Suggestion New Method For California Bearing Ration (CBR) Test

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Abstract

California bearing capacity (CBR) considered as an important laboratory method to find out the capacity of the soil to the pressure act upon which was depended by standard specifications such as AASHTO and ASTM for long period of time .

In this study some changes was taken place desiring to obtain more realistic results .In ASTM test changing take place in the number of hummer blows, using optimum moisture content (fixed), while in this study number of blows are fixed ,and changing are taken place in moisture content.
A good and reasonable results was obtained .

الخلاصة

تعتبر طريقة فحص التحمل الكليفورني النسبي (CBR) من الطرق المهمة مختبرياً لحساب قابلية تحمل التربة للضغط المسلط عليها والتي تم اعتمادها من قبل المواصفات العالمية مثل (AASHTO) و (ASTM) منذ وقت طويل.

في هذه الدراسة تم وضع بعض التغييرات على هذه الطريقة رغبة في الحصول على النتائج أكثر واقعية ، ففي طريقة الفحص المعتمدة من ال ASTM ان عدد ضربات المطرقة تتغير مع استخدام نسبة الرطوبة المثلى (ثابتة). في حين تم تثبيت عدد الضربات مع تغيير نسبة الرطوبة ، وقد تم الحصول على نتائج معقولة وجيدة.

1 . Introduction

There were many soil tests , and this engineering tests were taken place for many engineering purposes , 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 designs .

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 AASHTO and ASTM (Leelavathamma , 2005)

In this study some changes were taken place on ASTM procedures desiring to obtain more realistic results .

2 . Test Procedure

Two soil samples was taken , the first sample represent homogenous soil (clayey silt soil) The second sample non–homogenous soil (mixed ground coarse). The followed tests was taken place for both samples .

1 . According to ASTM 1883 . C.B.R. test the sample was divided for two parts . One of them was tested for modified proctor which is the relation between optimum moisture content and the maximum dry density .

The other part of soil was tested for CBR depending the optimum moisture content obtained by the first sample , i.e two CBR test was taken place on two stages . Results and drawings were recorded .

2 . In this study, the same soil sample which was tested for modified proctor have been tested for CBR before obtaining the optimum moisture content and maximum dry density. Then finding out optimum moisture content to complete

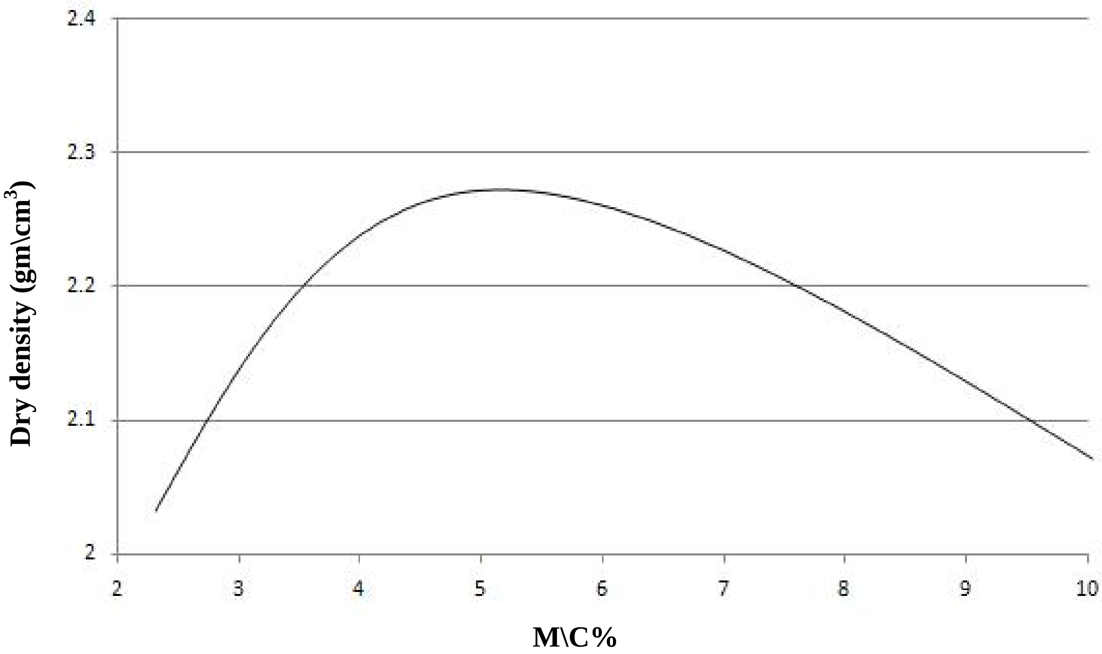
drawing the relationship between C.B.R.-m/c ; i.e CBR test was taken place on one stage using one sample It is considered that this study is more realistic due to use the same sample , on other hand the time of the test was decreased . All the results and drawings was recorded to compare the results .

3- Results

Table (1) Modified proctor sub base soil

Moisture- Density Relationship
Sub base soil
No. of Layers = 5 Wt. of hammer = 4.5 kg
Wt. of mold = 3986.0 cm^3 Vol. of mold= 2096.6 cm^3
Modified Effort = 56725 Ib ft / ft^3
Standard Effort = 12375 Ib ft / ft^3

Water added	**2%**	**4%**	**6%**	**8%**
Wt. of (Wet soil + mold)	8430.79	9091	9071.6	8418.7
(Wt. of mold) gm	3986	3986	3986	3986
Wt. of wet soil	4444.79	5105	5085.6	4932.7
Wt. of (wet soil + container)	1000	1000	1000	1000
Wt. of (dry soil + cont)	978	947.5	928.7	907.7
(Wt. of Water) gm	22	52.5	71.3	92.3
m/c %	2.25	5.54	7.677	10.17
Dry Density Y_d (gm / cm^3)	2.023	2.3069	2.2526	2.1355



Graph (1) Modified proctor Sub base soil

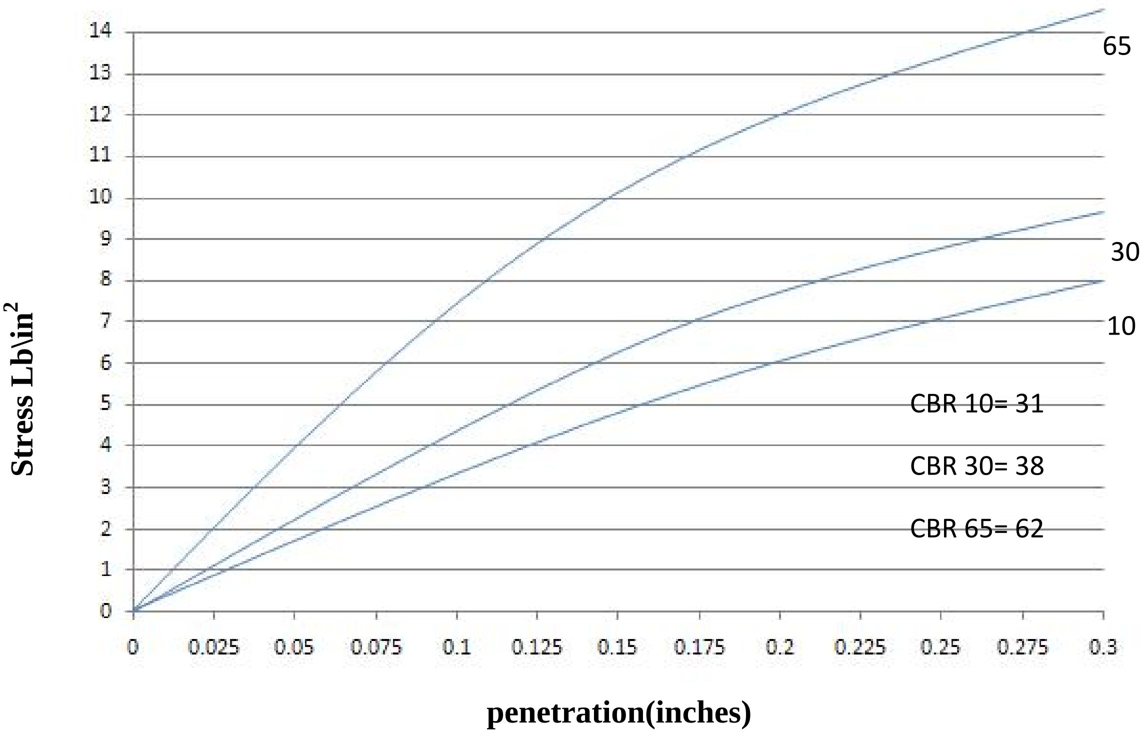
Table (2) CBR test for sub base soil Bearing Ratio
Laboratory Compacted Soils (C.B.R) Based on ASTM D 1883

Penetration		10 Blows		30 Blows		65 Blows	
In	Mm	I.D.R	Stress	I.D.R	Stress	I.D.R	Stress
0	0	0	0	0	0	0	0
0025	.64	15	,5	30	1.0	45	1.5
005	1.27	45	1.5	60	2.0	89	3.0
.075	1.91	68	2.25	90	3	120	4
.10	2.54	85	3	133	4	180	6
.125	3.18	112	3.75	140	4.75	225	7.5
.15	3.81	135	4.5	155	5.25	260	8.73
.175	4.45	155	5.25	185	6.25	300	10
.12	5.08	185	6	205	7	325	11
.25	6.35	200	6.75	265	9	390	13
.30	7.62	225	7.5	290	9.75	412	13.75

Volume = 2323.17 cm^3
I.D.R: Initial Dial Reading

Wt. of (soil+ mold + Base)	11542.5	11725.9	11946.3
Wt. of (mold + Base) gm	6197.3	6265.5	6265.5
Wt. of wet soil gm	5345.2	5460.4	5680.8
Wet Density g/cm	2.3	2.35	2.445
O.M.C %	5.4	5.4	5.4
Dry density	2.182	2.23	2.32

Stress = (L.D.RxF)/ Area of piston
Area of piston= 3in^2 or 1935.5 mm^2



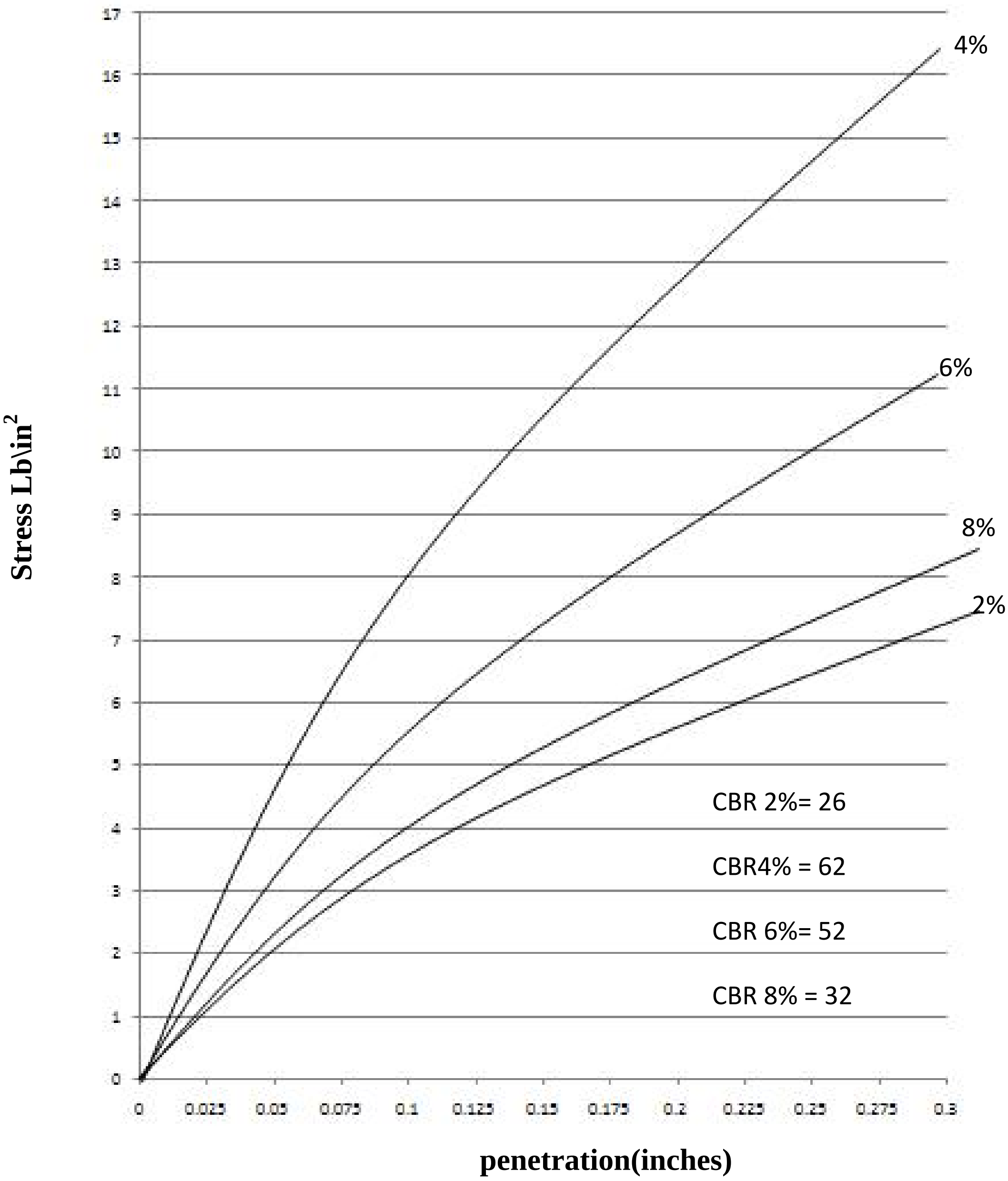
Graph(2) CBR For Sub Base Soil

Modified
Sub base
Weight of mold + base = 6256 & 6197 gm
Volume = 2323.17 cm^3

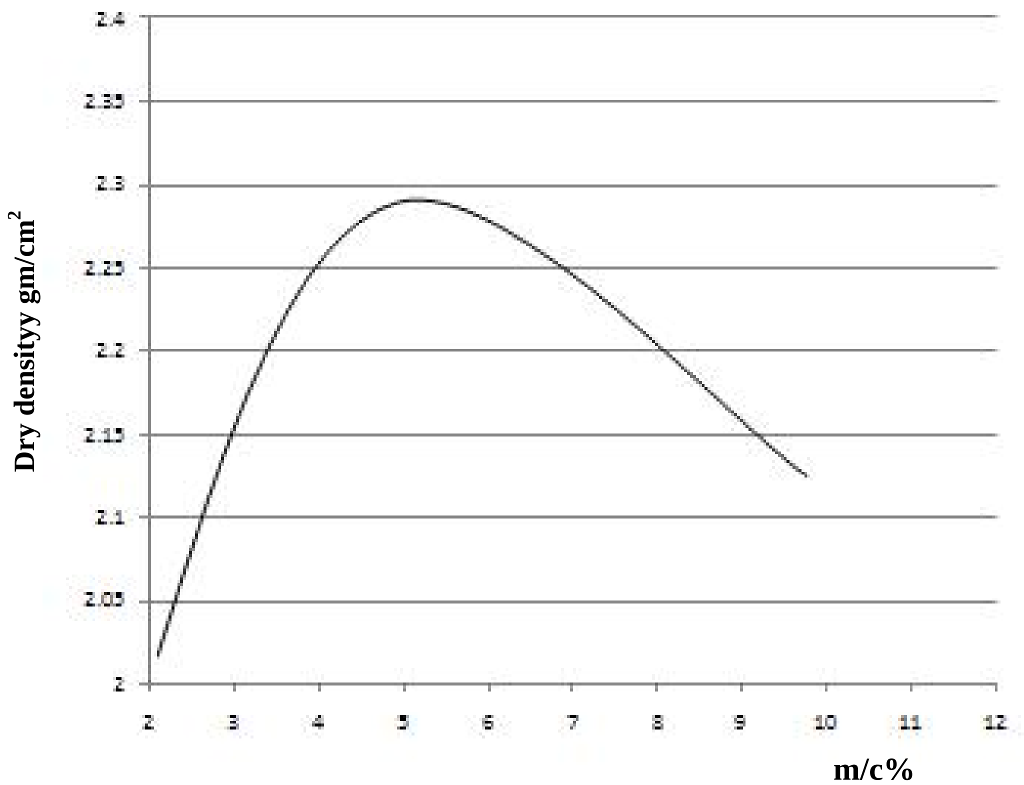
Penetration		**2%**		**4%**		**6%**		**8%**	
In	Mm	L.D.R	Stress	L.D.R	Stress	L.D.R	Stress	L.D.R	Stress
0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
.025	0.64	10	0.35	70	1.2	40	1.0	20	0.7
.05	1.27	30	1.0	90	3.0	60	1.9	45	1.5
.075	1.91	52	1.75	135	4.0	105	3.5	68	2.5
.10	2.54	78	2.5	190	6.0	155	5.2	90	3.00
.125	3.18	94	3.0	240	8.0	200	6.5	115	3.75
.15	3.81	106	3.5	285	9.5	230	7.5	135	4.5
.175	4.45	120	4.0	325	10.7	250	8.3	150	5.0
.20	5.08	160	5.3	370	12.0	270	9.0	165	5.5
.25	6.35	185	6.0	420	14.0	295	9.75	196	6.5
.30	7.62	205	6.8	490	16.7	310	10.5	225	7.5

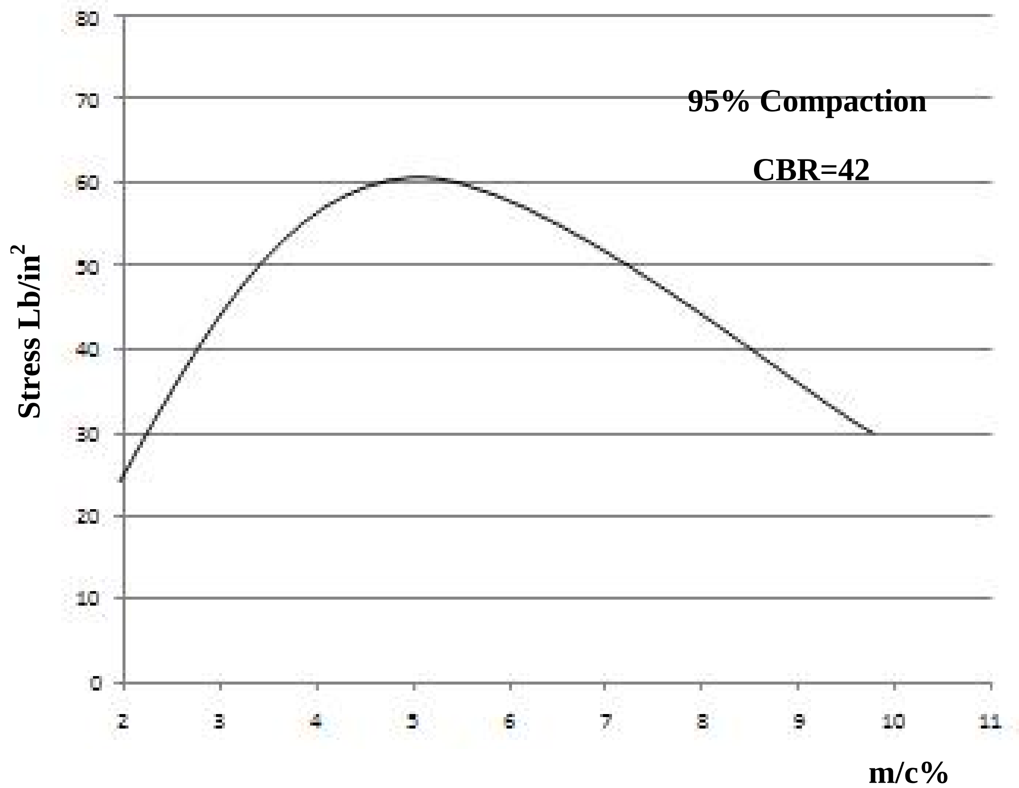
Table (3) Modified C.B.R for Sub base soil

	2%	4%	6%	8%
Weight of wet (soil + mold +base) gm	11121.6	11921.9	11893.9	11661.2
Weight of dry (soil + mold +base) gm	11013.3	11625.0	11492.6	11157.3
Weight of (mold +base) gm	6197.3	6265.5	6265.5	6197.3
Weight of wet soil gm	4924.3	5656.4	5628.4	5463.9
Weight of dry soil gm	4816	5395.5	5227.1	4960
m/c %	2.25	5.54	7.67	10.16
gm/cm^3	2.073	2.307	2.25	2.135



Graph (3) Modified CBR For Sub Base Soil





Graph (4) Modified CBR & Proctor For Sub Base Soil

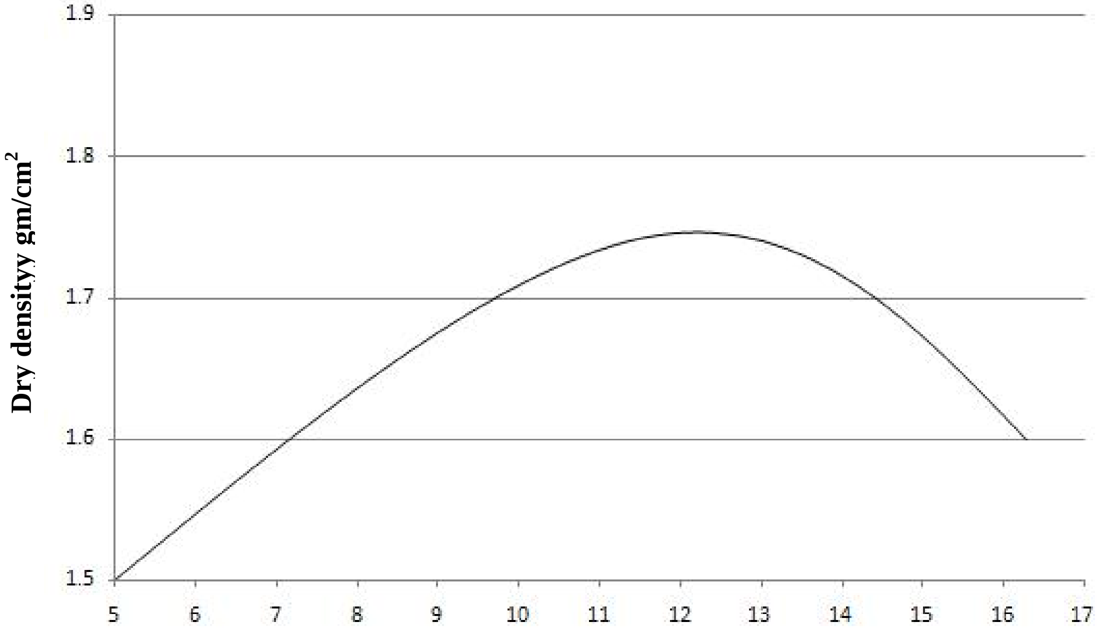
Table (4)Clayey silt soil Modified

Water added	4%	8%	12%	16%
Wt. of (Wet soil + mold)	7293.5	7536	7703.3	7346
Wt. of mold	3986	3986	3986	3986
Wt. of wet soil	3307.5	3550	3717.3	3360
Wt. of (wet soil)	1000	1000	1000	1000
Wt. of (dry soil)	47.6	83.4	115.0	858.4
Wt of Water	47.6	83.4	115.0	151.6
m/c %	5.0	9.1	13.0	16.5
Dry Density	1.5	1.69	1.77	1.6

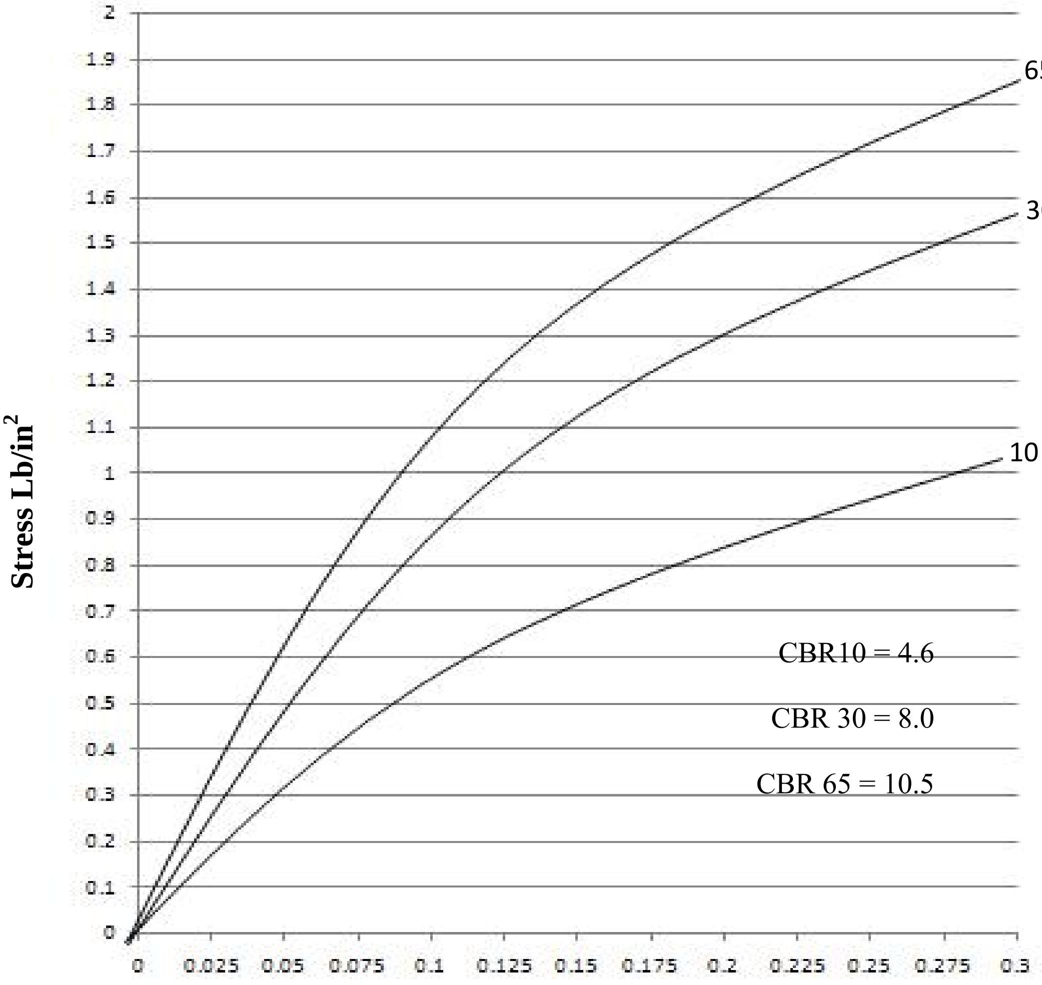
Table (5) (C.B.R) of clayey silt Soil
Based on ASTM D 1883

Wt of mold = 3986 gm
Volume = 2100 cm^3

Penetration		10 Blows		30 Blows		65 Blows	
In	Mm	L.D.R	Stress	L.D.R	Stress	L.D.R	Stress
0.0	0.00	0	0	0	0	0	0
.025	0.64	1	0.06	2.2	0.15	4.2	0.28
.05	1.27	3	0.22	6.0	0.39	9.3	0.61
.075	1.91	4.8	0.35	8.5	0.56	13.0	0.82
.10	2.54	7.2	0.50	12.0	0.80	15.6	1.03
.125	3.18	8.2	0.57	14.2	0.96	17.8	1.17
.15	3.81	9.2	0.62	16.5	1.10	200	1.33
.175	4.45	10.2	0.67	17.8	1.18	22.0	1.48
.20	5.08	11.0	0.72	18.7	1.23	23.1	1.56
.25	6.35	13.2	0.90	21.5	1.42	26.5	1.78
.30	7.62	16.8	1.05	26.0	1.71	31.5	2.08



Based on ASTMD 1883



Graph (5) CBR For Clayey Silt Soil

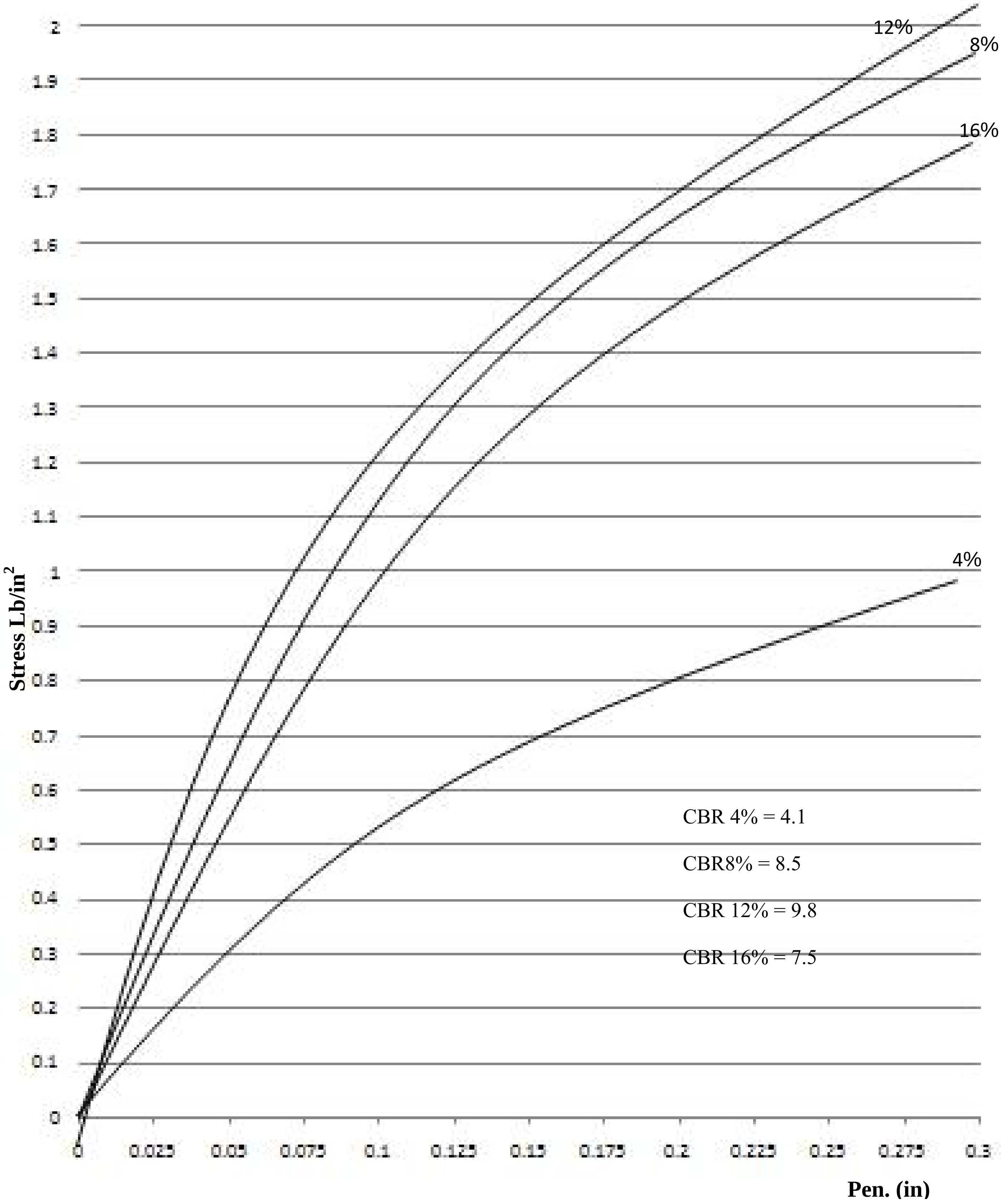
Table (6) Modified C.B.R clayey silt Soil

Modified (clayey silt Soil)

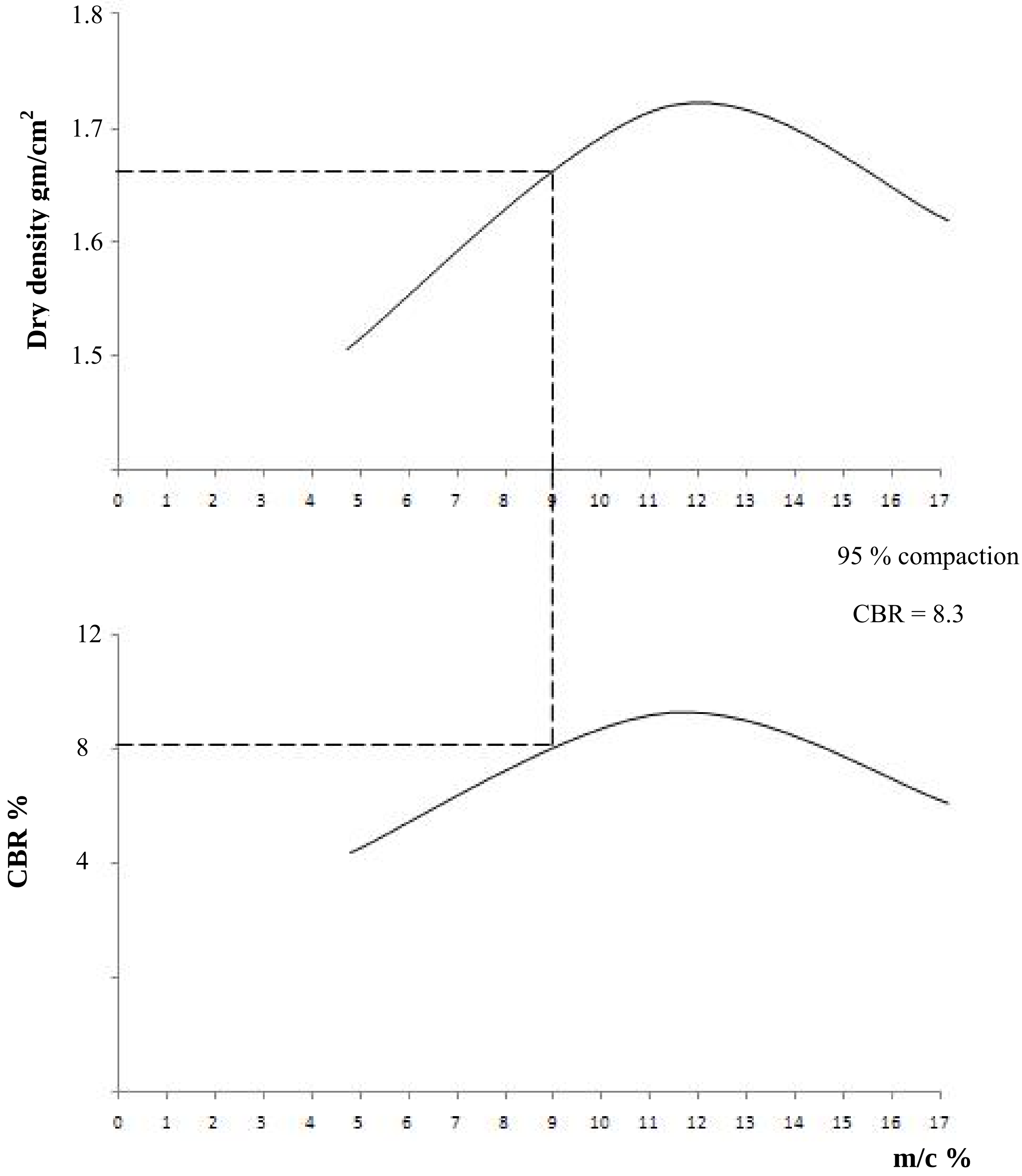
Volume = 2323.17 cm^3

Penetration		2%		4%		6%		8%	
In	Mm	L.D.R	Stress	L.D.R	Stress	L.D.R	Stress	L.D.R	Stress
0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
.025	0.64	1	0.06	1.5	0.00	4.1	0.27	2.1	0.14
.05	1.27	2.7	0.20	3.5	0.13	9.2	0.61	5.6	00.37
.075	1.91	4.5	0.30	6.8	0.30	13.0	0.82	8.2	0.54
.10	2.54	7	0.44	10.5	0.56	15.5	1.03	12.0	0.80
.125	3.18	8.1	0.55	12.6	0.88	17.7	1.10	14.1	0.94
.15	3.81	9.5	0.62	13.8	1.05	19.8	1.32	16.2	1.08
.175	4.45	10.1	0.66	14.5	1.15	21.9	1.48	17.5	1.16
.20	5.08	10.9	0.70	16.0	1.20	23.0	1.55	18.4	1.22
.25	6.35	13.0	0.84	19.6	1.35	26.1	1.74	21.2	1.41
.30	7.62	16.5	1.04	23.5	1.65	30.2	2.00	25.0	1.66

	2%	4%	6%	8%
Weight of wet (soil + mold +base) gm	9961.0	10578.2	10942.2	10612.6
Weight of dry (soil + mold +base) gm	9775.0	10214.9	10400.5	9960.8
Weight of (mold +base) gm	6197.3	6265.5	6265.5	6197.3
Weight of wet soil gm	3763.7	4312.7	4676.7	4415.3
Weight of dry soil gm	3577.7	3949.4	4135.0	3763.5
m/c %	5.2	6.20	13.1	17.32
gm/cm^3	1.54	1.70	1.75	1.62



Graph (6a) Modified CBR For Clayey Silt Soil



Graph (6b) Modified CBR & Proctor For Clayey Silt Soil

4-Discussions

1. Comparing results of the two methods there was a difference in CBR and optimum moisture content for the sub base soil, and this is due to the non–homogeneity of the soil which cause a difficulty to choose two identical parts for modified proctor and CBR tests, therefore the accuracy of the optimum m/c will affected and it is the purpose of the study.
2. The above difference was very slight in the case of using clayey silt soil , and this is of course due to the homogeneity of the soil .
3. In this study two relations was obtained, one of them between optimum m/c and maximum γd, and the other was between m/c and CBR. Both relations have almost same curvature . To find value of CBR related to 95 % compaction of the dry density, the desired value of CBR can be projected on the first curve then finding out the percent of compacting which achieve the desired value of CBR. This method will enable the engineer to move with the limits of the practical compaction .

5. Conclusions and Recommendations

5.1 Conclusions :

a. The method which was studied is more realistic than the depended method in ASTMD1883 .

b . In this study the value of CBR was found out on one stage, but in ASTMD1883 method the CBR value was found on two stages .

c . The time carried out in this study was shorter than the ordinary method time .

5.2 Recommendations

It is recommended to find out a direct relationship between value of CBR and maximum dry density of soil ; i.e finding out direct relationship between the dry density and the bearing capacity of the soil .

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