

Soil Stabilization using Fly Ash and Iron dust

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Abstract— Fly ash is one of the maximum flexible of the commercial through-products. Nearly one hundred fifty million tonnes of fly ash is being generated every year in India create twin trouble of environmental pollutants and issue in disposals. This calls for setting up techniques to apply the equal efficaciously and efficiently. However, it's far simplest in geotechnical engineering programs along with the development of embankments/dykes, as again fill fabric, as a sub-base fabric etc., its massive-scale usage is feasible both on my own or with soil. Soil stabilization may be done through numerous approach along with compaction, soil replacement, chemical development, earth reinforcement etc. Usually, in the case of clay soils, chemical development is typically handiest seeing that it can beef up the soil, to get rid of its sensitivity each to water and its next pressure history. Among chemical approach or additives, fly ash/lime presents an financial and effective approach of development, as verified through the enormous transformation this is glaring on blending with heavy clay. In the gift investigation, distinctive percentage fly ashes (10%, 20%, 40%, 60% & 80%) had been introduced to a pretty expansive soil from India through dry weight of the herbal soil, and subjected to numerous tests. The essential homes that are important for the use of fly ash in lots of geotechnical programs are index homes, compaction characteristics, compressibility characteristics, permeability and strength. Based on take a look at results, it's been located that the use of fly ash for development of soils has a twofold advantage. First, to keep away from the awesome environmental troubles because of massive scale dumping of fly ash and second, to lessen the value of stabilization of problematic/marginal soils and enhancing their engineering homes for secure creation of Engineering Structures.

Keywords: - soil stabilization, fly ash, iron dust.

1. Introduction

Soil is taken into consideration via way of means of the engineer as a complicated cloth produced via way of means of the weathering of the strong rock. Soils transported via way of means of means of gravitational forces are termed colloidal soils, which include talus. The accumulation of decaying and chemically deposited vegetable count number below situations of immoderate moisture consequences withinside the formation of cumulus soils, which include peat and muck.

For any land- primarily based totally structure, the muse could be very vital and subsequently to be sturdy to help the whole structure. In order for the stimuli to be sturdy, the soil round it performs a totally crucial role. So, to paintings with soils, we want to have a proper understanding approximately their homes and elements which have an effect on their behaviour. The manner of soil stabilization is to obtain the specified homes in a soil wanted for the development paintings. From the start of production paintings, the necessity of improving soil homes has come to the light. Ancient civilization of the Indians applied diverse approach to enhance the soil energy etc., a number of those strategies have been so powerful that their constructing and roads nevertheless exists. Expansive soils, that are additionally referred to as swell-decrease soil, have the tendency to decrease and swell with version in moisture content. As a end result of this modification in the soil, tremendous misery happens withinside the soil, that is sooner or later observed via way of means of harm to the overlying systems. During intervals of more moisture, like monsoons, those soils imbibe the water, and swell; sooner or later, they come to be tender and their water conserving ability diminishes. As against this, in drier seasons, like summers, those soils lose the moisture held in them because of evaporation, ensuing of their becoming harder. Generally observed in semi-arid and arid areas of the globe, those sort of soils are appeared as ability herbal hazard – if now no longer treated, those can purpose considerable harm to the systems constructed upon them, as properly inflicting loss in human life. Soils whose composition consists of presence of montmorillonite, in general, show those sort of homes. Tallied in billions of bucks yearly worldwide, those soils have brought about considerable harm to civil engineering systems.



Figure No. 1 fly ash for soil improvement

❖ PROBLEM STATEMENT

A huge part of primary India and a part of South India are protected with Black Cotton soils. These soils are residual deposits shaped from basalt or lure rocks. Black cotton soils are clays of excessive plasticity. The shearing power of the soil is extremely low, is fairly compressible and has very low bearing capacity. It may be very tough to paintings with this soil, as do now no longer own enough power to help the hundreds imposed upon them both in the course of production or in the course of the provider lifestyles of the structure. The terrible engineering overall performance of such soils has pressured engineers to try to enhance the engineering homes of terrible fine soils. The use of fly ash and iron dirt has efficaciously proved itself in growing shear power of the soil. The suitable percentage of each the fabric will assist to boom stabilization property of soil the use of minimal costing. From the studies paper it's miles concluded that via way of means of changing fly ash with black cotton soil at one of a kind percentage the liquid restriction and plastic restriction decreases because the percentage of fly ash increases & there may be simultaneous boom in CBR value .Swell percentage is likewise discovered to be reduced. Hence it improves maximum of the engineering homes of the black cotton soil.

2. OBJECTIVES

Study of geotechnical properties of soil is very important for designing the various structures.

But sometimes the properties of soil is not feasible for construction so to improve these geotechnical properties is very important before commencement of construction work. The objectives of our project are as follows :

1. To study the concept of 4D CAD from literature survey.
2. To study the impact of fly ash on stabilization process of black cotton soil.
3. To study the impact of iron dust on stabilization process of black cotton soil.

3. LITERATURE REVIEW

- S. Bhuvaneshwari 1 et al

As the domestically to be had borrow soil has usually high plasticity ($LL > 50$) it changed into hard to apply It without delay for production. The checks completed with extraordinary percentage of FA indicated that the workability is most with 25% FA. Also the dry density determined is most for 25. The herbal soil used for production will be dried with moisture content under 7%. If soil has extra moisture it's miles hard to blend with FA. Such soil will be unfold on floor and allowed to dry earlier than production.

- M Rupas Kumar, et al

An experimental research changed into executed to study the development in

geotechnical residences of an expansive soil stabilized with waste Iron Powder.

The following conclusions are drawn from this study. The liquid restrict values

are reducing with the share growth of Iron Powder withinside the soil, while

the Plastic restrict remained constant.

The Plasticity Index (P.I) reduced with growth in percent of Iron

Powder in Soil.

The Maximum dry density increased up to 6% substitute of Iron Powder

and reduced further. By the evaluation of the tests conducted

(Atterberg's Tests, Compaction Tests), it's far recommended to update 6% of

Iron Powder in Soil to get most dry density, higher CBR Values which might be the signs of Strength of a Soil.

- Satyendra Singh Rajput

In this observe, fly-ash is used as a stabilizing material to stabilize the expansive

soil coping with engineering traits as the parameter for it. Present

paper describes a observe completed to test the development withinside the homes

of expansive soil with fly-ash in various percentages. Fly-ash is delivered in 10%,

20%, 30%, 40%, and 50% and the alternate in index homes and engineering

traits is examined. It has been determined that considerable variant in liquid

limit, plasticity index, and swelling index. In expansive soil, liquid limit

reduced from 55.2% to 36.3% and plasticity index reduced from 27.1% to

18.1%, differential loose swell (DFS) additionally decreased from 52% to 14%

respectively

.the compaction check consequences confirmed boom in optimum moisture content

(OMC) from 19% to 23% and reduce in most dry density (MDD) from

1.63g/cc to 1.52g/cc. Test end result suggests that fly-ash has a capability to enhance the homes of black cotton soil,

4.MEHEDODOLOGY

Why Soil Stabilization and When Is It Used? :-

Traditionally, solid sub-grades, sub-bases and/or bases were built with the aid of using the use of selected, well-graded aggregates, making it pretty smooth to are expecting the load-bearing potential of the built layers. By the use of choose fabric, the engineer is aware of that the muse can be capable of aid the layout loading. Gradation is an essential soil function to understand. A soil is considered both well-gradedl or uniformly-graded. This is a connection with the sizes of the debris withinside the substances. Uniformly-graded substances are made up of man or woman debris of approximately the equal size. Well-graded substances are made up of an premiere variety of various sized debris. It is proper from an engineering viewpoint to construct upon a basis of perfect and consistent density. Thus, the purpose of soil stabilization is to offer a solid, solid basis. Densityl is the degree of weight with the aid of using extent of a fabric, and is one of the relied-upon measures of the suitability of a fabric for production purposes. The extra density a fabric possesses, the less voids are present.

Chemical stabilization:- One technique of enhancing the engineering houses of soil is through adding chemical compounds or different substances to enhance the present soil. This approach is normally fee effective: for example, the fee, transportation, and processing of a stabilizing agent or additive consisting of soil cement or lime to deal with an in-place soil fabric will in all likelihood be extra low cost than uploading mixture for the equal thickness of base course. Additives may be mechanical, which means that upon addition to the discern soil their very own load-bearing houses bolster the engineering traits of the discern soil. Additives also can be chemical, which means that the additive reacts with or adjustments the chemical houses of the soil, thereby upgrading its engineering houses.

Procedure of stabilization :-

- Site Preparation

- Introduce Additives
- Mixing
- Compaction and Shaping/Trimming
- Curing

Available material for soil stabilization :-

Fly Ash :- Fly Ash is an business waste product from thermal electricity plant life which uses coal as fuel .It is anticipated that a hundred and seventy million lots of fly ash is being produced from one of a kind thermal electricity plant life in India eating 70 thousand acres of treasured land for its disposal inflicting intense fitness and environmental. There are primary lessons of fly ash, magnificence C and sophistication F. The former is produced from burning anthracite or bituminous coal and the latter is produced from burning lignite and sub bituminous coal. Both the lessons of fly ash are pozzolans, that are described as siliceous and aluminous materials.



Figure No. 2 Fly Ash

Iron dust :- The waste iron dust used in this study collected from industrial Waste passing through BS sieve investigations are carried out on black cotton soil to increase the stabilization of soil up to greater extent.



Figure No. 3 Iron Dust

EXPERIMENTAL ANALYSIS:-

Nearly black enormously plastic silty clayey soil became used on this study, collected from Indira Nagar and Kathe Galli Nashik, Maharashtra, India. The collected soil became loose, moist and it became pulverized manually through hammer. Then the soil became screened via the sieve of 2.seventy five mm aperture earlier than getting ready the specimens for testing. And additionally oven dried the soil at a hundred and ten c for twenty-four hours earlier than the use of specimen.

Sr. No	Test Performed	Result with plain black cotton soil sample 1
1	Specific Gravity	2.65
2	Liquid Limit	65.48
3	Plastic Limit	35.14
4	Plasticity Index	31.34
5	MDD	1.4
6	OMC	7

Sr. No	Test Performed	Result with plain black cotton soil sample 1
1	Specific Gravity	2.57
2	Liquid Limit	61.56
3	Plastic Limit	33.10
4	Plasticity Index	28.42
5	MDD	1.2
6	OMC	6

Methods:

1. Specific gravity determination by Pycnometer :-

Reference: - I.S.-2720 (Part-II) 1964

Determination of Consistency limits and their use in soil classification as per I.S.Codes :-

Reference: - I.S. 2720 (Part-5)-1985.

I.S. 2720(Part- 6) -1972

Determination of liquid limit:

Determination plastic limit:

Standard Proctor test:

5. RESULT

Sample 1. Indira Nagar, Nashik.

Sr. No	Black cotton Soil Proportion	Fly A Proportion	Iron Dust Proportion	Specific Gravity	Liquid limit	Plastic limit	MDD	OMC
1	83.50%	15%	1.50%	3.36	39.73	37.52	18.78	1.23
	83.50%	15%	3.00%	2.38	37.99	39.21	14.72	1.27
	83.50%	15%	4.50%	2.26	37.37	39.06	14	1.25
2	73.50%	25%	1.50%	2.05	39.43	38.33	18.38	1.23
	73.50%	25%	3.00%	1.74	38.45	31.72	16.6	1.25
	73.50%	25%	4.50%	1.7	37.76	33.05	15.9	1.19
3	63.50%	35%	1.50%	1.88	31.46	32.24	20.5	1.18
	63.50%	35%	3.00%	1.62	31.06	31.75	14	1.16
	63.50%	35%	4.50%	1.61	31.02	31.98	22	1.15

Sample 2. Pathardi Phata, Nashik.

Sr. No	Black cotton Soil Proportion	Fly A Proportion	Iron Dust Proportion	Specific Gravity	Liquid limit	Plastic limit	MDD	OMC
1	83.50%	15%	1.50%	2.98	37.89	38.27	16.32	1.25
	83.50%	15%	3.00%	2.56	37.74	38.56	12.56	1.19
	83.50%	15%	4.50%	1.98	37.62	37.52	12.23	1.16
2	73.50%	25%	1.50%	1.86	38.97	35.34	16.24	1.25
	73.50%	25%	3.00%	1.57	38.72	36.24	15.23	1.21
	73.50%	25%	4.50%	1.23	37.24	35.87	14.84	1.20
3	63.50%	35%	1.50%	1.62	31.04	30.29	18.76	1.25
	63.50%	35%	3.00%	1.44	30.96	30.21	12.26	1.27
	63.50%	35%	4.50%	1.31	30.74	29.56	19	1.28

6. CONCLUSION

From the above listing of end result the subsequent end had been made:-

Sample no.1:

Specific gravity turned into to discover the particular gravity of soil which turned into pass through 4.75mm, begin reducing from the begin as the share of Fly ash and Iron dirt will increase minimal price turned into located to be 1.sixty one at 35% of Fly ash and 4.5% of Iron dirt and most turned into 3.36 at 15% of Fly ash and 1.5% of Iron dirt. Same massive lower turned into located in Liquid restrict and Plastic restrict, however there has been boom located in Liquid restrict at 25% of Fly ash and 1.5% of Iron dirt which similar to first one i.e. 39.forty three contrary case determined in plastic restrict there has been a sudden lower located at 25% of Fly ash & 3% Of Iron Dust Which turned into located to be 31.72. Plasticity Index turned into located most 25% of Fly ash & 4.5% Of Iron Dust which turned into 8.12. In Standard Proctor MDD and OMD had been Obtained, there had been fluctuation in the

price of MDD for extraordinary share in that 22 turned into the best MDD located for 35% of Fly ash & 4.5% Of Iron Dust and Maximum OMC turned into at 15% of Fly ash & 3% Of Iron Dust and minimal turned into 1.15 at 35percentof Fly ash &4.5% Of Iron Dust.

Sample no. 2:

Specific gravity turned into performed to discover the particular gravity of soil which turned into pass via 2.75mm, begin reducing from the begin as the share of Fly ash and Iron dirt will increase minimal price turned into located to be 1.23 at 25% of Fly ash and 4.5% of Iron dirt and most turned into 2.ninety eight at 15% of Fly ash and 1.5% of Iron dirt. . Same massive lower turned into located in Liquid restrict and Plastic restrict, however there has been boom located in Liquid restrict at 25% of Fly ash and 1.5% of Iron dirt. Plasticity Index turned into located most 15% of Fly ash & 1.5% Of Iron Dust. In Standard Proctor MDD and OMD had been Obtained , there had been fluctuation in the price of MDD for extraordinary share in that 18.seventy six turned into the best MDD located for 35% of Fly ash & 1.5% Of Iron Dust and Maximum OMC turned into at 35% of Fly ash & 4.5% Of Iron Dust.

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