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PROPERTIES OF SUB GRADE SOIL FOR PAVEMENT CONSTRUCTION

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ABSTRACT

This project deals with the study on properties of subgrade soil of pavement construction. During this project the layer thickness are going to be outlined counting on the soil type. Design of the varied pavement layers is incredibly abundant addicted to the strength of the sub grade soil over that they are reaching to be arranged. Sub grade strength is additionally counting on the essential properties of the soil. Weaker sub grade needs thicker layers whereas stronger sub grade needs thinner pavement layers. The pavement and also the sub grade reciprocally sustain the traffic volume. The Indian Road Congress (IRC) encodes the precise design strategies of the pavement layers based mostly upon the sub grade strength. The sub grade is often subjected to vary in its overflow or rise of groundwater level, capillarity action and moisture content due to rainfall. For associate engineer, it's vital to grasp the modification of sub grade strength because of variation of moisture content. This project is an attempt to grasp the essential properties of sub grade such as index properties, moisture content, Specific gravity and optimum moisture content (OMC) and maximum dry density (MDD).

KEYWORDS: Specific Gravity, Moisture Content, Index Properties, Maximum Dry Density (MDD) & Optimum Moisture Content (OMC).

I. INTRODUCTION

Road transport is a lone method for transport that offers itself to the entire group alike. It is acknowledged actuality that of the considerable number of modes the transportation, street transport is the closest to the general population. India is a rural nation. There are around 5.76 lakhs towns in India. The making of better access in country regions is an absolute necessity for the creating nations like India. In India the streets have been named national thruway, state roadway, significant areas street, other region street and town streets. In light of the assets accessible these streets are built with an assortment of material and differing development detail. The Rural roads are built with nearby material and are either cleared or unpaved. The decay of these streets is administered by the conduct of the road material and absence of upkeep exercises. These outcomes in rutting, pot gaps, folding and so on which makes a terrible shape and stances issues for the architects. Further, inadequate seepage, change in climate condition, expanded movement thickness and ineffectively evaluated material are the explanations behind the weakening which brings about higher expense of support for the repair procedure. Since the accessibility of assets is constrained, enhanced and cost successful procedures are to be considered to make the asphalt issue free.

Traditionally the planning of either quite pavement is predicated on the strength of the compacted soil within the pavement, known as sub grade. The planning of the pavement layers ordered over the sub grade soil starts off with the determination of sub grade strength and also the traffic volume that is to be carried. The planning of pavement is extremely abundant addicted to the sub grade strength of soil. A design criterion primarily wants thickness of layers. Weaker sub grade desires thicker layers whereas stronger sub grade desires Dilutant pavement layers. The Indian Road Congress (IRC) provides the exact procedures for the pavement layers design that primarily based upon the sub grade strength.

1.1 Sub Grade

Subgrade can be characterized as a compacted layer, by and large of normally happening neighborhood soil, just underneath the asphalt outside layer, giving an appropriate establishment to the asphalt. The subgrade in dike is compacted in two layers, generally to a higher standard than the bring down part of the dike the subgrade, whether in cutting or in dike, should be very much compacted to use its full quality and to manage on the in general asphalt thickness. The current MORTH Specifications require that the subgrade ought to be compacted to 100% MDD accomplished by the Modified Proctor Test (IS 2720-Part 8).

For both significant streets and rustic streets the material utilized for subgrade development ought to have a dry unit weight of at least 16.5kN/m3. Subgrade soil is a get-together or store of earth material, got normally from the breakdown of rocks or rot of undergrowth that can be unearthed promptly with force hardware in the field or crumbled by delicate reflex means in the research facility. The supporting soil beneath asphalt and its uncommon under course is called sub grade. Without intrusion soil underneath the asphalt is called common sub grade. Compacted sub evaluation is the dirt compacted by hindered development of overwhelming compactors. Taking after are the attractive Property of Subgrade Soil: Stability, Incompressibility, Permanency of quality, Minimum changes in volume and solidness under antagonistic states of climate and ground water, unrivaled waste, and Ease of compaction.

II. LITERATURE REVIEW

Mihai et al 2005 have done examinations on two sorts of soils with two compound items. The fundamental target is to explore the adjustment instrument of a portion of the monetarily accessible compound based items to comprehend their potential quality for street development. The soil tried for strainer examination and compaction. At that point the soil are treated with two sorts of Chemical with variable dose 0.5 cc, 1cc, 1.5cc/5 l. The consequence of the test demonstrated that soil treated with chemicals indicates negligible enhancements in strong modulus. The flexible modulus speaks to the solidness of the material tried. Testing comes about shows increment in the estimations of flexible modulus for the dirt's treated with Enzyme.After the expansion of protein the shear quality of soil additionally increments impressively.

Manoj Shukla et al (2003) have been made as broad study on five sorts of soils with low dirt substance to extremely mud content. These dirt specimens were tried for designing properties, Atterbergs limit, particular gravity, OMC and greatest dry thickness utilizing changed delegate test. The quality test, for example,CBR, UCC with and without the utilization of bio-chemical at various curing period. The asphalt plan thickness is assessed for chemical made soil tests for most extreme, CBR at ideal measurement and cost correlation graph

made with routine configuration and bioenzyme plan. He reasoned that bio-chemical adjustment has indicated little to high change in physical properties of soil.

Sharma (2001) has directed lab concentrates on utilization of Bio-Enzyme adjustment of three sorts of soils to be specific, dirt of high pliancy, mud of low versatility and sediment of low versatility. It was found that dirt demonstrates a minor change in CBR esteem and substantiates lessening in immersion dampness following four weeks of adjustment. The dirt demonstrates a peripheral change in unconfined compressive quality, direct elasticity and weariness quality.

II. EXPERIMENTAL INVESTIGATION

3.1 Laboratory Tests Conducted To Know the Soil Properities

The entire investigations have been conducted on three types of soil, i.e Clay soil (from Mahbubnagar district), Silt soil (from Karimnagar district) and red soil (from Nizamabad district)

There are distinctive sorts of lab tests directed on the given example. There are demonstrated as follows

1. Moisture content
2. Specific gravity
3. Atterberg limit
4. Compaction test

3.2 Determination of Moisture Content: (for clay soil, silts soil and red soil)

3.3 Need and Extent of the Experiment

In all soils tests natural moisture of the soils is to be resolved. The information of the natural moisture content is crucial in all investigations of soil mechanics. To locate a couple of, natural moisture content is utilized as a part of deciding the bearing limit and settlement. The natural moisture content will give a thought of the condition of soil in the field.

Definition:- The natural water content likewise called the natural moisture content is the proportion (ratio) of the heaviness (volume) of water to the heaviness (volume of the solids in a given mass of soil. This ratio is generally communicated as rate (%).

3.4 Observations

1. Clay soil,
2. Silt soil
3. Red soil

S. no	Details	Values (or) readings		
		Clay	Silt	Red
1	Weight of empty container + lid (w_1) gms	11	11	17
2	Weight of container + lid + wet soil(w_2) gms	83	59	64
3	Weight of container + lid+ dry soil(w_3) gms	66	50	56
4	Weight of water in sample (w_2-w_3) gms	17	9	8
5	Weight of dry sample (w_3-w_1) gms	55	39	-

The moisture content for clay soil = 30.9%

The moisture content for silt soil = 23.07%

The moisture content for red soil = 20.51%

3.5 Determination of Specific Gravity by Pycnometer

(For clay soil, silt soil and red soil) :- The Pycnometer is utilized for assurance of the specific gravity of soil particles of both fine grained and coarse grained soils. The specific gravity of soil is resolved utilizing the connection

The specific gravity for Clay soil = 2.67 – 2.9

The specific gravity for Silt soil = 2.65 – 2.7

The specific gravity for Red soil = 2.63 – 2.67

3.6 Determination of Liquid Limit: (For clay soil, silt soil and red soil)

3.7 Need and Scope

Liquid point of confinement is critical to know the anxiety history and general properties of the soil to met with development. From the consequences of liquid breaking point the pressure file might be assessed. The pressure list quality will help us in settlement investigation if the regular dampness substance of soil is nearer as far as possible, the dirt can be considered as delicate if the dampness substance is lesser than liquid limit of confinement. The soil is weak and stiffer.

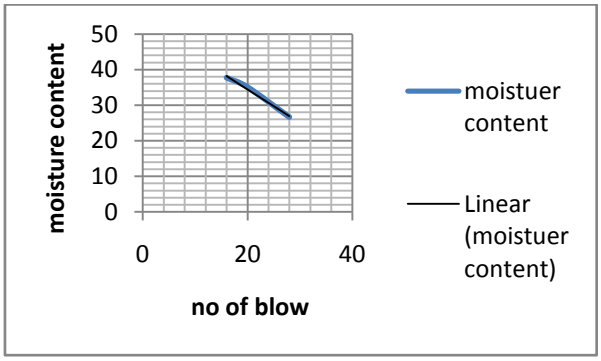
3.8 Theory

The liquid limit is the dampness content at which the notch, shaped by a standard device into the example of soil taken in the standard container, closes for 10mm on being given 25 blows in a standard way. At this breaking point the soil have low shear quality.

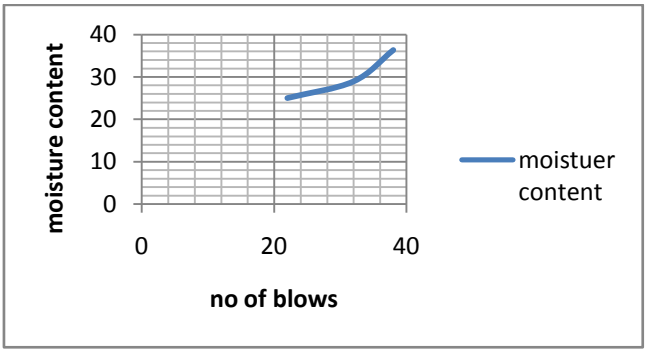
3.8.1 Observations

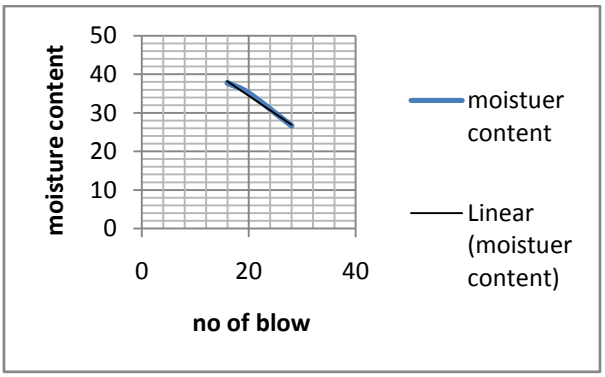
S.no	Details	Trail-1			Trail-2			Trail-3		
		Clay	Silt	Red	Clay	Silt	Red	Clay	Silt	Red
1.	Container no	1	18	11	2	8	18	4	19	19
2.	Weight of empty container + lid (w_1)	12	12	11	13	12	10	12	12	12
3.	Weight of container + lid + wet soil (w_2)	107	62	70	90	62	75	85	62	78
4.	Weight of container + lid+ dry soil (w_3)	87	52	62	70	52	65	65	52	69
5.	Weight of water in sample (w_2-w_3)	20	10	8	20	10	10	20	10	9
6.	Weight of dry sample (w_3-w_1)	75	40	51	57	40	55	53	40	57
7.	No. of. Blows	28	38	32	20	32	26	16	22	22

The average liquid limit of clay soil =33.16%



The average liquid limit of silt soil = 25%





The average liquid limit of clay soil = 33.16%

The average liquid limit of silt soil = 25%

The average liquid limit of red soil = 16.54%

3.9 Determination of Plastic Limit: (for clay soil, silt soil and red soil)

3.9.1 Plastic limit: A plastic limit (PL) is controlled by revealing a string of the fine partition of a soil on a level glass plate, non-permeable surface. On the off chance that the soil is plastic, this string will hold its shape down and shows up breaks on it. The specimen can be remolded and the test is rehashed. As the dampness content falls because of dissipation, the string will start to break.

3.9.2 Observations: Compare the diameter of thread at intervals with the rod. When the diameter reduces to 3mm note the surface of the thread for cracks.

S.no	Details	Trail-1			Trail-2			Trail-3		
		Clay	Silt	Red	Clay	Silt	Red	Clay	Silt	Red
1.	Container no	1	1	4	4	2	6	6	6	8
2.	Weight of container + lid (w_1) gms	11	12	12	12	13	12	12	12	12
3.	Weight of container + lid + wet sample (w_2) gms	50	46	67	60	55	73	61	56	74
4.	Weight of container + lid + dry sample (w_3) gms	41	40	60	51	49	66	52	50	67
5.	Weight of water in soil (w_2-w_3) gms	9	6	7	9	6	7	9	6	7
6.	Weight of dry sample (w_3-w_1) gms	30	28	48	39	36	54	40	38	55

The average plastic limit of clay soil = 25.16%

The average plastic limit of silt soil = 17.93%

The average plastic limit of red soil = 13.42%

3.10 Determination of Plastic Index: (for clay soil, silt soil and red soil)

The plastic index (PI) is a measure of the plastic of a soil. The versatility record is the measure of the scope of water substance where the dirt shows plastic properties. The PI is the contrast between liquid limit and plastic limit (PI = LL-PL). Soils with a high PI have a tendency to be mud, those with a lower PI have a tendency to be sediment, and those with a PI of 0 (non-plastic) have a tendency to have practically no residue or dirt.

Plastic index (PI) = Liquid limit (LL) – Plastic limit (PL)

The plastic index for clay soil = 8%

The plastic index for silt soil = 7.07%

The plastic index for red soil = 3.12%

3.11 Determination of Standard Compaction Test: (for clay soil, silt soil and red soil)

Scope: - Determination of the relationship between the moisture content and thickness of soils compacted in a mold.

Observations

Cylinder diameter (d) = 10cm

Height (h) = 12cm

Volume (v) = $(\pi/4) \times d^2 \times h$

$= (\pi/4) \times 10^2 \times 12$

$=944cc$

Weight of empty cylinder = 2242 gms.

S.no	Details	Trail-1			Trail-2			Trail-3			Trial-4		
		Clay	Silt	Red	Clay	Silt	Red	Clay	Silt	Red	Clay	Silt	Red
1.	Water to be added (%)	10%	8%	8%	12%	10%	10%	14%	12%	12%	16%	14%	14%
2.	Weight of water to be added	300	240	240	360	300	300	420	360	360	480	420	420
3.	Weight of compacted soil	1706	1706	1936	1936	1936	2055	2055	2055	2150	1650	2044	2120
4.	Weight of the cylinder + compacted soil	3948	3948	4178	4178	4178	4297	4297	4297	4392	3892	4286	4362
5.	Container no	2	2	2	4	4	4	6	6	6	8	8	8
6.	Weight of empty container + lid (W_1)	39	39	44	44	44	48	48	48	44	35	36	36
7.	Weight of container + lid + wet soil (W_2)	62	62	84	84	84	92	92	92	96	62	82	82
8.	Weight of container + lid + dry soil (W_3)	60	60	79	79	79	86	86	86	88	60	75	75
9.	Water content (%)	9.523	9.523	14.285	14.285	14.285	15.78	15.78	15.78	18.18	8.00	17.94	17.94
10.	Average moisture content (%)				11.647%	14.382%	16.546%						
11.	Wet density (gm/cc)	1.807	1.807	2.05	2.05	2.050	2.176	2.17	2.17	2.27	1.74	2.16	2.24
12.	Dry density (gm/cc)	1.649	1.649	1.79	1.79	1.793	1.885	1.88	1.88	1.93	1.67	1.83	1.899

The optimum moisture content for clay soil is 11.647%

The maximum dry density for clay soil is 1.617gm/cc

The optimum moisture content for silt soil is 14.382%

The maximum dry density for silt soil is 1.835gm/cc

The optimum moisture content for red soil is 16.546%

The maximum dry density for red soil is 1.89 gm/cc

IV. COMPARISION

A good pavement is needed for the comfortable, safe and economical movement of traffic. The thickness of road depends on geotechnical properties of subgrade soil and traffic intensity. The soil having lower Maximum dry density (MDD), more liquid limit (LL) and higher Optimum moisture content (OMC) is suitable for subgrade of road.

4.1 Comparison of Properties Of Mahbubnagar, Karimnagar And Nizamabad Soil's

Properties of soil	Mahbubnagar	Karimnagar	Nizamabad
Type of soil	Clay soil	Silt soil	Red soil
Water content	30.9	23.07	20.51
Specific gravity	2.8	2.7	2.67
Liquid limit	33.16	25	16.54
Plastic limit	25.16	17.93	13.42
Plastic index	8	7.07	3.12
optimum moister content	11.647	14.382	16.546
Maximum drydensity	1.617	1.835	1.89

V. CONCLUSION

Following conclusions square measure created on the idea of the check results.

1. The essential laboratory check results showed that the soil has low porousness, low strength and high volume modification properties and also water content of Mahbubnagar (clay soil) is 30.9% and water content of Karimnagar (silt soil) is 23.07% and water content of Nizamabad (red soil) is 20.51%.
2. The specific gravity of clay soil that is from Mahbubnagar is a 2.67, the specific gravity of silt soil that is from Karimnagar is 2.65 and also the specific gravity that is from Nizamabad is 2.63. So red soil is a lot of suitable for pavement construction.
3. The liquid limit of clay soil is 33.16%, silt soil is 25% and red soil is 16.54%. Thus clay soil is ideal for pavement however owing to swelling characteristics and red soil is a lot of appropriate.
4. Optimum moisture content of clay soil is 11.647% and maximum dry density is 1.617 gm/cc, Optimum moisture content of silt soil is 14.382% and maximum dry density is 1.835 gm/cc, Optimum moisture content of red soil is 16.54% and maximum dry density is 1.89 gm/cc. so red soil is ideal for pavement however owing to swelling characteristics thus in step with the optimum moisture content of silt soil is appropriate and in step with the maximum dry density is having for red soil, so it is appropriate for pavement construction.

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