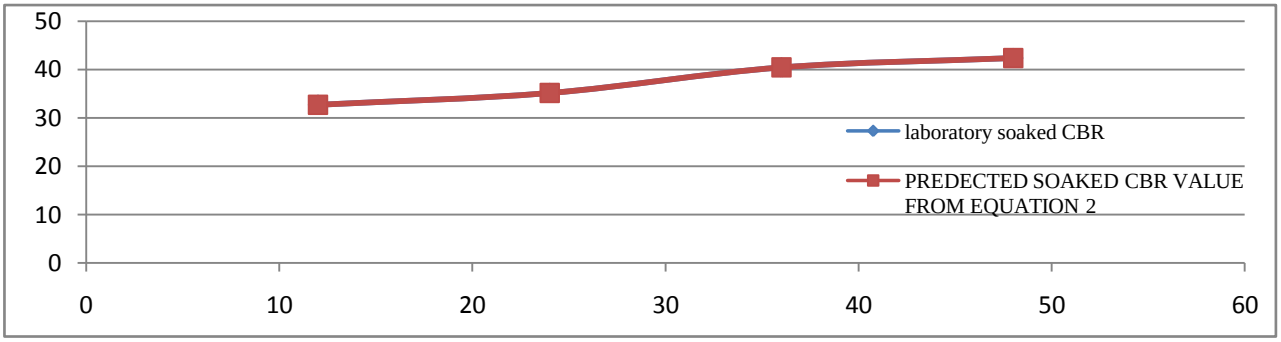
1) $CBR_{(soaked)}$ = 1.459*OPC+28.389with an R^2 value of 0.969
2) $CBR_{(soaked)}$ =1.524*OMC-0.990*PI+0.121*LL+29.393with an R^2 value of 1
3) UCS = 0.710*OPC+3.098 with an R^2 value of 0.99
4) UCS = 0.113*OMC-0.297*PI+0.310*LL-2.716 with an R^2 value of 1

Table 16. Experimental and predicted soaked CBR and UCS values of Red soil stabilized with ordinary Portland cement (opc)

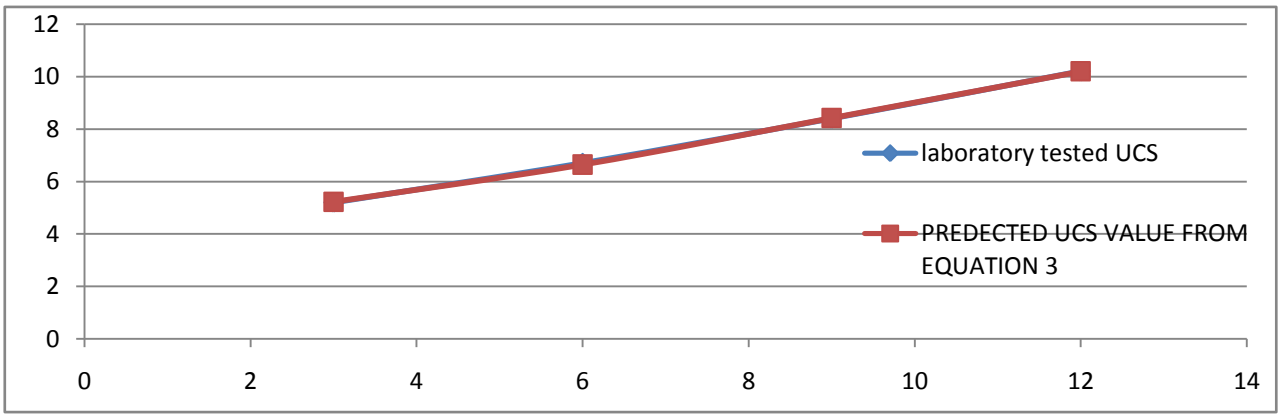
Laboratory Soaked CBR Value	Predected Soaked CBR Value From Equation 1	Predected Soaked CBR Value From Equation 2	Laboratory Tested UCS Value	Predected UCS Value From Equation 3	Predected UCS Value From Equation 4
32.73	32.77	32.72	5.2	5.23	5.19
35.17	35.68	35.16	6.7	6.65	6.69
40.46	39.33	40.45	8.4	8.42	8.39
42.4	42.98	42.39	10.2	10.20	10.18

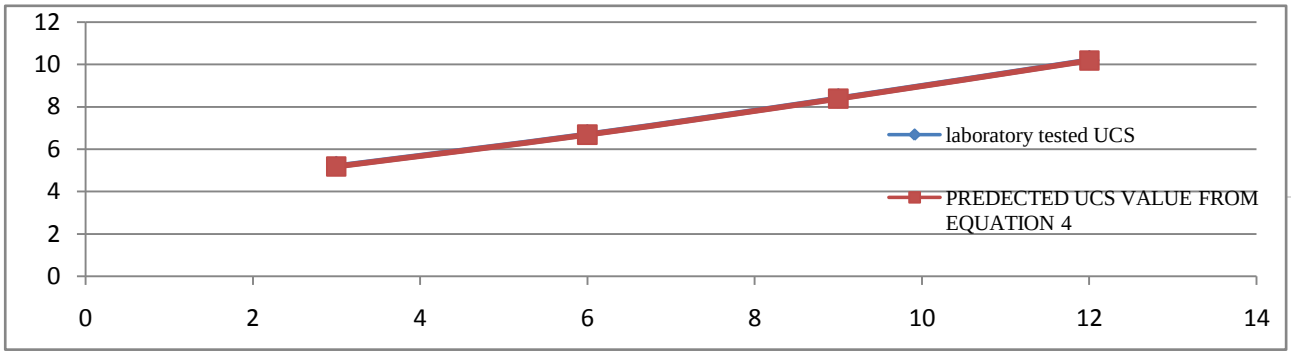
3.4.10 Comparison graph between experimental and predicted CBR values:





3.4.11 Comparison graph between experimental and predicted UCS values:





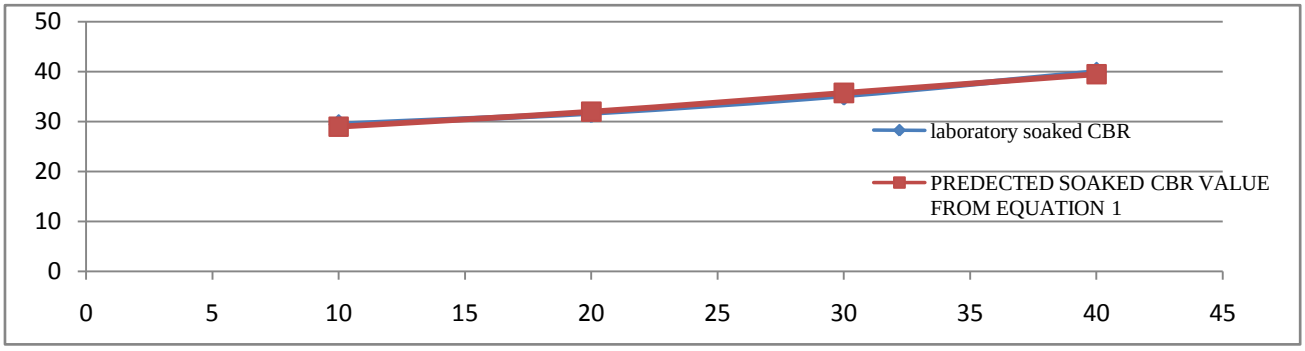
Proposed equations for predicting the soaked CBR and UCS value with index properties of red soil stabilized with Portland slag cement (psc)

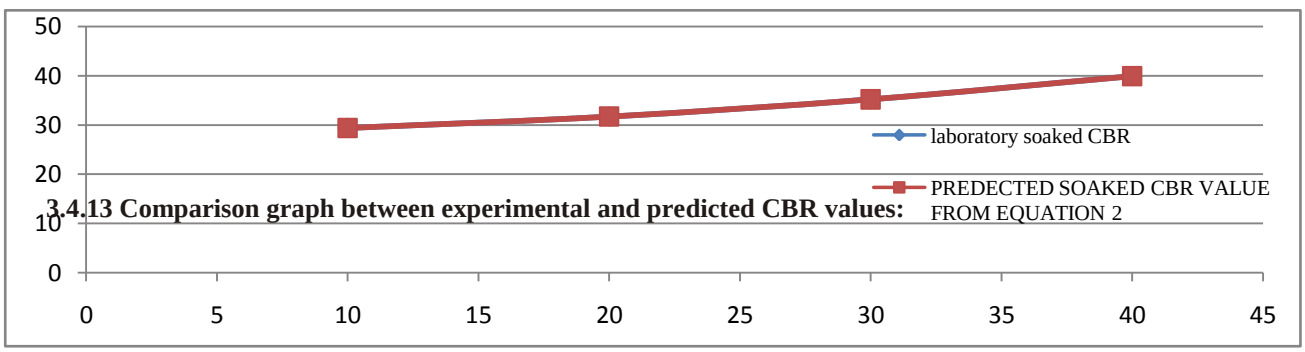
1) $CBR_{(soaked)}$ = 1.497*PSC+24.502with an R^2 value of 0.989
2) $CBR_{(soaked)}$ = 0.710*OMC-0.996*PI-81.101*MDD+185.217with an R^2 value of 0.99
3) UCS = 0.736*PSC+2.581with an R^2 value of 0.99
4) UCS =0.087*OMC-0.390*PI-66.579*MDD+130.530 with an R^2 value of 0.99

Table 17. Experimental and predicted soaked CBR and UCS values of red soil stabilized with Portland slag cement (PSC)

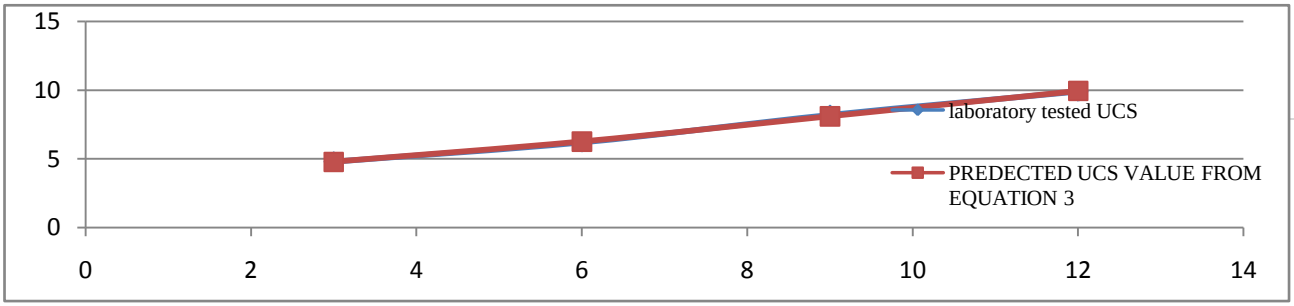
Laboratory Soaked CBR Value	Predected Soaked CBR Value From Equation 1	Predected Soaked CBR Value From Equation 2	Laboratory Tested UCS Value	Predected UCS Value From Equation 3	Predected UCS Value From Equation 4
29.39	28.99	29.39	4.8	4.79	4.80
31.7	31.99	31.70	6.2	6.26	6.20
35.2	35.73	35.20	8.2	8.10	8.20
39.9	39.47	39.90	9.9	9.94	9.90

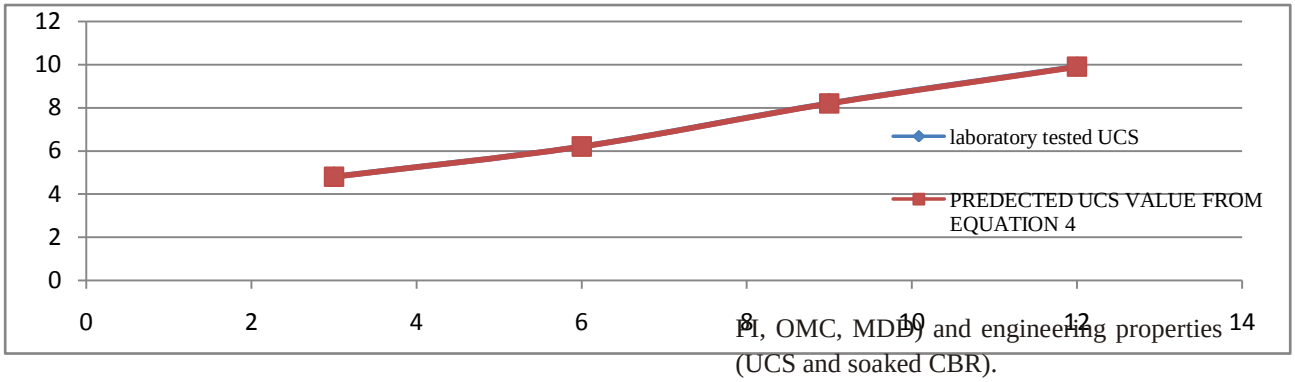
3.4.12 Comparison graph between experimental and predicted CBR values:





3.4.13 Comparison graph between experimental and predicted CBR values:





4.0 Conclusion

In this study 31 number of soil samples were tested for soaked CBR, UCS value and equations were developed using IBM SPSS and excel software. From the obtained results, it is concluded that

1) Here two different soils (black cotton soil, red soil) are stabilized with stone dust, ordinary Portland cement (OPC) and Portland slag cement (PSG).
2) For each stabilized material two equations were developed for soaked CBR and UCS
3) All of the simple linear regression analysis (SLRA) was carried out with only % of stabilized materials (%stone dust, %OPC, %PSC).
4) In all regression analysis types (SLRA, MLRA) Index properties (LL, PL, PI, OMC, and MDD) were used as independent variables were as CBR and UCS were dependent variables.
5) In all MLRA equations average R^2 value founded as 0.99.
6) In all SLRA equations average R^2 value founded as 0.98.
7) There is no perfect relation exists between soaked CBR and optimum moisture content as well as UCS and optimum moisture content.
8) All MLRA equations gives the perfect relation between index properties (LL, PL, PI, OMC, MDD) and engineering properties (UCS and soaked CBR).

5.0 FUTURE SCOPE OF THE STUDY

9) The exposure encountered in trying to conduct the current research has revealed areas where further efforts may be proved in the future. Following are some of the recommendations in relation to the subject study:
10) 1. It is recommended to carry out this correlation with a large number of samples including geographical areas in Sangareddy which are not covered by this research.
11) 2. It is also recommended to carry out such a study in other parts of Telangana State especially in regions where Black Cotton soil is abundantly to be found.
12) 3. It is advisable to conduct comparative correlations between soaked and Unsoaked CBR value with soil index properties.
13) 4. It would be of interest to investigate the effect of compaction and moisture content on the value of CBR under varying density and moisture conditions for coarse grained materials

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*e*ISSN 1303-5150