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Strength Improvement of Black Cotton Soil by using Different Materials

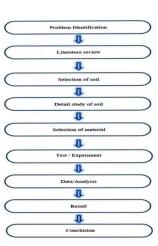
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Abstract: This study examines the effect of geotextiles, plastic rings, plastic shavings and fibres on soil California bearing capacity (CBR). The experiment evaluates the effectiveness of these additions to improve the bearing capacity and reduce the sedimentation of the soil samples. Geotextiles are introduced to improve soil compaction and reduce lateral movement. Plastic rings and chips are added to create voids and improve drainage, which can reduce water content and improve strength. Polypropylene Fibres were added to study their effect on soil reinforcement and stress distribution improvement. CBR tests are performed on soil samples with hand without these additives to quantify the improvement in strength and deformation properties. The results of this study should provide valuable information on the potential benefits of using geotextiles, plastic rings, plastic chips and polypropylene fibres in pavement construction to improve soil CBR of soils in pavement applications Keywords: CBR Test, Geotextiles, plastic chips, plastic rings, polypropylene fibres,

I. INTRODUCTION

- 1) Black Cotton Soil :Black cotton soil, also known as regur soil, is a type of soil found in the Deccan Plateau region of India. It is characterized by its brown-black color, high clay content, and high shrink-swell properties.
- 2) CBR Test : CBR (California Bearing Ratio) testing is performed primarily to provide information for pavement design. It was first developed by the California State Highway Department. It is a penetration or subsidence test under load, mainly used to evaluate the base strength of roads, pavements and foundations..
- 3) Geotextiles: Geotextiles are essentially strong fabrics used in construction projects. They are the most Versatile type of geosynthetic material, with a wide range of applications. Due to the variety of Geotextiles available, choosing the right one for a specific project is crucial.
- 4) Polypropylene Fibres: Experiments were conducted using different Percentages of polypropylene fibres mixed with compacted soil samples. The tests measured the Soil's strength, bearing capacity, and swelling behaviour. While the detailed results aren't provided. This research suggests that fibre reinforcement has promise for improving problematic soils.
- 5) Plastic bottle : The project involves mixing the soil with various percentages of these plastic strips. Tests like Compaction and California Bearing Ratio (CBR) will then be conducted to analyse the impact on Soil properties



II. METHODOLOGY



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III. TESTS AND RESULTS

To determine the properties of soil tests we conducted on soil are:

1) Free Swell Index

			IS2720 part			1 ±
Lab Jol	b No.:	235		Date of Sampling	. 251	02/24-
Sample	Description:	Black Cotton	Soil	Date of Testing:	261	02124
Source	/Location:	130+700LHS		Sampled By:	Joi	odiy
Propose	ed Use:	Embonisment	Subarcio	Tested By:		mir
Sr. No		Determination		Test-1	Test-2	Average
1		timen in Graduated Cylinder illed Water after 24 hrs = (ml)	Vđ	20	21	1
2		imen in Graduated Cylinder osene after 24 hrs = (ml)	Vk	13	13	
3	Difference of Ve	olume in Water & Kerosene (ml)	Vd-Vk	7	8	1
4	Free Swelling In		[(Vd-Vk)/Vk] × 100	53.85	61.54	57.70

2) Liquid Limit And Plastic Limit Tests

					G LIM				
			(By	Casagrand	a Apparatu	is)			
ab Jo	b No.	235				Date of Sam	pling	2510	2/27
Sample	Description	BLACK	Cotto	n Soi)	Date of Test	ing	2610	2124
Source	/Location	130+70	OLH	8		Sampled By			n+17
ropos	ed Use	Embl	sub.			Tested By		101	2412
ir. No.		Determination			Liquid	Limits			Limits
		Determination		1	2	3	5	1	2
1	No. of Blows			32	27	22	18	-	-
2	Container Num			2	3	4	5	6	7
3	Weight of conta		W1	18.62	19.02	17.25	16.83	18.65	18.28
4			W2	46.83	49.32	49.49	48.25	28.08	30.40
5			W3	35.81	37.44	36.67	35.62	26.17	27.76
6	WL. of Water	W4= W2-V	/3	11.02	11.88	12.82	12.63	1.91	2.64
7	Wt. of Dry Sam	ple W5 = W3-	W1	17.19	18.42	19.42	18.79	7.52	8.98
8	% Moisture con	tent W4/W5X1	00	64.11	64.50	66.01	67.22	25.40	29.40
							Average	27.	40
	8	~					LL: Moi	sture Cont Blows	ent @ 25
	6							RESULTS	-
Ħ	° •		1				Liquid Lim	it LL (%)	= 65.50
Conte	65		2					nit PL (%) =	
Moisture Content (%)	64		0				Plasticity In (LL-PL)	ndex PI (%)	= 38.1
W	63						·		
	10	20	30	40 5	D 60 70	80 90 10	•		
			o. of Blow						

3) Grain Size Analysis

		GRAIN SIZE			
Lab Job No.	235	[As per 13 27.	Date of Sampling	25/02/2	У
Sample Description	Black Ce	Hon Soil	Date of Testing	2610212	
Source/Location	130+200		Sampled By	Thriot	
Proposed Use	Empl Sut		Tested By	Jointly	
Wt. of Sample (gm)	1000				
IS Sieve Size (mm)	Weight Retained (gm)	Cumulative Weight Retained (gm)	Cumulative Perentage Retained (%)	Cumulative Percentage Passing (%)	Remarks
100					
75					
. 19	0	0	0	100	
4.75	16	16	1.6	98.4	
2.0	9	25	2.50	97.5	
0.425	47	72	7.2	92.8	
0.075	53	125	12.5	87.5	
Pan					
DESCRIPTION C	F PARTICLE	SIEVE SIZE (mm)		PERCENT	TAGE
	Coarse	75 - 19		1	
Gravel	Fine	19 - 4.75		1.60	1.60
	Coarse	4.75 - 2.00		0.90	
Sand	Medium	2.00 - 0.425		4.7	10.9
	Fine	0.425 - 0.075		5.3	
Silt & Clay		Passing through 0.07	5		87.5

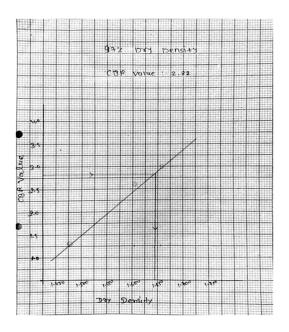


4) Modified Proctor Test

		MODIFIE		TOR CO		ON TEST		
ab Job No.	9	35			Date of Sampli	ng	25/02	124
		& Cotto	an Sa	.)	Date of Testing		26102	
Sample Description	biac	RCOTI	10	, ,			1 1	ortin
Source/Location		ttoo Lt	15		Sampled By			2160
roposed Use	Emb	Syb.			Tested By		201.	8111/
Mould No		Wt. of M	Mould, W1 (gm)	399	0	Volume of mor	uld, V (cc) 10	00
% of Water			18%	20%	22%	24%	26%	
Nt. of Wet Sample	mould, W2	(gm)	5786	5979	6058	5956	5871	
Nt. of Wet Sample,	W3=(W2-W1)	(gm)	1796	1989	2068	1966	1881	
Net density, Yp = W	5N	(gm/cc)	1.796	1.989	2.068	1.966	1.881	
Container No.			56	57	58	59	60	
Wt. of container,Ws		(gm)	40.30	46.4	47.57	48.25	48.15	
Wt. of wet soil + con	t., We	(gm)	146.99	161.89	166.61	170.47	171.92	
Wt. of dry soil + cont		(gm)	130.60	149.80	145.14	146.5	146.3	-
Wt. of water, Ws=(W	e-W7)	(gm)	16.39	19.09	21.47	23.97	25.62	
Wt. of dry soil, W _g =(w-w.)	(gm)	90.30	96.40	99.57	98.25	98.15	
Moisture content w =	W ₈ /W ₉ x 100	(%)	18.15	19.80	22.00	24.40	26.10	
Dry density Y = Yb/	(1+ w/100)	(gm/cc)	1.520	1.660	1.695	1.580	1.492	
1.800 0.00 0.00 0.00 0.00 0.00 0.00 0.00							Test Results MDD (gm/cc) = OMC (%) =	1.6959 22.00
1.400							×	
•	18	20	22	24		2.6		
		Mois	ture Conten	t (%)				

- 5) California Bearing Ratio Test
- a) CBR Test With Noramal Black Soil

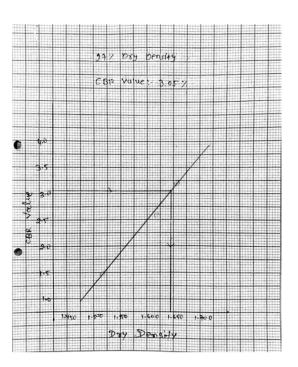
Laboratory Job	b No.	235		D	ate of S	ampling :	251021	24
Location/Sour	ce		O LHS	S	mpled t	w:	Teintly	
Type of Mater	ial :		Black	Inil T	ested by	:	Jointly	
Proposed use:		- martinuc	Durk A		ate of C	esting :	28/021	24
Period of Soal					ate of Te		03/03/2	u
	UNC:	96 Hou		10	ate of 16	sury.	22/02/2	
HOISTURE CO	ONTENT AND UNIT W		MPLES		Moul	d No. of 5	Mo	uld No. 96
No. of lavers		5	in and	5		E	5	5
No. of blows per	laver	10	10	2	0	30	65	65
CONDITION OF	SAMPLE	Before soaking	After soaking	Before s		After soaking	Before soaking	After soaking
Wt. of Mould, W		6995	6995	796	0	7960	6885	6885
Wt. of Wet Same	ple + Mould, W ₂ (am)	11072	11122	123		12424	11441	11493
	ple, W1=(W2-W1) (gm)	LIDY	LIDY	UU.		4464	4556	4608
Volume of moule		2250	2250	220		2250	1250	0250
Wet Density, Y.		1.812	1.834	1.9		1.984	2.025	2.048
MOISTURE DET		Before soaking	After soaking	Before so		After soaking	Before soaking	After soaking
Container No.		1	Y	2		4	5	6
Wt. of container	r, W _s (gm)	47.31	48,90	48,7	1	46.31	46.29	48.87
	ple +Cont., Ws (gm)	241,15	345.55	348	- 35	350.3	1 353.45	312.33
Wt. of Dry Samp	ple + Cont., W ₇ (gm)	289.31	281.90	293	171	292,71	298.29	261.87
Wt. of water, W	(g=(Wg-W)) (gm)	51.84	57.65	54	64	58.03	55.16	50.46
Wt. of Dry Sam	ple, W _s =(W ₇ -W ₅) (gm)	242.0	239.0	245	0	246.0	252.0	213.0
Moisture conten	t W = W,/W, (%)	21.42	24.12	22.	30	23.59	21,89	23.69
Dry Density Ye	= Y _b /(1+ w/100) (gm/cc	1.492	1,418	1.61	õ	1.605	1.661	1.656.
LOAD- PENET	TRATION TEST DATA :							
Proving rin	g No.:		ng Ring Calibrat	ion Facto				
		Mou	Id No. V			1 No. 95		id No. 96.
C. 10.	Departmention (mm)				Reading			
Sr.No.	Penetration (mm)	Proving ring Reading		Proving ring		Contected load (*	g) Proving ring Reading	Corrected load (Kg)
1	0.5	Proving ring Reading	3.35	Proving ring		10.05	3	10.05
1 2	0.5	Proving ring Reading	3.35	35	-	10.07		10.05
1 2 3	0.5 1.0 1.5	2	3,35	1147	-	10.05	3	10.0T 20.10 26.80
1 2 3 4	0.5 1.0 1.5 2.0	Proving ring Reading 1 2 3 4	3,35	1147w	-	10.05	36	10.0T 20.10 26.80 33.50
1 2 3 4 5	0.5 1.0 1.5 2.0 2.5	2	3.35	MAT WO	-	10.05	3 6 10 12	10.0T 20.10 26.50 33.50 40.20
1 2 3 4 5 6	0.5 1.0 1.5 2.0 2.5 3.0	1234	3.35 6.70 10.05 13.40 16.75 20.10	147001	-	10.05 16.75 23.05 26.80 33.50 36.85	3 6 10 12	10.01 20.10 26.50 33.50 40.20 U3.55
1 2 3 4 5 6 7	0.5 1.0 1.5 2.0 2.5 3.0 4.0	1234567	3,35 6,70 10,05 13,40 16,75 20,10 23,45	14T 0 0 1 3	-	10.05 16:75 23.05 26:80 33.50 36:85 46:95	3 6 10 12 13	10.01 20.10 26.20 33.50 40.20 U3.55 53.60
1 2 3 4 5 6 7 8	0.5 1.0 1.5 2.0 2.5 3.0 4.0 5.0	234567	3,35 6,70 13,40 13,40 16,75 20,10 23,45 26,80	14Tw01274		10.07 16.75 23.05 26.80 33.50 36.85 46.95 46.95	3 6 10 12 13 16	10.01 20.10 26.20 33.50 40.20 U3.55 53.60 60.30
1 2 3 4 5 6 7	0.5 1.0 1.5 2.0 2.5 3.0 4.0	1 2 3 4 5 6 7 8 10	3,35 6-10,55 13,40 13,45 20,45 23,45 24,80 23,45 24,80 23,50	1 WT & 0 1 1 1 4 9	-	10.07 16.75 23.05 23.05 33.50 36.85 46.95 53.60 53.60		10.01 20.10 26.20 33.50 40.20 U3.55 53.60
1 2 3 4 5 6 7 8 9	0.5 1.0 1.5 2.0 2.5 3.0 4.0 5.0 7.5	234567	3,35 6,70 13,40 13,40 16,75 20,10 23,45 26,80	14Tw01274		10.07 16.75 23.05 26.80 33.50 36.85 46.95 46.95	3 6 10 12 13 16 18 21 21	10.01 20.10 26.20 33.50 40.20 43.55 40.20 43.55 53.60 60.35
1 2 3 4 5 6 7 8 9 10	0.5 1.0 1.5 2.0 2.5 3.0 4.0 5.0 7.5 10.0 12.5 LATION	1 2 3 4 5 6 7 8 10 11 11	3.35 6.70 10.05 13.45 20.10 23.4500 23.4500 23.4500 23.4500 23.4500 23.4500 23.4500 23.4500 23.4500 23.4500 23.45000 23.45000000000000000000000000000000000000	1 WT @ 0 1 2 4 9 0	-	10.07 16.75 23.05 23.05 31.50 36.85 46.95 53.60 53.60 53.65		10.01 20.10 26. 60 33.50 40.20 40.20 40.20 40.40 60.40 70.35 70.35
1 2 3 4 5 6 7 8 9 10 11 CBR CALCU	0.5 1.0 1.5 2.0 2.5 3.0 4.0 5.0 7.5 10.0 12.5 12.5 12.5 12.5 12.5 12.5 12.5 12.5 12.5 12.5 13.0 12.5 13.0 13.5 13.	1 2 3 4 5 6 7 8 10 11 11	3, 30 3, 10 10, 00 10, 00	10 11 14 16 19 20 20 Note:		10.07 16.75 23.05 23.05 31.50 36.85 46.95 53.60 53.60 53.65	10 12 13 14 14 21 21	10.01 20.10 26. 60 33.50 40.20 40.20 40.20 40.40 60.40 70.35 70.35
1 2 3 4 5 6 7 8 9 10 11	0.5 1.0 1.5 2.0 2.5 3.0 4.0 5.0 7.5 10.0 12.5 ILATION Corrected Unit Load In Log Internet Control	1 2 3 4 5 6 7 7 8 10 11 11 11 11 11 25 mm 5.0 mm	3.35 6.10 10.65 13.40 16.15 23.45 23.45 23.45 23.45 36.85 36.85	10 11 14 16 19 20 22 Note: 1) Grap	th for los	10.05 16.75 23.05 23.05 36.85 46.96 53.60 53.60 67.0 73.7 dvs penetratio	10 12 13 14 14 21 21	10.01 20.10 26. 60 33.50 40.20 40.20 40.20 40.40 60.40 70.35 70.35
1 2 3 4 5 6 7 8 9 10 11 CBR CALCU	0.5 1.9 2.0 2.5 3.0 4.0 5.0 7.5 10.0 12.5 LUTON Corrected Unit Load in funding spot) 2.5 mm	1 2 3 4 5 6 7 7 8 10 11 11 11 11 25 mm 50 mm 1,22 1: -20	3.35 6.10 10.65 13.40 16.15 23.45 23.45 23.45 23.45 36.85 36.85	10 11 14 16 19 20 22 Note: 1) Grap	h for los	10.05 16.75 23.05 26.80 36.85 96.95 96	3 6 8 10 12 13 16 21 21 21 21 21 21 21	10.01 20.10 26.20 33.50 40.20 40.20 40.30 53.60 40.30 70.37 73.40 70.37
1 2 3 4 5 6 7 8 9 10 11 CBR CALCU	0.5 1.0 1.5 2.0 2.5 3.0 4.0 5.0 7.5 10.0 12.5 ILATION Corrected Unit Load In Log Internet Control	1 2 3 4 5 6 7 7 8 10 11 11 11 11 25 mm 50 mm 1,22 1: -20	3.35 6.10 10.65 13.40 16.15 23.45 23.45 23.45 23.45 36.85 36.85	10 10 11 14 16 19 20 22 Note: 1) Grap 2) CBR	h for los	10.05 16.75 23.05 26.80 36.85 96.95 96	3 6 10 12 13 14 15 16 18 21 21 21 22 21 22 21 22 21 22 21 22 21 22 21 22 21 21	-10.01 20.00 26.00 33.50 40.20 40.20 53.60 60.40 70.35 73.40 70.35





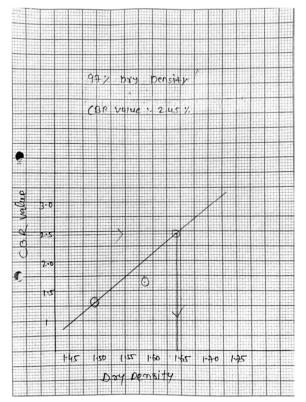
b) CBR Test with Geotextile

			CALIFORNI IIS 2220 (PA	A BEARING P	RATIO			
Laboratory		235	L'arrieff a		Sampling :	25/02	124	
Location/S			100 LHS	Sampled	by:	Jointly		
Type of Ma	aterial :	huth	textile	Tested b		Tointly		
Proposed u	ise:	nun	intelle	Date of (
Period of S	ioakino:	96 1				4103124		
	CONTENT AND UNIT	WEIGHT OF TEST	AMPLES	Date of 1	resting :	81031'21		
No. of layers		Mc	uld No. 25	Mou	ild No. 26		1d No. 34	
No. of blows		5	5	5	5	5	E	
CONDITION		10	10	30	30	65	65	
WL of Mould		Before soaking	After soaking	Before soaking	After soaking	Before soaking	After soaking	
	ample + Mould, W ₂ (gm)	6741	6741	6880	6880	1010	1070	
	ample + Hould, W ₂ (gm) ample, W ₂ =(W ₂ -W ₁) (gm)	10913	11016	11346	11403	11613	11620	
Volume of ma			4275	4466	4523	4543	4550	
	vuid, V (cc) Y ₈ = Wy/V (gm/cc)	2250	2250	2250	2250	2250	2250	
	Y ₆ = W ₃ /V (gm/cc) ETERMINATION	1.854	1.900	1.985	2.010	2.109	2.022	
Container No.		Before soaking	After soaking	Before soaking	After soaking	Before soaking	After soaking	
Wt. of contain		5	6	22	26	25	22	
	mole +Cont., W ₄ (gm)	45.30	46.80	43.61	48.70	48.71	46.23	
Wt. of Dev Sa	mple + Cont., W ₁ (gm)	292.56	292.06	310.58	353.95	307.01		
	Ws=(Ws-W) (gm)	248.86	242.65	262.81	294.55	261.25	254.12	
		43.70	49.41	41.71	59.40	45.76	46.01	
						010 01		
Wt. of Dry Sar Moisture contr	mple, W _s =(W ₇ -W ₅) (gm)	20356	195.85	216.56	245.85	212.54	210.89	
Moisture contr	ent W = Wy/W, (%)	21.47	25.23	22.03	24.16	212.54	22.13	
Moisture contr Dry Density Y,	mple, $W_{9}=(W_{7}-W_{5})$ (gm) ent $W = W_{9}/W_{4}$ (%) $_{g} = Y_{5}/(1 + w/100)$ (gm/ccc ETRATION TEST DATA :	21.47						
Moisture contr Dry Density Y,	ent $W = W_y/W_s$ (%) $_s = Y_b/(1 + w/100)$ (gm/cc ETRATION TEST DATA :	21.47	25.23	22.03	24.16	21.53	22.13	
Moisture contr Dry Density Y, LOAD- PENE Proving ri	ent W = Wy/W. (%) = Y ₀ /(1+ w/100) (gm/cc ETRATION TEST DATA : ng No.:	21.47 1.526 Provi	25.23	22.03	24.16	21.53	22.13	
Moisture conte Dry Density Y, LOAD- PENE Proving ri Sr.No.	ent W = Wy/W ₄ (%) ₁ = Y ₂ /(1+ w/100) (gm/ccc ETRATION TEST DATA : ng No.: Penetration (mm)	21.47 1.526 Provi	25.23 1.517 ing Ring Calibrat	22.03 1.627 ion Factor :	24.16	21.53	22.13	
Moisture contr Dry Density Y, LOAD- PENE Proving ri Sr.No.	ent W = W _y /W ₁ (%) = Y _y /(1+ w/100) (gm/ccc ETRATION TEST DATA : ng No.: Penetration (mm) 0.5	21.47 1.526 Provi	25.23 1.517 ing Ring Calibrat	22.03 1.627 ion Factor : Moul Proving ring Reading	24.16	21.53 1.661 Mou	22.13 1.656 dNo. 34	
Moisture contr Dry Density Y, LOAD- PENE Proving ri Sr.No. 1 2	ent W = W _y /W ₁ (%) = Y _y /(1+ w/100) (gm/cc ETRATION TEST DATA : ng No.: Penetration (mm) 0.5 1.0	21.47 1.526 Proving ring Reading 1 3	AS 23 1.517 ing Ring Calibrat Ad No. 25 Corrected load (Kg)	22.03 1.627 ion Factor : Moul	2.4.16 1.619 d No. 26 Corrected laad (Kg)	21.53 J.66 J Mou Proving ring Reading	22.13 1.656 d No. 3.4 Corrected load (Kg	
Moisture contr Dry Density Y, LOAD- PENE Proving H Sr.No. 1 2 3	ent W = W _p /W ₄ (%) _g = Y _p /(1+ w/100) (gm/cc TTRATION TEST DATA : ng No.: Penetration (mm) 0.5 1.0 1.5	21.47 1.526 Proving ring Reading 1 3 4	25.23 1.517 ing Ring Calibrat dd No. 25 Corrected load (Kg) 3,35	22.03 1.627 ion Factor : Moul Proving ring Reading	24.16 1.619 1.619 10.26 Corrected laad (Kg) 10.05	21 . 53 1 . 66 1 Mou Proving ring Reading 3 6 9	22.13 1.656 d No. 3.4 Corrected load (Kg 10:05	
Moisture contr Dry Density Y ₁ LOAD- PENE Proving ri Sr.No. 1 2 3 4	ent W = W _y /W ₄ (%) = Y _y /(1+ w/100) (gm/cc TRATION TEST DATA : ng No.: Penetration (mm) 0.5 1.0 1.5 2.0	21.47 1.526 Provi Proving ring Reading 1 3 4 5	25.23 1.517 ing Ring Calibrat idd No. 25 (corrected load (Kg) 3.35 10.05	22.03 1.627 ion Factor : Mouil Proving ring Reading 3 4 5 7	24.16 1.619 1.619 10.026 (Kg) 10.02 13.40 16.75 23.45	21.53 1.661 Mou Proving ring Reading 3 6 9 11	22.13 1.656 d No. 3.4 Corrected load (Kg 20.10 30.15 36.85	
Moisture contr Dry Density Y ₁ LOAD- PENE Proving ri Sr.No. 1 2 3 4 5	ent W = W _y /W ₄ (%) = Y ₀ /(1+ w/100) (gm/cc TRATION TEST DATA : ng No.: Penetration (mm) 0.5 1.0 1.5 2.0 2.5	21.47 1.526 Proving ring Reading 1 3 4	25-23 1-517 ing Ring Calibrat 40 No. 25 Corrected load (Kg) 3.35 10.05 13.40 16.75 20.1	22.03 1.62.7 ion Factor : Moul Proving ring Reading 4 5	24:16 1.619 d No. 26 Corrected load (Kg) 10.05 13.4D 16.75 23.45 23.45	21.53 1.661 Mou Proving ring Reading 3 6 9 11 13	22.13 1.656 d No. 3.4 Corrected load (Kg 20.10 30.15 36.65 43.5	
Moisture contr Dry Density Y, LOAD- PENE Proving ri Sr.No. 1 2 3 4 5 6	ent W = Wy/W ₄ (%) = Y ₂ /(1+ w/100) (gm/cc TTRATION TEST DATA : ng No.: Penetration (mm) 0.5 1.0 1.5 2.0 2.5 3.0	21.47 1.526 Proving rag Reading 1 3 4 5 6 1	25-23 1.517 ing Ring Calibrat dd No. 25 corrected load (kg) 3.35 10.05 13.40 16.75 20.1 23.45	22.03 I.627 ion Factor : Moul Proving ring Reading 4 4 5 7 9 1 1	24.16 1.619 1.619 10.05 13.40 14.75 23.45 36.85	21.53 1.661 Proving ring Reading 3 6 9 11 13 14	22.13 1.656 d No. 34 Corrected load (Kg 10.05 20.10 30.15 36.85 U3.5 U6.90	
Moisture contr Dry Density Y, LOAD- PENE Proving rit Sr.No. 1 2 3 4 5 6 7	ent W = WyW.(%) = V ₂ /(1+ w/100) (gm/cc TRATION TEST DATA : ng No.: Penetration (mm) 0.5 1.0 1.5 2.0 2.5 3.0 4.0	21.47 1.526 Proving rang Reading 1 3 4 5 6 8	25.23 1.5]7 ing Ring Calibrat dd No. 25 (concted load (Kg) 3.35 13.40 16.75 20.1 23.45 26.8	22.03 1.627 ion Factor : Moul Proving ring Reading 9 9 1 1 2	24.16 1.619 1.619 10.05 13.40 16.75 23.45 20.15 36.85 40.2	21,53 1,661 Mou Proving ring Reading 3 6 9 11 13 14 16	22.13 1.656 dNo. 34 Corrected load (Kg 10.05 20.10 30.15 36.65 43.60 33.60	
Moisture contr Dry Density Y, LOAD- PENE Proving rit Sr.No. 1 2 3 4 5 5 6 7 8	ent W = WyWx(%) = "y/(1* w/00) (gm/cc/ transformation (mm) 0.5 1.0 2.0 2.5 3.0 4.0 5.0	21.47 1.526 Proving ray Reading 1 3 4 5 6 7 8 9	25.23 1.517 ing Ring Calibrat at No. 25 constel kad (14) 3.35 13.40 13.40 16.75 20.1 23.45 26.8 30.15	22.03 1.627 ion Factor : Moul Proving ring Reading 9 1 1 1 1 1 5	24.16 1.619 d No. 26 Conected laad (Kg) 10.05 13.40 16.75 23.40 23.45 30.15 36.85 40.2 (0.25	21,53 1,661 Mou Proving ring Reading 3 6 9 11 13 14 16 18	22.13 1.656 allo. 34 Corrected load (Kg 20.10 30.15 36.65 43.5 46.90 43.60 60.30	
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Moisture contr Dry Density Y, LOAD- PENE Proving rit Sr.No. 1 2 3 4 5 5 6 7 8	ent W = WyWx(%) = "y/(1* w/00) (gm/cc/ transformation (mm) 0.5 1.0 2.0 2.5 3.0 4.0 5.0	21.47 1.526 Proving reading Proving reading 1 3 4 4 5 6 7 10 11	25.23 1.517 ing Ring Calibrat da No. 25 Control bad (M) 3.35 10.05 13.40 16.75 20.1 23.45 30.15 30.15 3.6.85	22.03 1.627 ion Factor : Moul Paving mg Reading 9 1.1 1.2 1.5 1.8 1.9 1.9	24.16 1.619 1.619 10.05 13.40 16.15 23.45 36.85 40.2 50.25 61.3 63.65	21.53 1.661 Mou Proving ring Reading 3 6 9 11 13 14 16 16 18 21 23	22.13 1.656 atro. 3.4 Corrected load (Kg 20.10 30.15 36.65 43.5 46.95 3.60 60.30 40.35 77.05	
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Moisture contr Dry Density Y, LOAD- PENE Proving ri Sr.No. 1 2 3 4 4 5 6 6 7 8 8 9 9 10 11	erk W = WyWr (%) = V/(12 + w/10) (pm/c) TRATION TEST DATA : Penetation (mm) 10 15 15 20 23 30 40 50 50 75 50 25 50 100 125 LGTTOH Una Load in Usad	21.47 1.526 Proving rang Reading 1 3 4 4 5 6 7 7 7 8 9 10 11 10 11 10 11 10 11 10 11 10 10	25.23 1.517 ing Ring Calibrat da No. 25 Control bad (M) 3.35 10.05 13.40 16.75 20.1 23.45 30.15 30.15 3.6.85	22.03 1.627 ion Factor : Mouth Proving ring Reading 3 4 4 7 7 7 9 11 12 15 18 19 20 Note: 1) Graph for los	24.16 1.619 1.619 1.619 1.619 1.0.05 1.3.40 1.4.40 1.3.40 1.5.40 1.3.40 1.5	21.53 1.661 Mou Proving ring Reading 3 6 9 11 15 16 18 21 24 ttached	22.13 1.656 atro. 3.4 Corrected load (Kg 20.10 30.15 36.65 43.5 46.95 3.60 60.30 40.35 77.05	
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c) CBR Test with Fibre

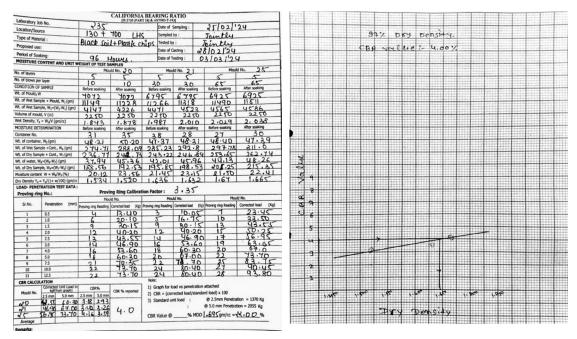
			CALIFORNIA	BEARING R			
Laboratory	y Job No.	235	[KT/#(FAR)	Date of S	ampling :	15/02/	124
Location/S	Source	130+	too LH	IC Sampled h		Jointly	
Type of M		Linth				Joint	4
	Proposed use:		JUDICE		esting :	08/03	1/24
	the second se				an a la seten deservation and the		19.21
Period of 5			lowis	Date of Te	isting :	12/031	14
MOISTUR	E CONTENT AND UNIT W			Maul	16 .0M	Mouk	ING. 35
No. of layers			10 No. 32	5	Í	5	6
No. of blows	per laver	10	10	30	30	65	65
CONDITION	OF SAMPLE	Before scaking	After soaking	Before soaking	After soaking	Before soaking	After soaking
WL of Mould	LW.	6959	6959	1910	7910	7005	1005
WL of Wet S	ample + Mould, W ₂ (gm)	1097	11164	12211	12334	11521	11513
	Sample, Wy=(W_1-W_1) (gm)	4138	4205	4367	4424	4516	4568
Volume of m		2200	2250	2250	2250	2250	2250
	Ya = WyV (pm/cc)	1.839	1.869	1.941	1.966	2.001	2.030
	ETERMINATION	Before soaking	After soaking	Before soaking	After soaking	Before soaking	After soaking
Container No		28	24	26	33	39	38
Wt. of contai	ner, W ₃ (gm)	49.80	48.15	U.8. 87	48.69	47.31	u7.37
Wt. of Wet S	ample +Cont., W, (gm)	330 34	316.85	324.15	317.36	968.67	352.28
Wt. of Dry Sa	ample + Cont., W, (gm)	219.94	263.2	282.99	265. 27	310.62	293.88
	W_=(WW_) (om)	50.40	53.65	51.16	52.09	58.05	58.40
WL of Dry Sa	ample, W,=(W,-W,) (gm)	230.14	215.05	234.12	216.58	263.25	246.5
	tent W = Wa/W. (%)	21.90	24.95	21.85	24.05	22.05	23.69
	(a = Y _b /(1+ w/100) (gm/cc	1.009	1.496	1.593	1.585	1.644	1.64
	ETRATION TEST DATA :						
Proving r	ing No.:	Provi	ng Ring Calibrat	tion Factor :			
		Mou	1d No. 32	Mou	Ad No. 31	Mox	NO. 35
Sr.No.	Penetration (mm)	Proving ring Reading	Corrected load (Kg)	Proving ring Reading	Corrected load (Kg	Proving ring Reading	
1	0.5	1	3.35		3.35	3	10.05
2	1.0	2	A.YO	3	10.05	5	16.15
3	1.5	3	10.05	Ŷ.	13,40	1	23.45
4	2.0	4	13.40	5	16.75	8	26.80
5	2.5	5	16.45	6	20.10	10	33.50
6	3.0	6	20.10	7	23.45	1 11	36.85
	4.0	1	23.45	9	30.15	14	46.90
7	5.0	8	26.80	18	33.50		50.25
8			.30.15		43.53		60.30
8	7.5	9	10 00			19	63.65
8 9 10	10.0	10	33.50	14	46.90		
8 9 10 11	10.0		33.50	14	46.9	0 20	67.00
8 9 10	10.0 12.5 ULATION	10	33.50	Note:	46.9		67.00
8 9 10 11 CBR CALCO	10.0 12.5 ULATION Corrected Unit Load in	10 10 CBR%	33.50	Note: 1) Graph for k	LI 6.9	n attached	67.00
8 9 10 11 CBR CALCO Mould No.	10.0 12.5 ULATION Corrected Unit Load in Log(from graph) 2.5 mm 5.0 mm	10 10 088% 2.5 mm 5.0 mm	33.50	Note: 1) Graph for k 2) CBR = (cor	u 6.9	n attached lard load) x 100	
8 9 10 11 CBR CALCO Mould No.	10.0 12.5 ULATION Corrected Unit Load in kdt from graph 2.5 mm 5.0 mm 16.4 (4.6 × 80)	10 10 25 mm 5.0 mm 1-22 \$30	33.50 33.5D	Note: 1) Graph for k	u 6.9	n attached Sard Ioad) x 100 @ 2.5mm Peneti	ration = 1370 Kg
8 9 10 11 CBR CALCO Mould No.	10.0 12.5 ULATION Corrected Unit Load in keft from graph 2.5 mm 5.0 mm 16.4 (10 10 25 mm 5.0 mm 1-22 130 1-97 1-63	33.50	I U Note: 1) Graph for k 2) CBR = (cor 3) Standard u	uad vs penetratio rected load/stand init load : ;	n attached Sard Ioad) x 100 @ 2.5mm Penetr @ 5.0 mm Penetr	ration = 1370 Kg ation = 2055 Kg
8 9 10 11 CBR CALCO Mould No.	10.0 12.5 ULATION Corrected Unit Load in kdt from graph 2.5 mm 5.0 mm 16.4 (4.6 × 80)	10 10 25 mm 5.0 mm 1-22 130 1-97 1-63	33.50 33.5D	I U Note: 1) Graph for k 2) CBR = (cor 3) Standard u	uad vs penetratio rected load/stand init load : ;	n attached Sard Ioad) x 100 @ 2.5mm Peneti	ration = 1370 Kg ation = 2055 Kg



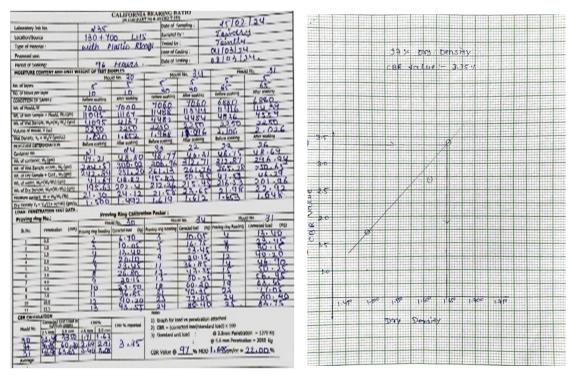


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d) CBR Test Black with Plastic Bottle Chips



e) CBR test with Plastic Bottle Ring



IV. RESULT ANALYSIS

A. Free Swell Index Result Analysis

Here's an analysis of the Free Swell Index test results :

- Free Swell Index: The Free Swell Index of the soil sample is 57.70%. A free swell index greater than 30% indicates a high swelling potential
- Interpretation:



The high Free Swell Index suggests that the soil sample has a high potential to swell when saturated with water. This can cause problems with foundations and other structures built on this soil, as the swelling soil can cause cracking and movement.

B. Liquid Limit Result Analysis

Atterberg Limits

- Liquid Limit (LL): The Liquid Limit is 65.50%. This is the moisture content at which the soil changes from a liquid state to a plastic state
- Plastic Limit (PL): The Plastic Limit is 27.40%. This is the moisture content at which the Soil changes from a plastic state to a brittle state .
- Plasticity Index (PI): The Plasticity Index (PI) is calculated as the difference between the
- Liquid Limit (LL) and the Plastic Limit (PL). In this case, the PI is 65.50% 27.40% = 38.10%. A higher PI value indicates a more plastic soil.

C. Grain Size Analysis Result Analysis

Here's an analysis of the grain size distribution:

- Gravel(75-19 mm): 1.60% of the sample falls into the gravel size category.
- Sand (4.75-0.075 mm): 10.9% of the sample falls into the sand size category. This can be Further broken down into: Coarse sand (4.75-2.00 mm): 0.90% ,Medium sand (2.00-0.425 mm): 4.7% &Fine sand (0.425-0.075 mm): 5.3%
- Silt and Clay (particles smaller than 0.075 mm): 87.5% of the sample falls into the silt And clay size category.
- D. Modified Proctor Test Result Analysis
- Dry Density (g/cm³): The data sheet shows the Dry Density for five different moisture Content values. The Dry Density increases as the moisture content increases up to a certain Point, and then starts to decrease. The highest Dry Density is 1.695 g/cm³ at a moisture Content of 22.00%, which is considered the Maximum Dry Density (MDD).
- Optimum Moisture Content (OMC): The Optimum Moisture Content (OMC) is the Moisture content at which the Maximum Dry Density (MDD) is achieved. In this case, the OMC is 22.00%

E. Cbr Test Result Analysis Noramal Black Soil

The report shows the results of the CBR test for three soil samples (moulds 24, 25, and 26).

The CBR values for the three samples are:

- Mould 24: 16.75 corrected load at 2.5 mm penetration, 26.80 corrected load at 5.0 mm Penetration
- Mould 25: 33.50 corrected load at 2.5 mm penetration, 53.60 corrected load at 5.0mm penetration
- Mould 26: 40.20 corrected load at 2.5 mm penetration, 60.30 corrected load at 5.0 mm penetration
- The CBR values are all relatively low, which indicates that the soils are weak and may not be Suitable for use in pavements without additional treatment. The report does not specify what The soils will be used for, but the CBR values are typically used to design the thickness of Pavement layers.
- CBR VALUE IS :- 2.82%

F. CBR Test Result Analysis Black Soil + Geotextile

The report shows the results of the CBR test for three soil samples (moulds, 25, 26, and 34). The CBR values for the three samples are:

- Penetration Mould 25: 20.10corrected load at 2.5 mm penetration, 30.15 corrected Load at 5.0 mm
- Penetration Mould 26: 30.15 corrected load at 2.5 mmpenetratioloa50.25 corrected Load at 5.0 mm
- Penetration Mould 34: 43.55 corrected load at 2.5 mm penetration, 60.30 corrected Load at 5.0 mm
- Penetration The CBR values are all relatively low, which indicates that the soils are weak and

May not be suitable for use in pavements without additional treatment. The report does not Specify what the soils will be used for, but the CBR values are typically used to design the Thickness of Pavement layers CBR VALUE IS :- 3.05%



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G. CBR Test Result Analysis Black Soil + Fiber

The report shows the results of the CBR test for three soil samples (moulds, 33, 31, and 35). The CBR values for the three samples are:

- Penetration Mould 33: 16.75 corrected load at 2.5 mm penetration, 26.80 corrected load at 5.0 mm
- Penetration Mould 31: 20.10 corrected load at 2.5 mm penetration, 33.50 corrected load at 5.0 mm
- Penetration Mould 35: 33.50 corrected load at 2.5 mm penetration, 50.25 corrected load at 5.0 mm
- Penetration The CBR values are all relatively low, which indicates that the soils are weak and may not be suitable for use in pavements without additional treatment. The report does not specify what the soils will be used for, but the CBR values are typically used to design the thickness of Pavement layers
- CBR VALUE IS :- 2.40%

H. CBR Test Result Analysis Black Soil + Plastic Chips

The report shows the results of the CBR test for three soil samples (moulds, 20, 21, and 25). The CBR values for the three samples are:

- Penetration Mould 20: 43.55 corrected load at 2.5 mm penetration, 60.30 corrected load at 5.0 mm
- Penetration Mould 21: 46.90 corrected load at 2.5 mm penetration, 67.00 corrected load at 5.0 mm
- Penetration Mould 25: 56.95 corrected load at 2.5 mm penetration, 73.70 corrected load at 5.0 mm
- Penetration The CBR values are all relatively low, which indicates that the soils are weak and may not be suitable for use in pavements without additional treatment. The report does not specify what the soils will be used for, but the CBR values are typically used to design the thickness of Pavement layers
- CBR VALUE IS : 4.00 %

I. CBR Test Result Analysis Black Soil + Plastic Rings

The report shows the results of the CBR test for three soil samples (moulds, 30, 34, and 31). The CBR values for the three samples are:

- Penetration Mould 25: 23.45 corrected load at 2.5 mm penetration, 33.50 corrected load at 5.0 mm
- Penetration Mould 26: 36.85 corrected load at 2.5 mm penetration, 60.30 corrected load at 5.0 min
- Penetration Mould 34: 46.90 corrected load at 2.5 mm penetration, 63.65 corrected load at 5.0 mm
- Penetration The CBR values are all relatively low, which indicates that the soils are weak and May not be suitable for use in pavements without additional treatment. The report does not Specify what the soils will be used for, but the CBR values are typically used to design the Thickness of Pavement layers
- CBR VALUE IS :- 3.35 %

V. CONCLUSION

Black cotton soil, despite its weakness, can be boosted for embankments using plastic waste. Crushed plastic or strips mixed in the soil improve its strength and reduce swelling. This creates a Stronger, more stable material for building embankments. However, this method doesn't address the core issue for subgrades – shrinkage and swelling with Moisture changes. Embankments sit above ground with less water exposure, but subgrades are Directly impacted by seasonal variations. The treated soil might still experience these drastic volume Changes, causing cracks and compromising the structural integrity of the road or building above. In short, plastic waste strengthens black cotton soil for embankments, but it doesn't address the Moisture sensitivity that plagues subgrades.

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