# STRENGTHENING OF RED MUD SOIL USING RBI GRADE 81

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**ABSTRACT**

*Soil is the basic foundation for any civil engineering structures. It is required to bear the loads without failure. In some places, soil may be weak which cannot resist the oncoming loads. In such cases, soil stabilization is needed. Soil stabilization can be explained as the alteration of the soil properties by chemical or physical means in order to enhance the engineering quality of the soil. The main objectives of the soil stabilization are to increase the bearing capacity of the soil, its resistance to weathering process and soil permeability. The long-term performance of any construction project depends on the soundness of the underlying soils. Unstable soils can create significant problems for pavements or structures, Therefore soil stabilization techniques are necessary to ensure the good stability of soil so that it can successfully sustain the load of the superstructure especially in case of soil which are highly active, also it saves a lot of time and millions of money when compared to the method of cutting out and replacing the unstable soil. This study deals with the complete analysis of the improvement of soil properties and its stabilization using RBI Grade 81. In this study 'RBI Grade 81' is mixed with soil to investigate the relative strength gain in terms of bearing capacity and compaction. The effect 'RBI Grade 81' on the geotechnical characteristics was investigated by conducting 'standard compaction tests', 'CBR test' .The test were performed as per Indian Standard specifications.*

**Keywords:** *soil stabilization, RBI Grade 81, geotechnical characteristics, Compaction test, CBR test.*

## 1. INTRODUCTION

The RBI Grade 81is an inorganic soil stabilizer and pavement material. Some characteristic of RBI Grade 81 is given in the following.

- Patented worldwide including India
- Cementitious powder
- Non-toxic
- Non inflameable
- Gray color powder

Advantages of **RBI GRADE 81**

- Construction time and cost reduction
- Drastically increases the strength
- Stabilization water proofs the soil.
- Reduces thickness, use of transport, and earth moving machinery substantially
- Enviroment Eco-Friendly
- Longer durability which reduces maintenance

*The Physical Properties of RBI Grade 81:*

| Physical Properties | RBI Grade -81 |
|---|---|
| Odour | Odourless |
| Ph | 12.5 |
| Freezing point | None |
| Flammability | Non-flammable |

| | |
|---|---|
| Shelf life | 12 months |
| Storage | Dry storage |
| Bulk density | 700 kg/m$^3$ |

*Chemical Properties of RBI Grade 81:*

| PROPERTIES | % BY MASS |
|---|---|
| Ca | Cao 52-56% |
| Si | SiO2 15-19% |
| S | SO3 9-11% |
| Al | Al2O3 5-7% |
| Fe | Fe2O3 0-2% |
| Mg | MgO 0-1% |
| Mn, K, Cu, Zn | 0.1-0.3% |
| H2O | 1-3% |
| Fibers | 0-1% |
| Additives | 0-4% |

## 2. TEST PERFORM

### 2.1 Liquid Limit Test:

Preparation of Samples:

a) Air dry soil sample and break the clots. Remove the organic matter like tree roots pieces of bark, etc.
b) About 100g of specimen passing through 425µm IS sieve is mixed thoroughly with distilled water in the evaporating dish and left for 24 hours for soaking.

### 2.2 Plastic Limit Test:

Preparation of sample:

Take out 50 gm of air dried soil from a thoroughly mixed sample of soil passing through 4.25 µ m IS sieve. Mix the soil with the distilled water in an evaporating dish and leave the soil mass for nurturing. This period may be up to 24 hrs.

### 2.3 Standard Compaction Test (IS2720 Part VIII )

The test consists in compacting soil at various water contents in the mould, in three equal layers, each layer being given 25 blows of the 2.5 kg rammer dropped from a height of 310mm. The dry density obtained in each test is determined by knowing the mass of the compacted soil and its water content. The compactive energy used for this test is 5880 kg cm per 2250 ml of soil.

### 2.4 California Bearing Ratio Test :( CBR Test)

This is a penetration test developed by the California division of highways as a method for evaluating the stability of soil sub Grade and other flexible pavement materials. The load values are noted corresponding to penetration values of 0.0,05,1.0,1.5,2.0,2.5,3.0,4.0,5.0,7.5,10.0 and 12.5mm.The load corresponding to 2.5 and 5.0 mm penetration are values are noted. The CBR value is calculated using the relation:

$$\text{CBR\%} = \frac{\text{[Load sustained by the specimen at 2.5 or 5.0mm penetration]}}{\text{[Load sustained by standard aggregates at the corresponding Penetration level]}} \times 100$$

Normally the CBR value at 2.5 mm penetration which is higher than that 5.0mm .Reported as the CBR value of test material .However, if the CBR value obtained from the test at 5.0mm penetration is higher than 2.5 mm then the test is to be repeated for checking if it comes at 5mm it is reported as CBR value of test material.

**Table for Characteristic Value of Soil**

| S.NO | CHARACTERISTICS | VALUE |
|---|---|---|
| 1. | Optimum Moisture content | 13% |

| | | |
|---|---|---|
| 2. | Maximum dry density | 1.91gm/cm$^3$ |
| 3. | Plasticity limit | 9.78 |
| 4. | Liquid limit | 31.5% |

## 3. TEST RESULT

**3.1 Table for Standard Compaction Test**

| S NO. | STANDARD COMPACTION TEST | WATER CONTENT | MAXIMUM DRY DENSITY |
|---|---|---|---|
| 01 | Standard Compaction Test Of Untreated Soil Sample | 26 % | 1.581 |
| 02 | Standard Compaction Test Of Soil Sample With 0 % Of RBI GRADE 81 | 25% | 1.59 |
| 03 | Standard Compaction Test Of Soil Sample With 2% Of RBI GRADE 81 | 24 % | 1.63 |
| 04 | Standard Compaction Test Of Soil Sample With 4 % Of RBI GRADE 81 | 23.7 % | 1.631 |
| 05 | Standard Compaction Test Of Soil Sample With 6 % Of RBI GRADE 81 | 22.4% | 1.64 |

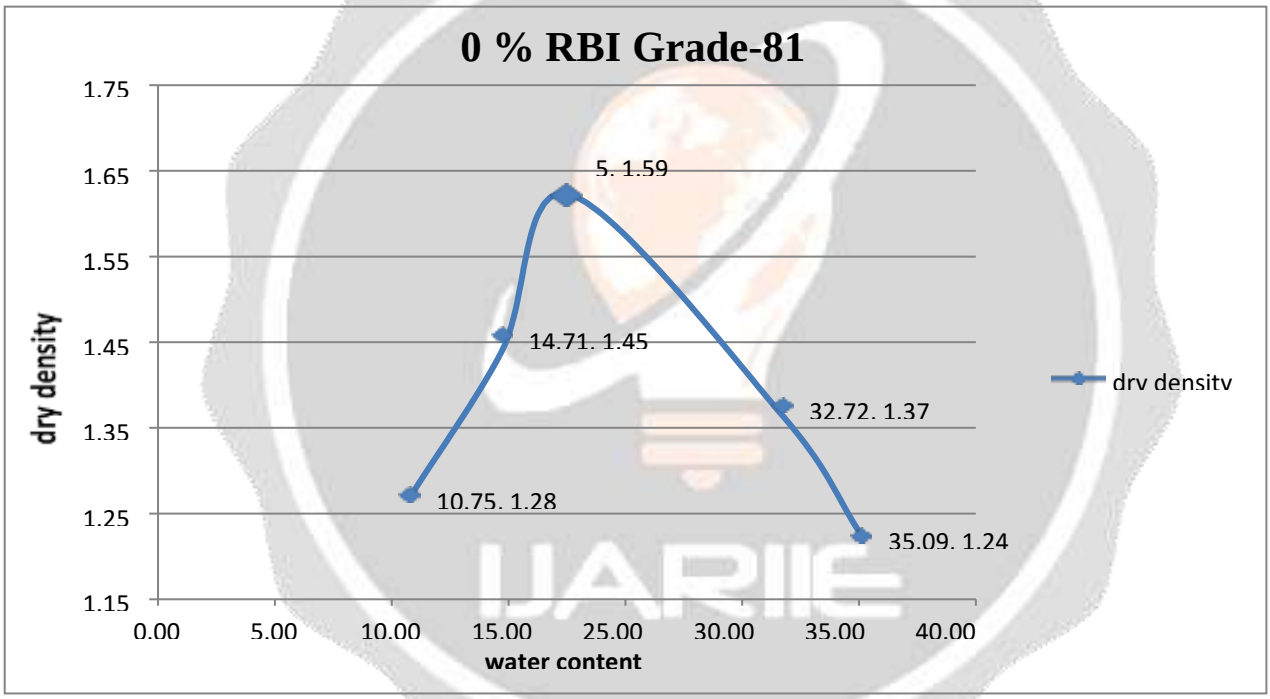


**Fig.3.1 OMC and MDD 0% RBI-81**

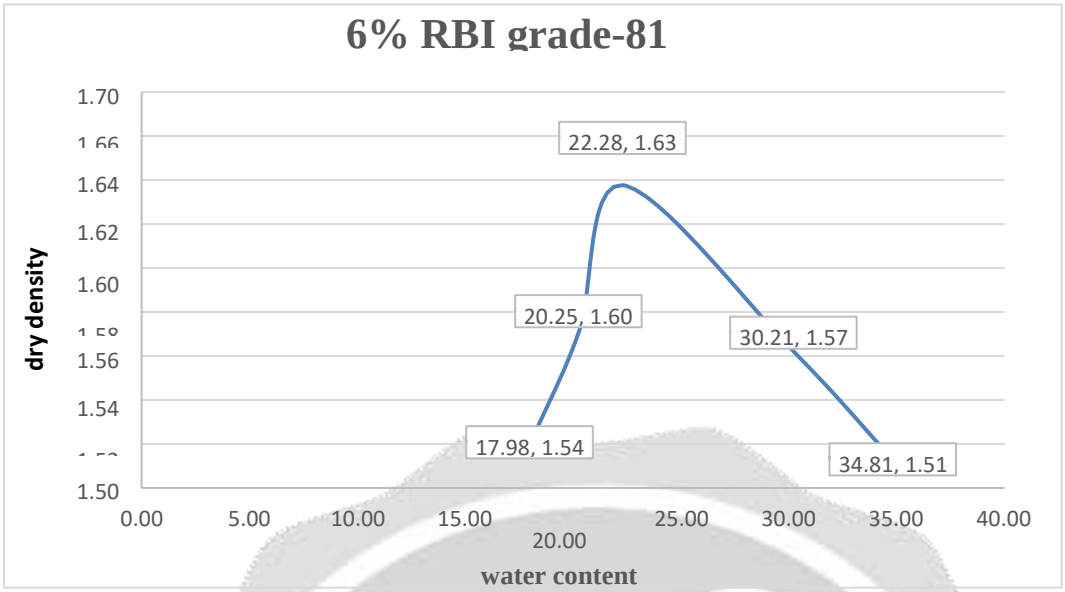


**Fig.3.2 OMC and MDD 6% RBI-81**

**3.2 Table for California Bearing Ratio Test**

| S. No | CBR TEST | CBR Value Of Soil |
|---|---|---|
| 01 | Soil Sample | 2.15mm |
| 02 | Soil Sample + 0% RBI | 2.54mm |
| 03 | Soil Sample + 2% RBI | 3.15mm |
| 04 | Soil Sample + 5% RBI | 3.59mm |
| 05 | Soil Sample + 7% RBI | 4.07mm |

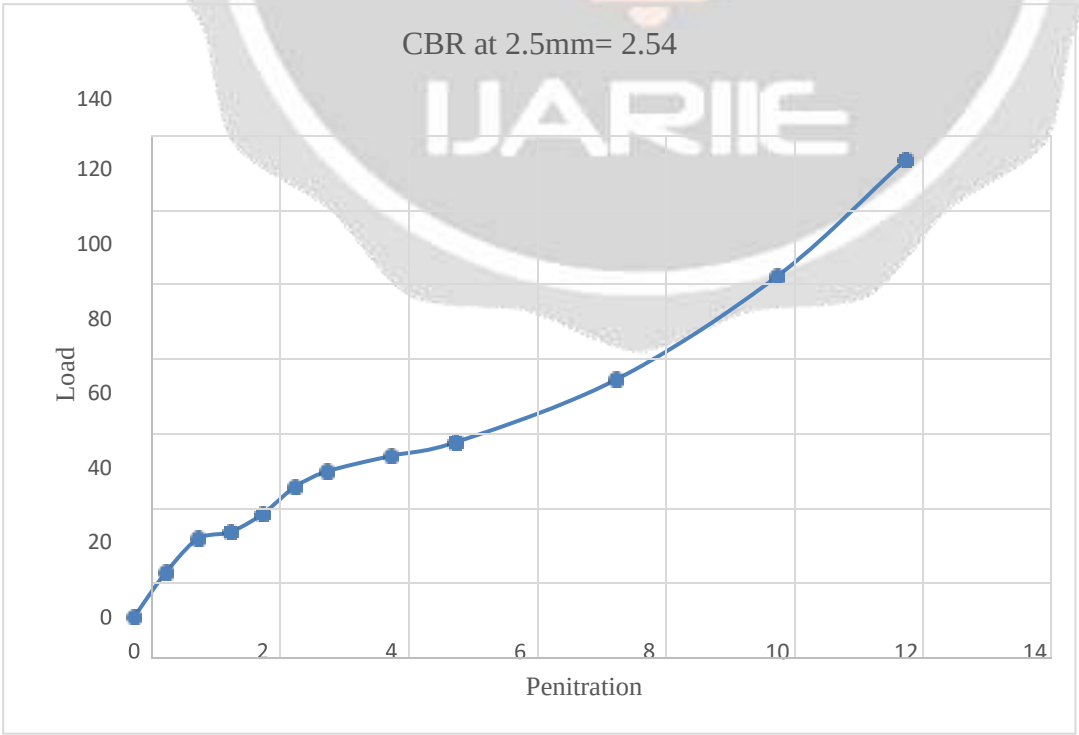


**Fig. 3.3 Un-Soaked CBR Value At 0% RBI Grade-81**

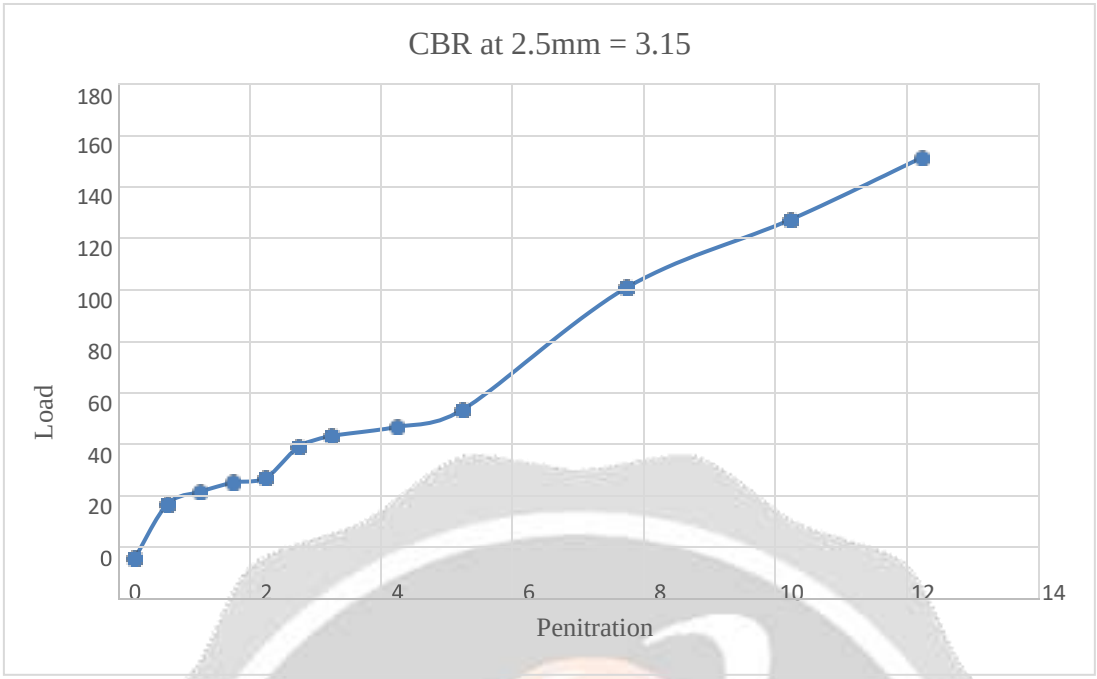


**Fig. 3.4 Un-Soaked CBR Value At 2% RBI Grade-81**

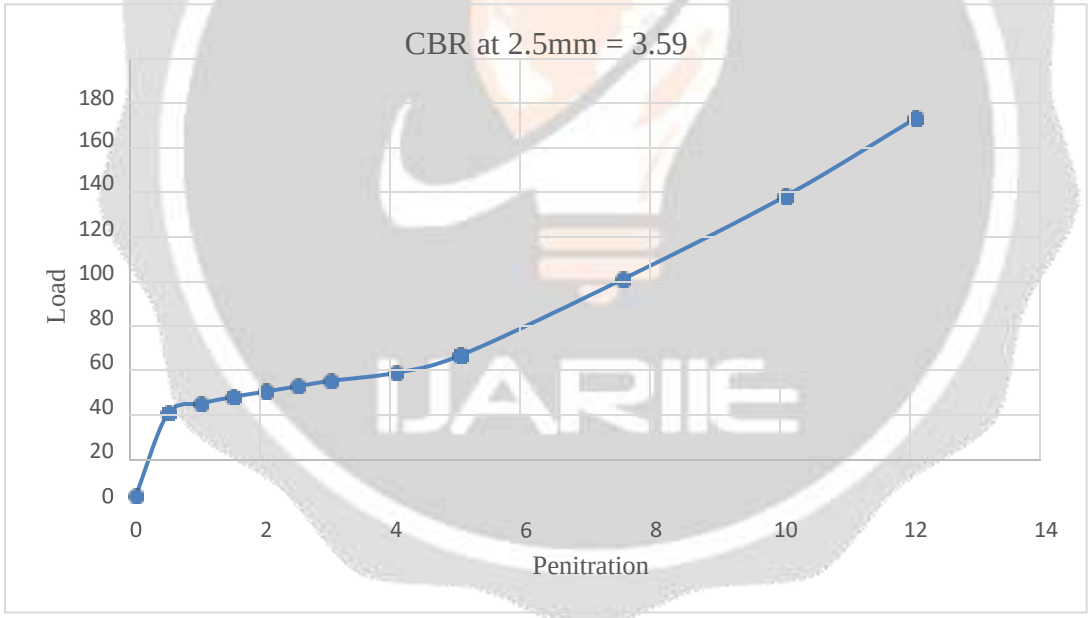


**Fig. 5.18 Un-Soaked CBR Value At 5% RBI Grade-81**

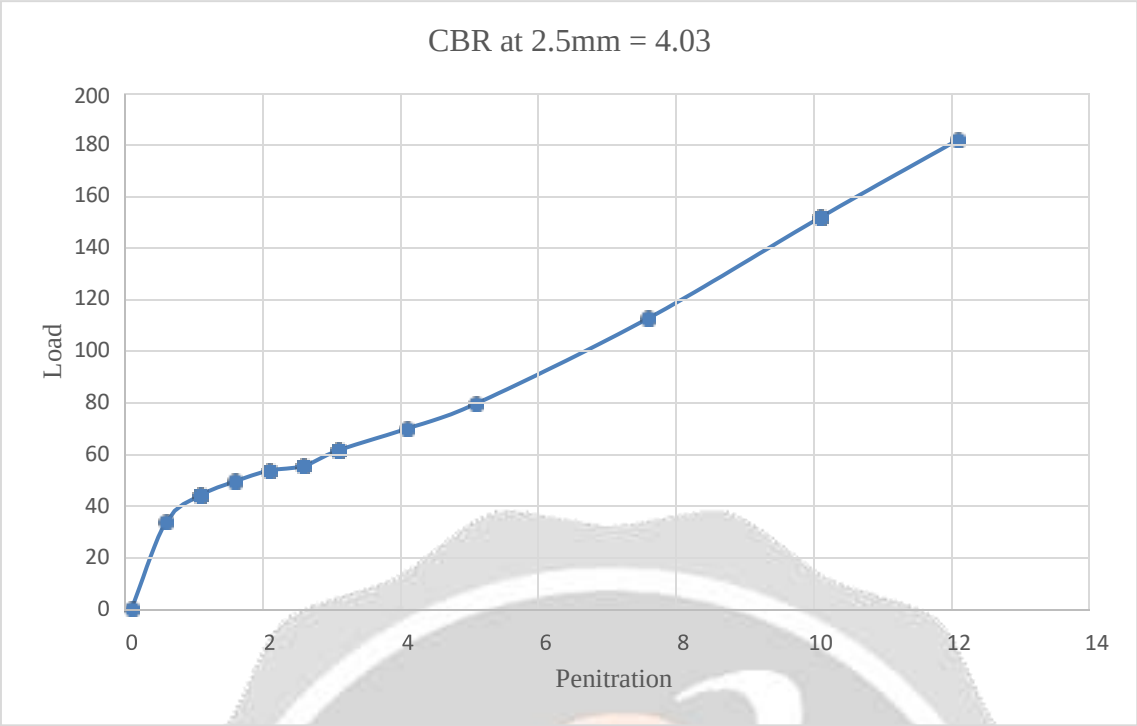


**Fig. 5.20 Un-Soaked CBR Value At 7% RBI Grade-81**

## CONCLUSION

Based on the result of CBR feasibility of RBI Grade 81stabilizer for used in different layers of road pavement i.e. sub grade, sub base and base are evaluated .The following are the broad conclusions. The conclusion is based on the test carried out on soil selected for the study.

1) RBI Grade 81 additives may be successfully used to enhance the engineering properties of soil particularly CBR.
2) It has been observed that CBR value increases with RBI content 1%-7%, for red mud soil.
3) It is observed that value increases significantly after addition of 1% RBI content.
4) The stabilized soil can be used as a sub grade, sub base, and base course without aggregate .The test result indicates that RBI Grade 81 may be used to save natural resources like aggregate and murum.
5) RBI Grade 81 can be used as a soil stabilizer to reduce the thickness of sub grade, sub base and base course for road construction as the strength is more if compared with traditional WBM roads.
6) In earth roads RBI Grade 81 can be used as a soil stabilizer inhanced the Engineering properties of the road and provide smoother surface for vehicle to travel.
7) No need for any foreign material like aggregate ,better quality soil for pavement construction in region of low quality soil as RBI Grade 81 inhanced the Engineering properties of soil.
8) The cost of construction of an earth road with RBI Grade 81 in a region of low quality of soil is laser.
9) As the strength of soil increases with an addition of RBI Grade 81, the quality, durability and life period of road will be more as compare to traditional constructed road.

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