

# Stabilization of Black Cotton Soil Using RBI Grade 81 and Flyash

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## Abstract:

Rapid development is going on in the construction industry. For the better and stable construction subgrade soil should have good strength to retain the upcoming load from the superstructure. Black cotton soil which is commonly found in many places is very weak in strength and it has the high-volume change properties for the environmental factors as it has high affinity towards water. As Black cotton soil consists of Montmorillonite mineral which has very weak bond and it shows high swelling and shrinking behaviour when it comes in contact with water. Black cotton soil needs to be replaced or these soils has to be stabilized for the construction purpose. For the stabilization's additives like RBI Grade 81 and Flyash are used to reduce the construction time and cost.

**Keywords— Black Cotton Soil, RBI Grade 81, Fly ash, Stabilization.**

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## I. INTRODUCTION

Soil stabilization is a process used to enhance the physical properties of the soil. Soil stabilization improves the shear strength of the soil and it control shrink-swell behaviour of soil. In India, Black cotton soil is found mainly in Maharashtra, Madhya Pradesh, Andhra Pradesh and Karnataka. Developing countries like India experience various challenges due to the presence of black cotton soil during the development of infrastructure projects. To improve the subgrade, it is stabilized by using chemical additives or biopolymers. Strength and bearing capacity of the soil is mainly considered to transfer the loads to the below layers effectively without any failure. Therefore, to improve the desired properties of the soil it needs stabilization. In

many sectors soil stabilization is used namely, roads, landfills, industries, slope protection, dam cores, etc.

The different materials that are used in the construction work should have enough strength and durability to retain the wetting and drying condition, freezing and also thawing. Durability can be explained as the material capacity to withstand its stability and the integrity over the years against destructive forces mainly weather. Black cotton soil is not able to sustain for the wetting and drying condition as one of the environmental factors.

This project includes the study about RBI Grade 81 that is Road Building International Grade 81. It is in powder form and is inorganic in nature and it is added to Black cotton soil. The main reason of this study is to analyse

the strength of soil when it is stabilized with Fly ash and RBI Grade 81 and to analyse the volume change properties after stabilization with various percentage of Fly ash and RBI Grade 81. Study is carried out to know the Free swell index (FSI) with different percentage of stabilizers. Durability studies are also carried out in this project.

## LITERATURE REVIEW

1S. ANDAVAN “**VOLUME CHANGE BEHAVIOUR OF EXPENSIVE SOILS STABILIZED WITH RECYCLES ASHES AND FIBRES**” (MAY 2013, ASCE): IN THIS PAPER, IT IS OBSERVED THAT LIME AND FLY ASH INCREASES THE STRENGTH OF THE SOIL AFTER 7 AND 28 DAYS. BY USING THE LIME AND FLY ASH THERE IS INCREASE IN THE DENSITY OF THE SOIL BUT THE OPTIMUM LIME TO FLY ASH RATIO IS INFLUENCED IN SIGNIFICANT. THESE ADDITIVES ARE NOT SUITABLE FOR THE SANDY SOIL.

2SHAOLI“**EXPERIMENTAL STUDY ON THE STABILIZATION OF ORGANIC CLAY WITH FLY ASH AND CEMENT MIXED METHOD**” (JULY 2013, ASCE) IN THEIR PAPER, THEY HAVE CONCLUDED THAT THE UCS OF CEMENT TREATED SOIL DEPENDS ON THE ORGANIC MATTERS PRESENT IN THE SOIL. FLY ASH IS GOOD FOR THE HIGH ORGANIC CONTENT SOIL. IN THIS PAPER THE MAIN CONCLUSION IS THAT THE OPTIMUM VALUE OF THE 12% OF THE FLY ASH CONTENT IN TERMS OF THE LONG LIFE. WHEN THERE IS INCREASE IN THE FLY ASH CONTENT THEN THERE IS INCREASE IN THE SHAPE FACTOR AND FORMATION FACTOR.

3T. RAGHAVENDRA “**ENGINEERING PROPERTIES OF CONTROLS LOW STRENGTH MATERIAL USING FLY ASH AND WASTE GYPSUM WALL BOARDS**” (AUG 2015, SCIENCE DIRECT)THEY HAVE DONE THE LABORATORY TESTS ON THE BLACK COTTON SOIL BY USING THE FLY ASH AND GYPSUM. IN THEIR PAPER, THEY HAVE CONCLUDED THAT, TO ATTEND THE FULL STRENGTH OF THE SOIL 28 DAYS ARE REQUIRED, STRENGTH OF THE SOIL IS

INCREASES TILL 28 DAYS, OBSERVED STRENGTH OF THE SOIL AT 28 DAYS IS 0.36 TO 3.49. THEY ALSO HAVE OBSERVED THE STRENGTH AND THAT THE REDUCED VALUE IS 7% TO 36% WITH RESPECT TO MAXIMUM VALUE. IF THERE IS INCREASE IN GYPSUM CONTENT, THEN THE DEMAND OF WATER WILL BE MORE.

4JAYA PRAKASH BAB“**ENGINEERING PROPERTIES OF BLACK COTTON SOIL MODIFIED WITH FLY ASH AND CEMENT**” (2016 IJETT): THEY HAVE DONE THE ALL-BASIC TESTS IN THIS JOURNAL PAPER ON THE EXPENSIVE SOIL MIXED WITH FLY ASH AT DIFFERENT PERCENTAGE. IN THIS THEY HAVE CONCLUDED THAT WE CAN MAKE USE ON THE TREATED EXPENSIVE SOIL AS A GEO TECHNICAL MATERIAL BY ADDING 6-10% OFCEMENT AND 30-40% OF FLY ASH. THERE IS IMPROVEMENT IN THEPROPERTIES LIKE SWELLING, SHRINKAGE, MDD AND OMC.

5ALAKA SREEDHAR “**STABILIZATION OF BLACK COTTON SOIL USING RBI GRADE 81**” (APRIL 2017, IJCESR):HE HAS DONE THE STUDY ON THE BLACK COTTON SOIL STABILIZATION IN WHICH HE HAS MAINLY FOCUSED ON THE CBR AND UCC TESTS RESULTS. BY OBSERVING THE RESULTS FROM THE TESTS, HE HAS MADE THE CONCLUSION THAT WE CAN USE THE STABILIZED SOIL FOR THE CONSTRUCTION OF SUB GRADE, SUB BASE AND BASE COARSE. IF THERE IS INCREASE IN THE DOSAGE OF RBI GRADE 81 THEN THERE IS IMPROVEMENT IN THE CBR AND ALSO THERE IS IMPROVEMENT IN THE UCC VALUE.

6KISHORE KUMAR “**EVALUATION OF RBI GRADE 81 FOR STABILIZATION OF EXPANSIVE SOIL AS SUB-GRADE MATERIAL**”(APRIL 2017, SCIENCE DIRECT) THEY HAVE CONCLUDED THAT THE CALIFORNIA BEARING RATIO (CBR) VALUE DEPENDS ON THE CURING PERIOD AND PERCENTAGE OF RBI GRADE 81. THEY HAVE OBTAINED MAXIMUM CBR VALUE AS 19.54 AT 28 DAYS OF CURING PERIOD AND AT 4% OF RBI GRADE 81. UCS WILL INCREASE IF THERE IS INCREASE IN THE RBI CONTENT. UCS IS SUFFICIENT AT 4% OF RBI GRADE 81. THERE IS A DECREASE IN FSI WITH INCREASE IN THE RBI CONTENT. THE MAXIMUM DRY DENSITY (MDD) IS 1.850 G/CC AND OPTIMUM MOISTURE CONTENT (OMC) IS 15.40% AT THE RBI CONTENT OF 5%. MDD WILL INCREASE WITH INCREASE IN RBI CONTENT. THERE IS A DECREASE IN THE LIQUID LIMIT WITH INCREASE IN THE RBI CONTENT AND PLASTIC LIMIT INCREASES WITH INCREASE IN RBI CONTENT.

7SHIVA PRASHANTH KUMAR KODICHERL  
**“EFFECT OF RBI GRADE 81 ON STRENGTH CHARACTERISTICS OF CLAYEY SUBGRADE”**  
(NOVEMBER 2017, INTERNATIONAL JOURNAL OF GEO ENGINEERING):THEY HAVE STUDIES ABOUT THE EFFECT OF THE RBI GRADE 81 ON THE SOIL REGARDING THE STRENGTH OF THE SOIL. THE OUTCOMES OF THE TESTS MADE BY USING THE RBI GRADE 81 ASH IN THE PAPER ARE, AT 8% CONTENT LIQUID LIMIT AND PLASTIC LIMIT IS SAME, MDD DECREASES AND OMC INCREASES WITH INCREASE IN THE CONTENT VALUE OF TREATED SOIL AT 8% OF RBI IS 3.5 TIMES OF UNTREATED SOIL. IN CBR VALUE THEY HAVE OBSERVED THAT IMPROVEMENT IS AT 4% OF RBI.

8 GAGAN V **“SOIL STABILIZATION ON BLACK COTTON SOIL USING RBI GRADE 81”**(APRIL 2018, IRJET): STUDIED THE STABILIZATION OF THE EXPANSIVE SOIL BY USING THE RBI GRADE 81.THEY HAVE TOLD THAT THERE IS A SIGNIFICANT IMPROVEMENT IN THE INDEX PROPERTIES OF THE BLACK COTTON SOIL. THEY HAVE MADE THE BASIC TEST SUCH AS LIQUID LIMIT, PLASTIC LIMIT, MAXIMUM DRY DENSITY, OPTIMUM MOISTURE CONTENT, CBR ETC. THEY HAVE DONE THESE TEST AT 0%, 2%, 4% AND 6%. THEY HAVE GIVEN THE SUGGESTION THAT THIS PERCENTAGE CAN BE IMPROVED 8% TO 12%. FOR THE GOOD SOIL STABILIZATION. AND IT REDUCES THE CONSTRUCTION TIME 40%.

9 MADHUSUDAN RAMCHANDRA **“EFFECTS OF RICE HUSK ASH AND FLYASH ON INDEX PROPERTIES OF BLACK COTTON SOIL”**  
(AUGUST 2018, IRJET): THEY HAVE DISCUSSED ABOUT THE INDEX PROPERTIES OF THE EXPENSIVE SOIL WHEN IT IS MIXED WITH THE RICE HUSK ASH AND FLY ASH. STABILIZATION OF BLACK COTTON SOIL USING RBI GRADE 81 AND FLY ASH THEY HAVE DONE THE CBR TEST AT 5%, 10%, 15%, 20% AND 25% AND THE RESULT INCREASES 24.17%, 37.09%, 45.69%, 39.40% AND 26.15%. THE MAXIMUM CBR IS AT 15% OF BOTH ASHES. SIMILARLY, THERE IS IMPROVEMENT IN THE STRENGTH, MDD AT 15% OF THE BOTH ASHES.

10 KAVYASHREE L**“AN EFFECT OF RBI GRADE 81 ON BLACK COTTON SOIL STABILIZATION”** (APRIL 2019, IJESC): IN THIS PAPER, EFFECT OF RBI GRADE 81 ON BLACK COTTON SOIL

STABILIZATION STUDY IS CARRIED OUT. AFTER TESTING RESULTS WERE OBSERVED THAT, MDD OF THE SOIL INCREASES WITH INCREASE IN THE CONTENT OF THE RBI GRADE 81 AND OMC WILL DECREASE WITH INCREASE IN THE RBI CONTENT. IN THIS PAPER THEY HAVE CONCLUDED THAT IN 6% OF THE RBI CONTENT IS BENEFICIAL FOR THE TREATMENT OF THE BLACK COTTON SOIL. IF THE RBI CONTENT IS MORE THAN 6% THEN THERE IS DECREASE IN THE MDD AND ALSO THERE IS INCREASE IN THE OMC. BY ADDING THE RBI GRADE 81 LIQUID LIMIT WILL REDUCE AND PLASTIC LIMIT INCREASES WHICH RESULTS THE INCREASE IN THE PLASTICITY INDEX. BY ADDITION OF THE RBI GRADE 81 THERE IS ALSO INCREASE IN THE CBR VALUE AND THE UCS. SO THAT THE RBI GRADE 81 IS UNIQUE.

## OBJECTIVES

The objectives of our project is to study the feasibility of RBI grade 81 and Fly ash used as effective and suitable stabilizer for stabilization of expansive soil. The main objectives of this experimental project include the following:

- To analyse the characterization of Black cotton soil and suitability of use of Black cotton soil as subgrade material after stabilization.
- To examine the compaction, strength and volume change properties of Black cotton soil mixed with stabilizers.
- To study the influence of RBI grade 81 and fly ash as stabilizer on Durability of soil.

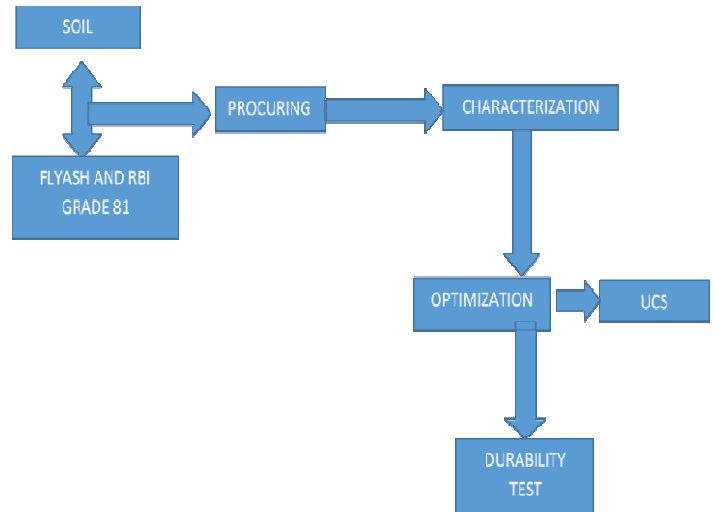
## METHODOLOGY

Various tests such as compaction test, unconfined compressive strength test, free swell index test and consolidation test are conducted to study the effect of RBI Grade 81 and Fly ash on Black cotton soil.

Different percentage of Fly ash and RBI Grade 81 are added separately to the Black cotton soil to find out the optimum content of Fly ash and RBI Grade 81 needs to be added for the effective stabilization of Black cotton soil and later both Fly ash and RBI Grade 81 are added simultaneously keeping RBI Grade 81 as constant and varying the percentage of Fly ash as 5%, 10%, 15%, 20%, 25%, 30%.

These are the experiments conducted on Black cotton soil with or without additives:

1. Specific gravity
2. Atterberg's limits
  - a) Liquid limit
  - b) Plastic limit
  - c) Shrinkage limit
3. Free swell index test
4. Compaction test
5. Unconfined compressive strength test
6. Hydrometer analysis
7. Durability Test



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