

Best Fit Model to Estimate Relation Between (CBR) and the Dry Density of Fine Grains Soils

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Abstract

CBR test and dry density of fine soil from 12 test results collected from Central Laboratory and Engineering College laboratory , and a statistical method was used to find out a relationship between the CBR and dry density of the soil desiring to obtain a straight line relationship and a formula combining the previous two variables .A reasonable straight line relationship represented by formula was obtained . In other hand the time and efforts was minimized .

Key words: Download Alklforne , Dry density, soft granules of Education

الخلاصة

لقد تم اخذ قيمة التحمل الكليفورني والكثافة الجافة لـ (١٢) نموذج من ترب ناعمة مختلفة تم تجميعها من مختبر بابل المركزي و مختبر كلية الهندسة، وتم استخدام طرق احصائية للربط بين المتغيرين للحصول على علاقة خطية مع معادلة رياضية، وفعلا تم الحصول على علاقة و معادلة معقولة، من ناحية اخرى فان كثير من الوقت و الجهد قد تم اختصارهما .
الكلمات المفتاحية: التحميل الكليفورني ، الكثافة الجافة ، حبيبات التربة الناعمة

Introduction :

There were many soil tests , and this engineering tests were taken place for many engineering purpose , and there was one or more manners to test one of the engineering features of soil . (P. N. Khanna , 1979). These manners have founded because of the improvement of the used equipments and scientific progressing . (Baraja , 2007)

C.B.R. test one of these tests which can find out the pressure act on the soil related to the California soil capacity. C.B.R. test took a large field in civil engineering designs and especially pavement design .

It was an empirical test , found and improved by Porter , then it was used by (U.S Army Corps of engineers) in 1942, and it is considered the first test in world which gives right and considerable results , besides the pavement designs which depends C.B.R. test was practical and suitable, so it was depended by America Association of standards for test and Materials ASTM (Leelavthamma , 2005) .

According to ASTM1883Results of the soil test completed after at least four days (ASTM, 2004).

In this study a number of CBR tests was taken to obtain a relationship between CBR value and the maximum dry density of fine soil , desiring to find out the value of CBR from the value of the dry density directly . A straight line relationship was obtained, and CBR could be founded directly by using the formula of this study.

Collecting data :

A twelve samples was choose cooperated with Babylon central laboratory and engineering collage laboratory . non real samples was excluded aiming to have realistic results .

Table (1) max dry density vs C.B.R

$\frac{yd}{kn}$ m^3	17.54	17.63	17.75	17.86	17.96	18.03	18.14	18.25	18.36	18.45	18.56	18.64	217.7
CBR%	3.0	3.3	3.7	4.1	4.4	4.8	5.1	5.5	5.9	6.3	6.7	7.0	59.9

Table (2) Calculation of least square formula

$\frac{yd}{KN}$ m^3	17.54	17.63	17.75	17.86	17.96	18.03	18.14	18.25	18.36	18.45	18.56	18.64	217.17
CBR%	3.0	3.3	3.7	4.1	4.4	4.8	5.1	5.5	5.9	6.3	6.7	7.0	59.9
X ²	307.65	310.82	315.06	318.98	322.56	325.08	329.06	333.06	337.09	340.4	344.47	347.45	3931.68
Y ²	9.0	10.89	13.69	16.81	20.25	23.04	26.01	30.25	34.81	39.69	44.89	49.0	318.33
XY	52.62	58.18	65.68	73.23	80.82	86.54	92.51	100.38	108.32	116.24	124.35	130.48	1089.35
y [^]	2.90	3.236	3.676	4.08	4.45	4.7	5.107	5.51	5.91	6.24	6.65	6.94	
$\frac{(y^{\square-\gamma})^2}{y^{\square-\square}}$	0.003	0.0012	0.00015	0.0001	0.00056	0.002	8.00	0.000018	0.00017	0.00057	0.00037	0.00052	0.0085
X [^]	17.55	17.63	17.74	17.85	17.96	18.04	18.13	18.24	18.35	18.46	18.57	18.65	

Best fit model :

In order to find a best fitting line between the two variables , max dry density (x) , and CBR (Y) the statistic method above was used to find out the best formula linking the two variables .

$$a = \frac{\sum y \sum x^2 - \sum x \sum xy}{n \sum x^2 - (\sum x)^2} = \frac{59.9 * 3931.68 - (217.71 * 1089.35)}{(12 * 3931.68) - (217.71)^2}$$

$$a = \frac{1066.5075}{17.3511} = -61.466$$

$$b = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2} = \frac{12 * 1089.35 - 217.71 * 59.9}{(12 * 3931.68) - (217.71)^2}$$

$$b = \frac{(12 * 1089.35) - (217.17 * 59.9)}{(12 * 3931.68) - (217.17)^2}$$

$$b = \frac{63.717}{63.717}$$

$$b = 1$$

$$b = 3.67$$

$$y^{\wedge} = a + bx$$

$$y^{\wedge} = -61.466 + 3.67x$$

$$y^{\wedge} = 3.67x - 61.466$$

It is possible to find a^1, b^1 To formula

$$a^1 = \frac{\sum x \sum y^2 - \sum y \cdot \sum xy}{n \sum y^2 - (\sum y)^2}$$

$$a^1 = \frac{(217.17 * 318.33) - (59.9 * 1089.35)}{(12 * 318.33) - (59.9)^2}$$

$$a = \frac{(12 * 318.33) - (59.9)^2}{(217.17 * 318.33) - (59.9 * 1089.35)}$$

$$a = -\frac{3879.66}{231.95} = -16.726$$

$$a = -\frac{3879.66}{231.95} = -16.726$$

$$b^1 = \frac{n \sum xy \sum y - \sum y \sum y}{n \sum xy \sum y - \sum y \sum y}$$

$$b^1 = \frac{(12 * 1089.35) - (59.9 * 217.17)}{(12 * 318.33) - (59.9)^2}$$

$$b^1 = \frac{63.717}{63.717}$$

$$b^1 = 1$$

$$b^1 = 0.275$$

$$x^{\wedge} = a^1 + b^1 y$$

$$x^1 = 16.726 + 0.275y$$

Hypothesis test:

1-Ho zero hypothesis which mean there is no deference between taken values and theoretical obtained values

2-H1 alternative hypothesis, which mean that there is a deference between taken values and the theoretical values

$$f_2 = \frac{\sum (y - \bar{y})^2}{n} = 0.0085$$

It is more less then the table value of chi – square distribution

$$f^2 [0.95, 11] = 19.67$$

So the H0 hypothesis will accepted

Discussion :

- 1-Referring to the graph (1) the relationship between CBR can be found directly from the graph or from the formula obtained .
- 2-This relationship can enable the engineer to move around the dry density he have to obtain the value of CBR he want , for example , if the CBR wanted is 6% , and the laboratory CBR was 4% . Engineer may get the 6% CBR by increasing compacting (i-e increasing γ_d) .
- 3-Graph 2 , graph 3 is almost congruent as shown in graph 4 when the two previous graphs were combined .
- 4-In this study the time (4 days) and the effort of the CBR test according to ASTM1883 is minimized , and CBR value can be obtained directly .
- 5-This study was taken place and it is might to be reasonable depending upon what the CBR test according to ASTM 1883 is an empirical method to obtain CBR.

Conclusions and Recommendation :

5.1 Conclusion :

- a. This study obtained a straight relationship between CBR and dry density of the soil represented by a formula :

$$CBR = - 61.466 + 3.67\gamma_d$$

- b. The time and the efforts of finding out CBR of the soil is minimized .

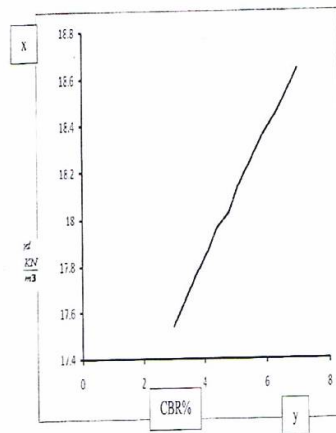
5.2 Recommendation :

It is recommended to take another type of soil such as granual soil cover a wide range of soils .

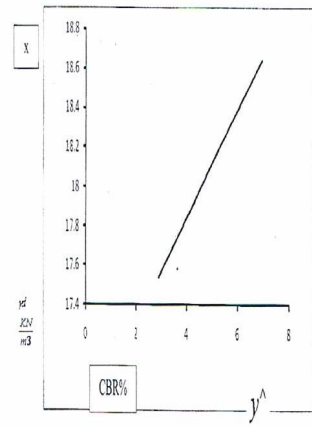
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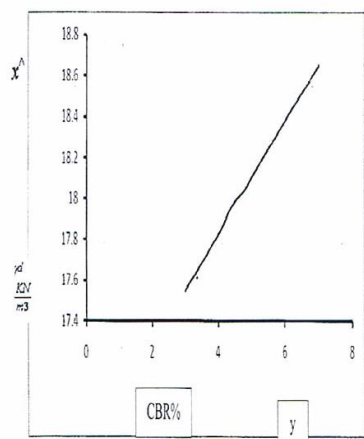
Graph (1)



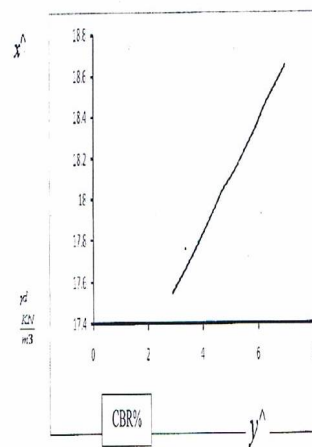
Graph (3)



Graph (2)



Graph (4)



يتبع الجدول (4) جدول X^2

$\begin{matrix} 1 \\ v \end{matrix}$	.75	.90	.95	.975	.99	.995
1	1.323	2.706	3.841	5.024	6.635	7.879
2	2.773	4.605	5.991	7.378	9.210	10.597
3	4.108	6.251	7.815	9.348	11.345	12.838
4	5.385	7.779	9.488	11.143	13.277	14.860
5	6.626	9.236	11.071	12.833	15.086	16.750
6	7.841	10.645	12.592	14.449	16.812	18.548
7	9.037	12.017	14.067	16.013	18.475	20.278
8	10.219	13.362	15.507	17.535	20.090	21.955
9	11.389	14.684	16.919	19.023	21.666	23.589
10	12.549	15.987	18.307	20.483	23.209	25.188
11	13.701	17.275	19.675	21.920	24.725	26.757
12	14.845	18.549	21.026	23.837	26.217	28.299
13	15.984	19.812	22.362	24.736	27.688	29.819
14	17.117	21.064	23.685	26.119	29.141	31.319
15	18.245	22.307	24.996	27.488	30.578	32.801
16	19.369	23.542	26.296	28.845	32.000	34.267
17	20.489	24.769	27.587	30.191	33.409	35.718
18	21.605	25.989	28.869	31.526	34.805	37.156
19	22.718	27.204	30.144	32.852	36.191	38.582
20	23.828	28.412	31.410	34.170	37.566	39.997
22	26.039	30.813	33.924	36.781	40.289	42.769
24	28.241	33.196	36.415	39.361	42.980	45.559
26	30.435	35.563	38.885	41.923	45.642	48.290
28	32.620	37.916	41.337	44.461	48.278	50.993
30	34.800	40.256	43.773	46.979	50.892	53.672
40	45.616	51.805	55.758	59.342	63.691	66.766
50	56.334	61.167	67.505	71.420	76.154	79.490
60	66.981	74.397	79.082	83.298	88.379	91.952
70	77.577	85.527	90.531	95.023	100.425	104.215
80	88.130	96.578	101.879	106.629	112.329	116.321
90	98.650	107.565	113.145	118.136	124.116	128.299
100	109.141	118.498	124.342	129.561	135.807	140.169
110	119.608	129.385	135.480	140.917	147.414	152.948
120	130.055	140.233	146.567	152.211	158.950	163.648
130	140.482	151.045	157.610	163.453	170.423	175.278
140	150.894	161.827	168.613	174.648	181.840	186.847
150	161.291	172.581	179.581	185.800	193.208	198.360
200	213.102	226.021	233.994	241.058	249.445	255.264
500	520	450.930	553.127	563.852	576.493	585.207