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Investigation of Sub Grade Properties of G. T. Road, Pir Pyai Area

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Abstract: Arrangement of the diverse black-top layers mostly depend on the nature of the layers over which they will be laid. Subgrade quality is for the most part conveyed similarly as CBR (California Bearing Ratio). Weaker subgrade fundamentally obliges thicker layers however more grounded subgrade runs well with thinner black-top layers. The black-top and the subgrade usually must backing the development volume.Despite the way that a black-top's wearing course is most detectable, the accomplishment or frustration of a black-top is when in doubt subordinate upon the concealed subgrade i.e., the material whereupon the black-top structure is fabricated. Subgrade be made out of a broad mixture of materials but some are immeasurably enhanced than others in regards to kind of soil.The examination focus tests were performed for the determination of planning properties of soil, of Pir Pyai area, Nowshera. Consequently, the earth example was assembled structure "Pir Pyai Range, Nowshera" & passed on to CECOS soil mechanics research office. The example was protected from sunlight & air so that its moistness substance may retain.

Keywords: *Soil Density, Atterberg's Limits, Soil Gradation, Proctor Compaction Tests, California Bearing ratio*

Introduction:

The sub assessment is the layer of standard soil whereupon the dark top or sub base is made. Sub assessment soil offers sponsorship to whatever is left of the dark top structure. The method for the sub audit colossally influence the dark top design and the certifiable imperative vicinity of the dark top that is made. The significance of a not all that awful quality sub assessment to the entire arrangement presence of the dark top can't be downplayed.Sub grade properties are vital dark top format parameters. Materials routinely experienced in sub assessments are delineated by their quality and their impervious to mutilation under weight (endurance).

2. Investigational Procedure:

The following tests were used to characterize subgrade materials.

- Atterberg's Limits
- Soil gradation
- Proctor compaction tests
- California Bearing Ratio (CBR)

3. Testing Stage:

3.1 Atterberg's Limits:

This test was performed to focus the plastic and fluid breaking points of a fine grained soil. Past what numerous would consider conceivable (LL) is self-unequivocally depicted as the water content, in percent, at which a touch of soil in a standard compartment and cut by a despairing of standard estimations will stream together at the base of the wrinkle for a parcel of 13 mm (1/2 in.) when subjected to 25 trances from the glass being dropped 10 mm in a standard fluid most far off point device worked at a rate of two stuns reliably. Past what numerous would consider conceivable (PL) is the water content, in percent, at which an earth can never again be contorted by moving into 3.2 mm (1/8 in.) width strings without separating.

3.1.1 Standard Reference:

ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

3.1.2 Equipment:

Fluid most great gadget, Porcelain (scattering) dish, Flat cutting gadget with gage, eight saturation containers, Balance, Glass plate, Spatula, Wash compartment stacked with refined water, Drying stove set at 105^{o}C.

3.2 Determination of Grain Size Analysis:

This test was performed to focus the rate of grouped grain sizes contained inside of a dirt.

3.2.1 Equipment:

Parity of limit 15 Kg and affectability 1 gram.
Strainers 100mm, 75mm, 19mm, 4.75mm, 2mm, 425microns and 75 microns fitting in with IS: 460 (Part 1) 1978, Non-corrodible trays, Bucket 1no

3.2.2 Standard Reference:

ASTM D 422 - Standard Test Method for Particle-Size Analysis of Soils

3.3 Standard Proctor Compaction Test:

Proctor (1933) developed an examination focus compaction test framework to center the dry unit weight of compaction of soils, which can be used for determination of field compaction.

3.3.1 Equipment:

Compaction form, No. 4 U.S. strainer, Standard Proctor pound (5.5 lb), Balance delicate up to 0.01g, Balance touchy up to 0.1g, Large level dish, Jack, Steel straight edge, Moisture jars, Drying broiler, Plastic press bottle with water.

3.3.2 Standard Reference:

Standard AASHTO method (ASTM D 698)

3.4 Density of Soil By Core Cutter Method:

To focus the field or in-situ thickness or unit weight of soil by center cutter.

3.4.1 Equipment:

a) Special: Tube shaped center cutter, Steel rammer, Steel dolly.

b) General: Parity of capacity5 Kg and affectability 1 gm, Balance of limit 200gms and affectability 0.01 gms, Scale, Spade or pickaxe or crowbar, Trimming Knife, Oven, Water content holders, Desiccators.

3.4.2 Mathematical Representation:

Field density is defined as weight of unit volume of soil present in site. That is

$\gamma = W/V$

Where, γ = Density of soil
W = Total weight of soil
V = Total volume of soil

$$\gamma_d = \frac{\gamma_b}{1+w}$$

Where, γ_d = dry density of soil
γ_b= Wet density of soil
w = moisture content of soil.

Hear we use core cutter method, the equipment arrangement is shown as fallows

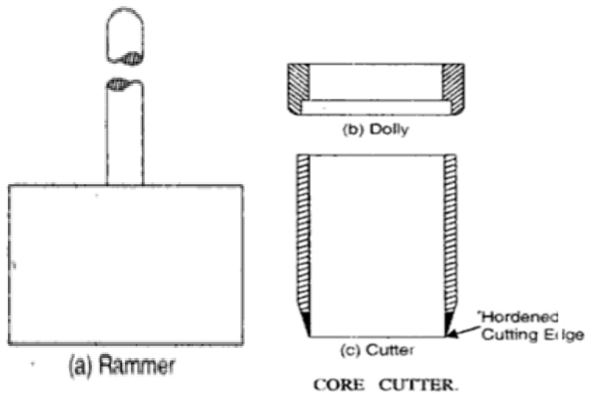

Fig. 1: Core Cutting Apparatus

3.4.3 Standard Reference:

Core cutter method (ASTM D 2937)

3.5 Determination of California Bearing Ratio Standard:

California bearing degree is the degree of power per unit zone anticipated that would go into a dirt mass with a circumlocutory plunger of 50mm estimation at the rate of 1.25mm/min

3.5.1 Equipment:

Molds 2250cc limit with base plate, stay shaft and wing nut declaring to 4.1, 4.3 and 4.4 of IS: 9669-1980, Collar demanding to 4.2 of IS: 9669-1980, Spacer Disk acknowledging to 4.4 of IS: 9669-1980, Metal rammer ensuring to IS: 9189-1979, Expansion measuring mechanical party with the versatile stem, punctured plates, tripod bearing witness to and to weights affirming to 4.4 of IS: 9669-1980, Loading machine having a most extreme of no under 5000kg and furnished with an adaptable head or base that goes at a uniform rate of 1.25mm/min for use in convincing the intrusion plunger into the case, Penetration plunger demanding to 4.4 of IS: 9669-1980, Dial gage two numbers inspecting to 0.01mm, IS sifters 37.50 or 22.50 or 19mm and 4.75mm, Miscellaneous device, for occasion, blending dish, straight edge, scales, soaking tank, drying stove, channel paper, dishes and balanced measuring holder. IS sifters 37.50 or 22.50 or 19mm and 4.75mm, Miscellaneous contraption, for occasion, blending dish, straight edge, scales, sprinkling tank, drying stove, channel paper, dishes and adjusted measuring compartment.

3.4.2 Standard Reference:

ASTM D1883 - 14

4.0 Results:

4.1 Atterberg Limits:

4.1.1 Liquid Limit Determination:

Table 1: Fluid limit Determination

Sample No.	1	2	3	4
MC = Mass of void, clean can + top (grams)	22.23	23.31	21.87	22.58
MCMS =Mass of can, top, and damp soil (grams)	28.56	29.27	25.73	25.22
MCDS = Mass of can, cover, and dry soil (grams)	27.40	28.10	24.90	24.60
MS = Mass of soil solids (grams)	5.03	4.79	3.03	2.02
MW = Mass of pore water (grams)	1.16	1.17	0.83	0.62
w = Percentage of Water Quantity	23.06	24.43	27.39	30.69
No. of drops (N)	31	29	20	14

4.1.2 Plastic Limit Determination

Table 2: Fluid breaking point Determination

Sample no.	1	2	3
MC = Mass of empty, clean can + lid (grams)	7.78	7.83	15.16
MCMS = Mass of can, lid, and moist soil (grams)	16.39	13.43	21.23
MCDS = Mass of can, lid, and dry soil (grams)	15.28	12 .69	20.43
MS = Mass of soil solids (grams)	7.5	4.86	5.27
MW = Mass of pore water (grams)	1. 11	0.74	0.8
w = Water content, w%	14.8	15.2	15.1

Plastic Limit (PL)
= Average w %
= $\frac{14.8 + 15.2 + 15.1}{3} = 15.0$

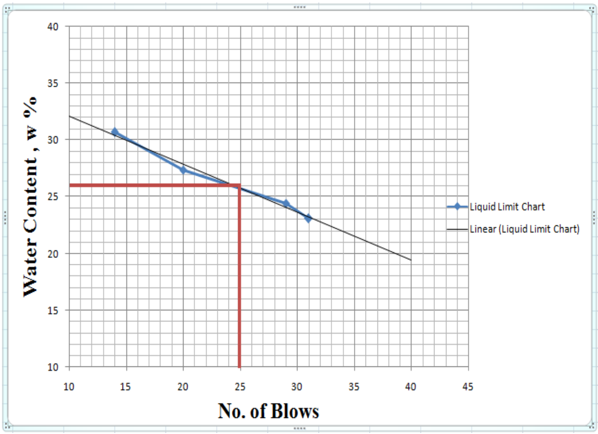

Fig. 2: Fluid Limit Chart

From the diagram
Liquid Limit = 26 %
Plastic Limit = 15 %
Plasticity Index =11
AASHTO Classification: Group: A-6
Soil Type: Clayey
General Rating as a Subgrade: Fair to poor
The soil was classified as CL according to Unified Soil Classification System.

4.2 Determination of Grain Size Analysis

Weight of sample=1000 gm

Table 3: Sieve Analysis Data

Sieve No	Sieve size (mm)	Wt of Soil (gm) retained	% wt retained	Cumulative % wt retained	% passing
#4	4.76	280	28	28	72
#10	2.00	150	15	43	57
#40	0.425	200	20	63	37
#50	0.300	80	8	71	29
#60	0.251	30	3	74	26
#100	0.150	50	5	79	21
#120	0.125	110	11	90	10
#200	0.075	15	1.5	91.5	8.5
PAN		85	8.5	100	0

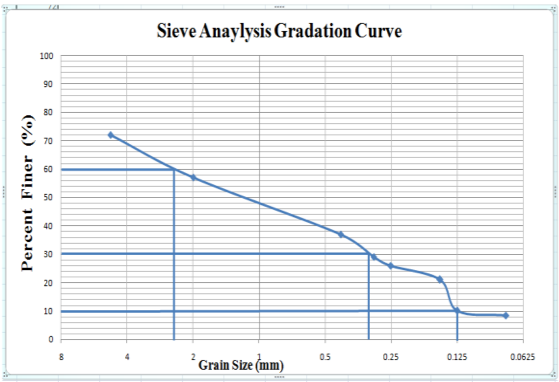

Fig. 3: Sieve Analysis Gradtion Curve

Coefficients of Uniformity, $C_{u:}$

$$C_u = \frac{D_{60}}{D_{10}}$$

D_{60} = 2.6mm D_{10} = 0.125 mm
C_u= 20.8
Coefficient of curvature, C_c:

$$C_c = \frac{(D_{30})^2}{D_{10} \times \ D_{60}}$$

D_{30} = 0.3 mm
C_c= 0.276

4.3 Standard Proctor Compaction Test:

4.3.1 Determination of water content:

w % (w = Ww/Wd x 100)

Table 4: Water Content

Sample No.	1	2	3	4
Wt of empty Container (gm)	23.3	24	27.3	25
Wt of empty Container + compacted soil gm)	55.8	56.2	58.1	57
Wt of Container + Dry soil (gm)	52.3	51.7	53.8	51.7
Wt of water (gm)	3.5	4.5	4.3	5.3
Wt of Dry soil (gm)	30	33.1	26.5	26.7
Water content, W%	11.66	13.6	16.22	19.85

4.3.2 Determination of Dry Density:

Table 5: Dry Density

Sample No.	1	2	3	4
Wt of empty mould (gm)	3395	3395	3395	3395
Wt of empty mould + Compacted Soil (gm)	4970	5215	5385	5235
Volume of mould (c.c)	945	945	945	945
Wt of Compacted Soil (gm)	1575	1820	1990	1840
Bulk Density , Ws/V (g/cc)	1.67	1.93	2.11	1.95
Dry density (pcf)	93.43	105.88	112.74	101.53

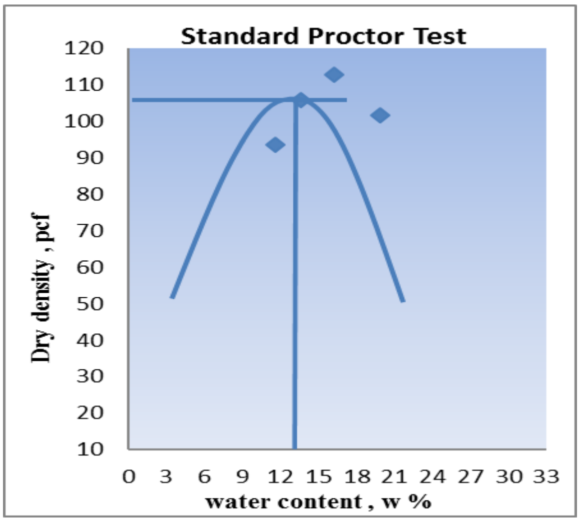

Fig. 4: Standard Proctor Test

4.4Determination of filed Density by Core Cutter Method:

Internal diameter of cutter: 10cm
Height of the cutter: 11.5 cm
Cross sectional area of the cutter: 78.54cm^2
Volume of the cutter, V: 903.2cm^3

Table 6: Field Density by Core Cutting Method

Sample	**1**	**2**	**3**
Wt of empty Cutter (W1)	735 gm	735 gm	735 gm
Wt of Cuter + Wet Soil (W2)	2200 gm	2350 gm	2500 gm
Volume of Cutter, V	903.2 cm^3	903.2 cm^2	903.2 cm^2
Wt of Wet Soil, W3 = W2-W1	1465gm	1615 gm	1765 gm
Bulk Density = W3/V	1.62 gm/c.c	1.79 gm/c.c	1.95 gm/c.c
Wt of empty Container	25 gm	24.8 gm	24.3 gm
Wt of Container + Wet Soil	100 gm	105 gm	110 gm
Wt of Container + Dry Soil	89 gm	96 gm	102 gm
Wt of Water, Ww	11 gm	9 gm	8 gm
Wt of Dry Soil, Wd	64 gm	71.2 gm	77.7 gm
Water Content, W	17.2 %	12.6 %	10.3 %
Dry Density	1.38 g/c.c	1.59 g/c.c	1.77 g/c.c
	Average dry density = 1.58 gm/c.cor 98.41 pcf		

4.5 Determination of California Bearing Ratio
4.5.1 CBR Sample 1

Area of plunger=11.66 cm^2
Providing Ring Reading
Ring Factor=2.28

Table 7: CBR Test Sample 1

No. of Blows	10	30	65
Mould + Sample (gm)	11205	11640	11870
Wt of Mould (gm)	6775	6750	6730
Volume (c.c)	2115	2110	2120
Wet Density (gm/c.c)	2.095	2.318	2.425
Dry Density (g/c.c)	1.80	1.991	2.083
Wt of Soil (gm)	4430	4890	5140

Table 8a: CBR Test 1

Penetration (mm)	**10 Blows**	**Load for Blows**	**Stress**
0.64	5	11.4	0.97770
1.27	10	22.8	1.95540
1.91	18	41.04	3.51972
2.52	27	61.56	5.27958
3.81	45	102.6	8.79931
5.08	60	136.8	11.7324
7.62	95	216.6	18.5763

Table 8b: CBR Test 2

Penetration (mm)	**30 Blows**	**Load for Blows**	**Stress**
0.64	10	22.8	1.95540
1.27	19	43.32	3.71526
1.91	30	68.4	5.86620
2.52	40	91.2	7.82161
3.81	60	136.8	11.7324
5.08	81	184.68	15.8387
7.62	125	285	24.4425

Table 8c: CBR Test 3

Penetration (mm)	**65 Blows**	**Load for Blows**	**Stress**
0.64	21	47.88	4.106346
1.27	48	109.44	9.385935
1.91	119	271.32	23.2693
2.52	183	417.24	35.78388
3.81	313	713.64	61.20412
5.08	403	918.84	78.80274
7.62	520	1185.6	101.681

5.1 Results:

The results of laboratory tests on soil of Pir Pyai area, Nowshera is summarized in the table 5.1.

Table 9: Subgarde Properties of Pir Paya Road

S. no	Test description	Result
1	Fluid Breaking Point	26%
2	Plastic Point of Confinement	15%
3	Pliancy List	11
4	Type of Soil, as per USCS and AASHTO	Cl
5	Optimum Moisture Content	16.4 %
6	Maximum Dry density	114.3 lb/ft^3
7	Field Density	98.41 lb/ft^3
8	Wet Density	110.9 lb/ft^3
9	CBR	7.65 %

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