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# Soil Stabilization using Fly Ash and Rice Husk Ash

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**ABSTRACT**: Soil is a complex material. Recycled and waste materials like fly ash, bagasse ash, rice husk ash can be used to soil stabilization to improve physical and chemical properties of soil. In addition to that properties which can improved by soil stabilization are CBR, shear strength of soil, UCS and bearing capacity etc. The objective of this study to check the amount of fly ash at which sample of soil and fly ash gives optimum values of CBR and UCS and after that rice husk ash is added in different proportions in the sample of soil and optimum quantity of fly ash to achieve the optimum value of CBR.

## I. INTRODUCTION

Due to rapid growth in highway construction there is need of good earth. Soil cannot be replaced with good soil everywhere as it is very costly and increase the project cost. This problem can be overcome with improvement in properties of soil which is to be used for infrastructure project. Many investigations had been carried out to use waste materials to improve the soil properties and to utilize the waste materials in view of better environment.

Objective of this study is to improve the properties of locally available clayey soil.For this research, soil sample was taken from Mohali district. Stabilization is done by adding different percentages of fly ash and rice husk ashes. Stabilization is done for following purposes-

1. To evaluate the CBR by using optimum content of fly ash
2. To evaluate the UCS by using optimum content of fly ash
3. To evaluate the CBR by using optimum content of rice husk ash

## II. MATERIALS AND METHODOLOGY

Fly ash is residual material remained after combustion of coal in thermal power plant. Fly ash contains fine particles of silicon dioxide ($Sio_2$), aluminum oxide, iron oxide and calcium oxide. Fly ash has been used in many civil engineering projects successfully. Fly ash provides stability to sub grade, reduce earth pressure and also improves stability of slopes. Usually fly ash is mixed with clayey soils to improve properties as these soils cannot be used directly for construction due to their unfavorable properties.RHA is a carbon neutral green product. Lots of ways are being thought of for disposing them by making commercial use of this RHA. RHA is a good super- pozzolan.

1. Natural soil.
2. 92 % Soil + 8% Fly ash
3. 86 % Soil + 14% Fly ash
4. 82 % Soil + 18% Fly ash
5. 76 % Soil + 24 % Fly

## 2.1 INDEX PROPERTIES OF SOIL Plasticity Index

Plasticity index of soil was 5 % which is numerical difference between liquid limit and plastic limit.

## Type of soil

The type of soil was checked from plasticity chart. It was seen that soil which is taken for this study is intermediate plasticity. As per IS 1498 soil is classified as CI.

Engineering properties are indicated by index properties of in table 2.1.

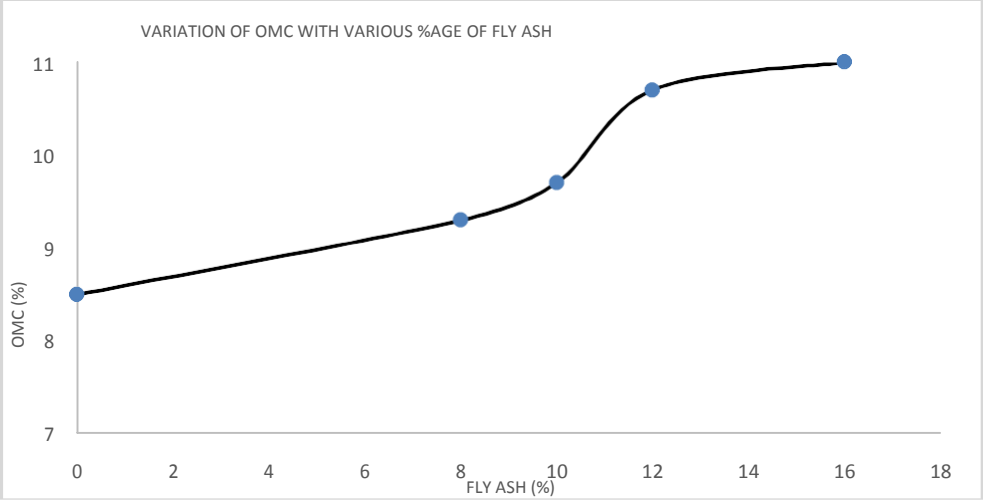
**Table2.1 GeotechnicalPropertiesofsoil**

| SR.NO | PROPERTIES | VALUE | CONFIRMINGTOIS CODE |
|---|---|---|---|
| 1. | Specificgravity(G) | 2.60 | IS 2720 : Part 3 : Sec 1 :1980 |
| 2. | Maximum drydensity(MDD) | 2.124 gm/cc | IS 2720 : Part VII: 1980 |
| 3. | Optimum moisture content(OMC) | 8.4 % | IS 2720 : Part VII: 1980 |
| 4. | Naturalmoisture content | 8.6 % | IS 2720 : Part 2 : 1973 |
| 5. | Liquid limit | 24 | IS 2720 : Part 5 : 1985 |
| 6. | Plastic limit | 19 | IS 2720 :Part 5 : 1985 |

### III. RESULTS AND DISCUSSION

Maximum dry density (MDD) and Optimum moisture content (OMC) of soil at different fly ash contents given in table 3.1

| Ash content (%) | 0 | 8 | 14 | 18 | 24 |
|---|---|---|---|---|---|
| OMC (%) | 8.5 | 9.3 | 9.7 | 10.7 | 11.0 |
| MDD (gm/cc) | 2.124 | 2.012 | 1.990 | 1.920 | 1.900 |



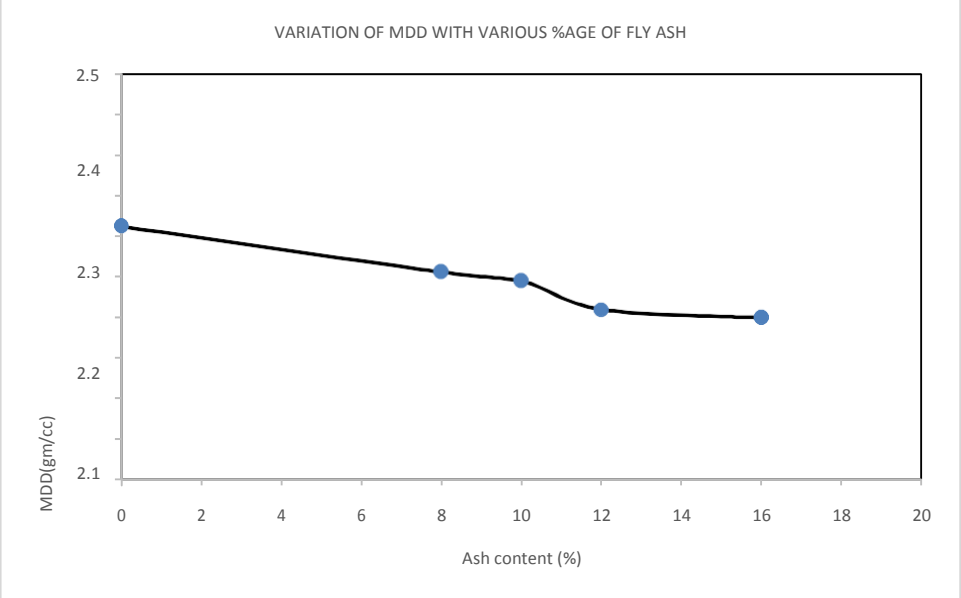



**FIG . 3.1 OMC AND MDD AT VARIOUS PERCENTAGES OF FLY ASH**

### 3.1 CALIFORNIA BEARING RATIO OF VIRGIN SOIL (CBR TEST)

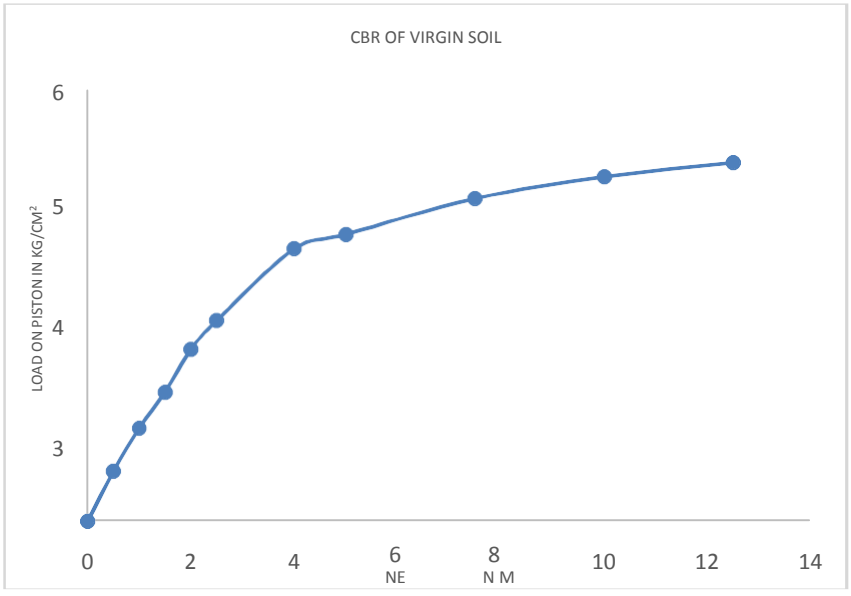



**Figure 3.2 CBR of virgin Soil**

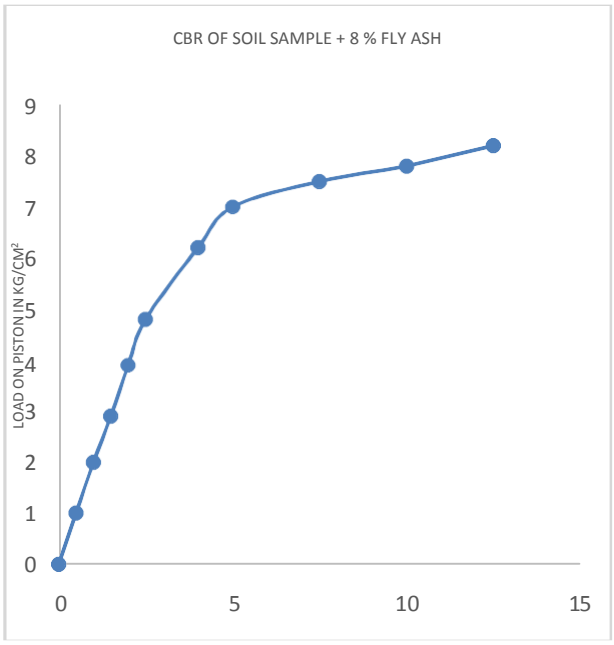



Figure 3.3 CBR of soil sample with 8% fly ash

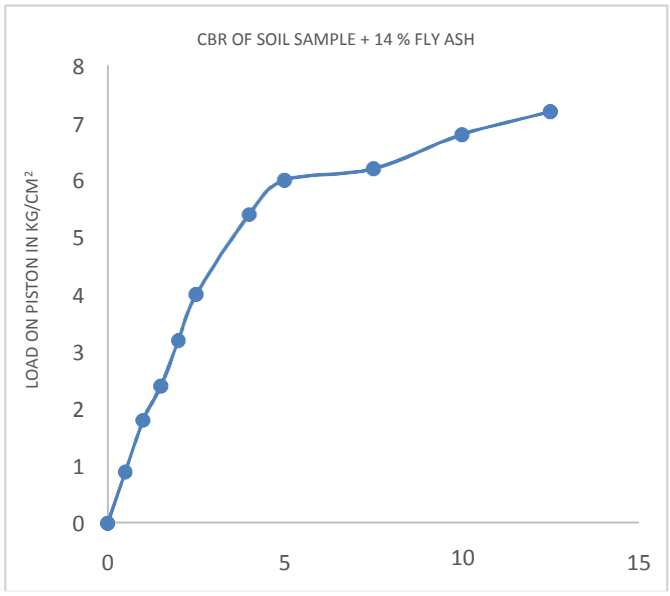



Figure 3.4 CBR graph at 14 % fly ash

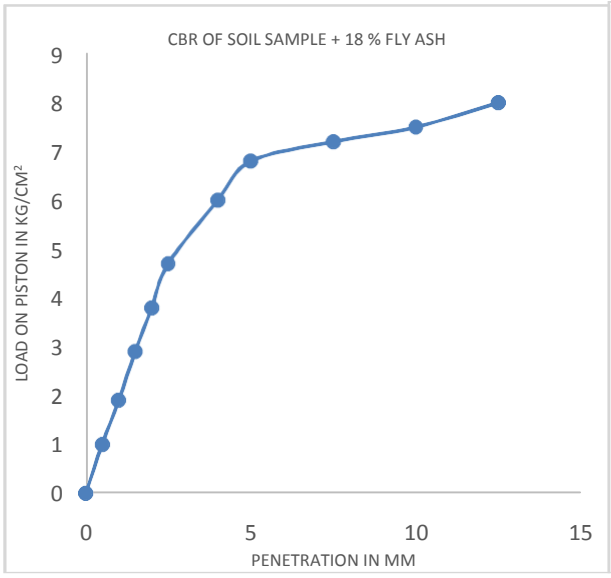



Figure 3.5 CBR graph at 18 % fly ash

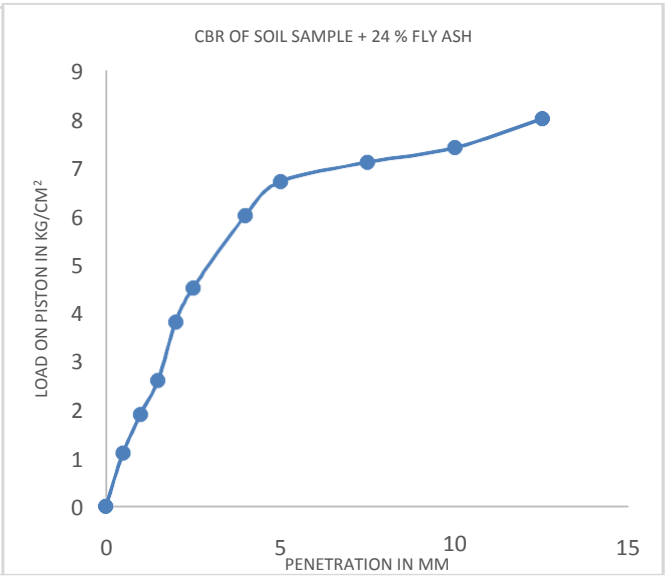
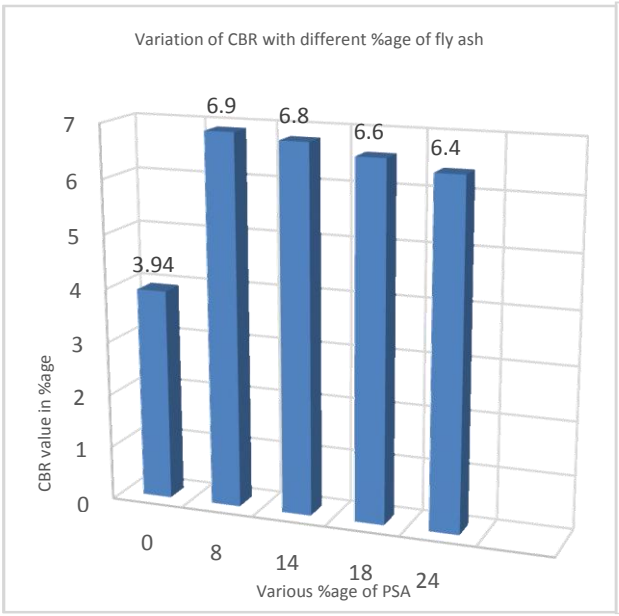



Figure 3.6 CBR graph at 24 % fly ash

**Table 3.2: Summary of CBR test with various percentages of fly ash**

| Sample No | Composition | Soaked CBR (%) | | |
|---|---|---|---|---|
| | | At 2.5 mm penetration | At 5 mm penetration | CBR |
| 1 | Soil | 3.94 | 3.86 | 3.94 |
| 2 | Soil with 8% fly ash | 6.9 | 6.7 | 6.9 |
| 3 | Soil with 14 % fly ash | 6.8 | 6.3 | 6.8 |
| 4 | Soil with 18 % fly ash | 6.6 | 6.2 | 6.6 |
| 5 | Soil with 24 % fly ash | 6.4 | 6.3 | 6.4 |



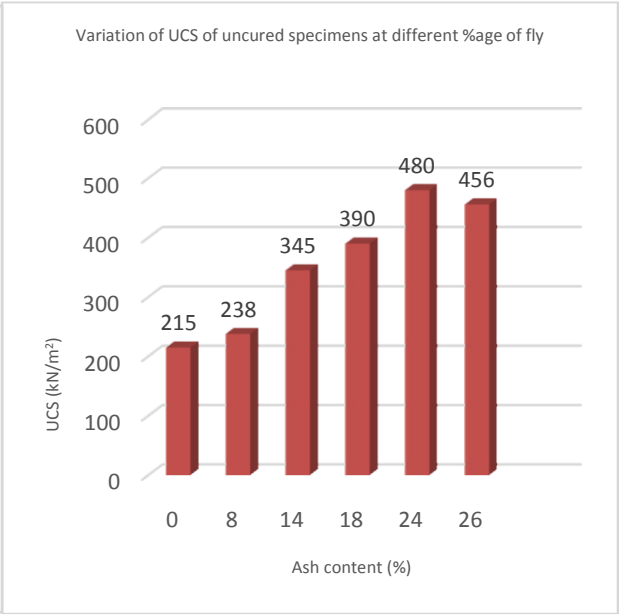




**Figure 3.8 Variation of CBR with different %age of fly ashFigure 3.9 unconfined compressive strength at different percentages of fly ash**

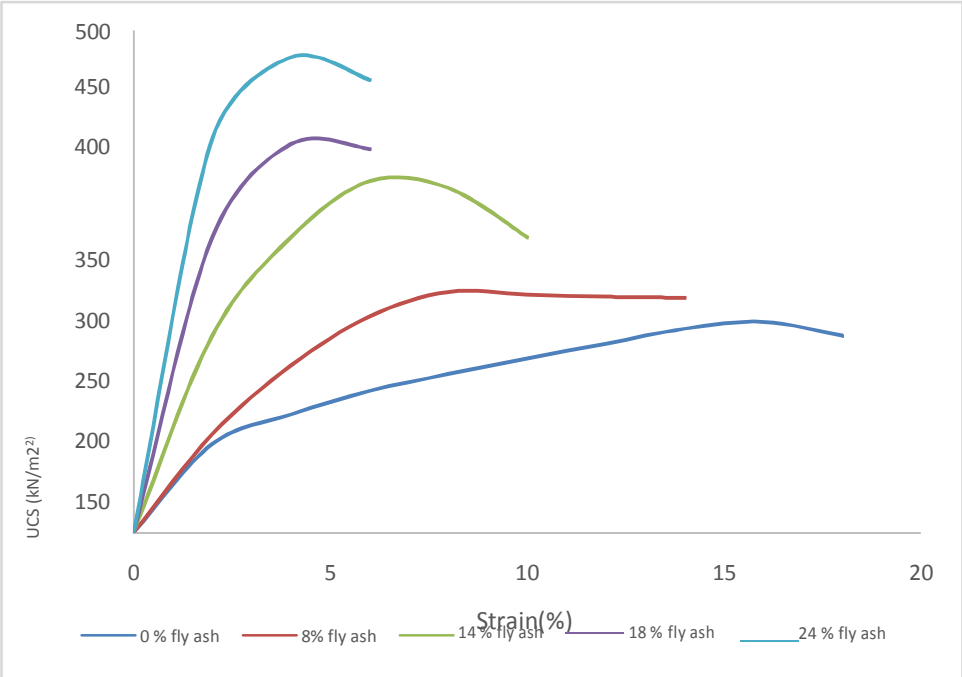
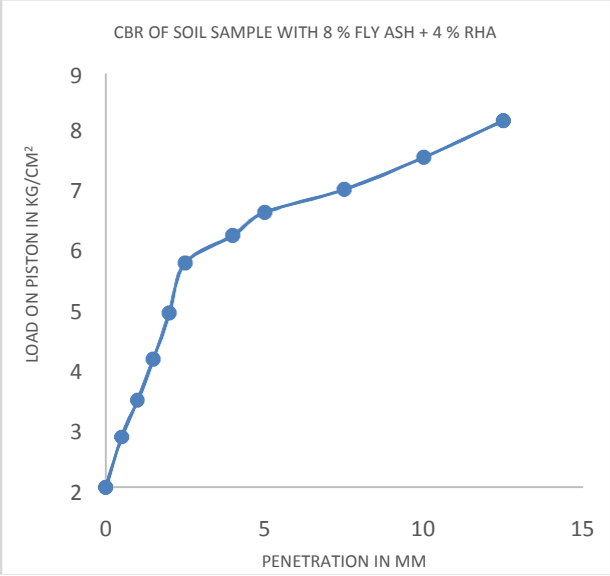



**Fig 3.10 Variation of strain with different percentages of ash content**



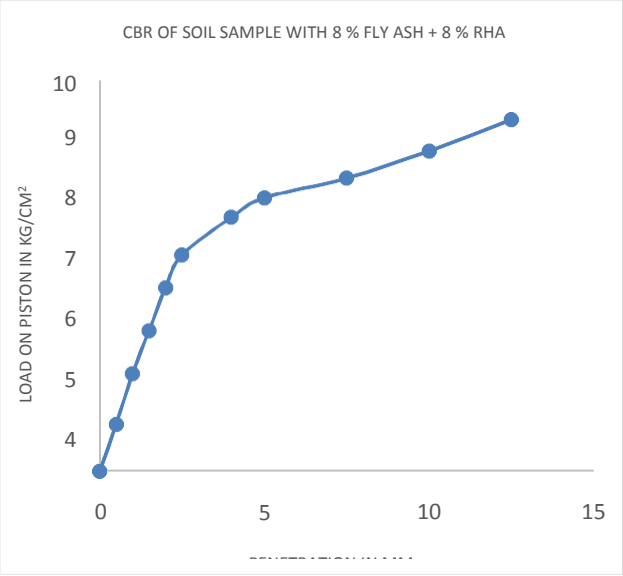
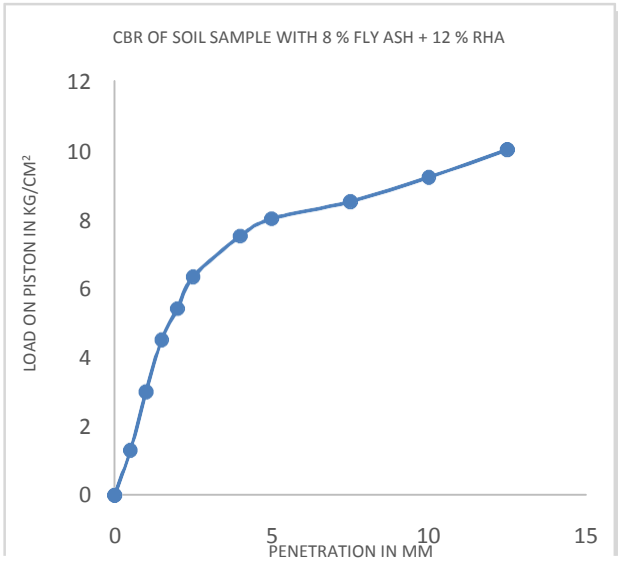




**Figure 3.11 CBR graph at 8% fly ash and 4% RHA** **Figure 3.12 CBR graph at 8% fly ash and 8 % RHA**



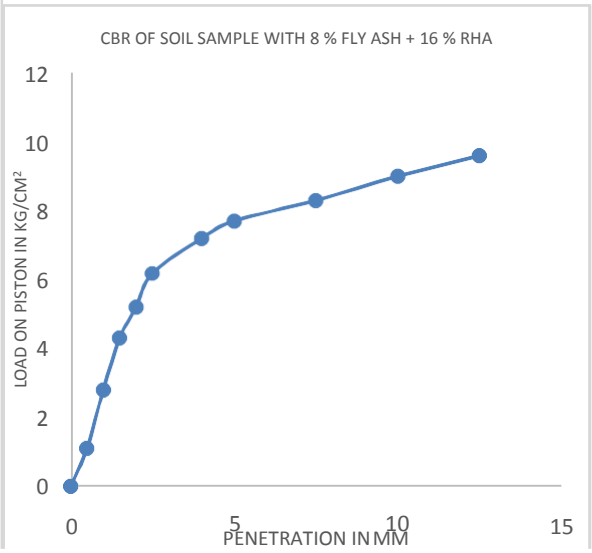
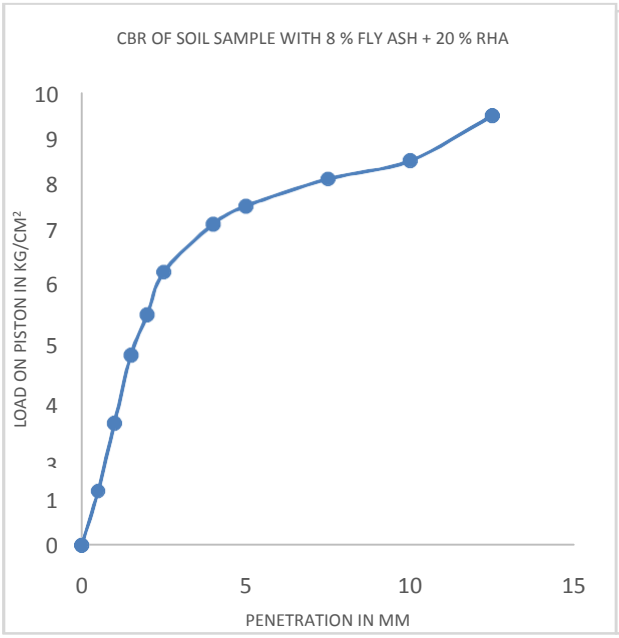




**Figure 3.13 CBR graph at 8% fly ash and 12% RHAFigure 3.14 CBR graph at 8% fly ash and 16% RHA**



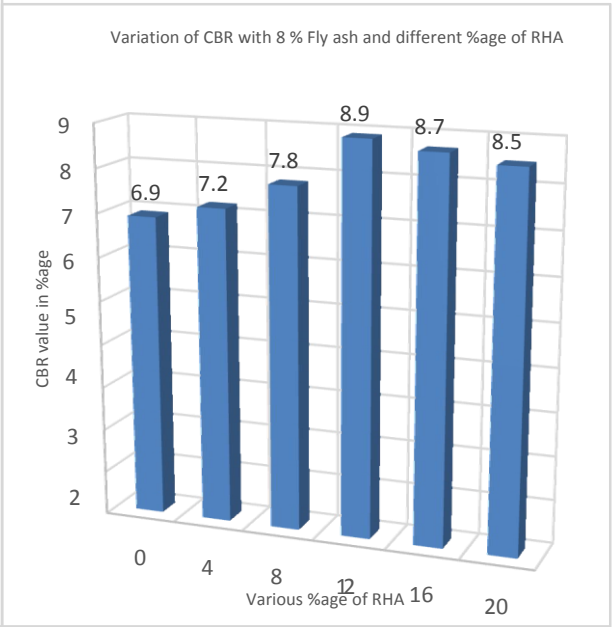




**Figure 3.15 CBR graph at 8% fly ash and 20 % RHAFigure 3.15 CBR Summary of soil with 8% fly ash and different %age of RHA**

## IV. CONCLUSIONS

The experimental work done on soil stabilization with fly ash and rice husk ash can be concluded as follows -

- Soil with varying percentage of fly ash gives maximum CBR value at 8% fly ash. It increases from 3.94 % to 6.8 %. With further addition of fly ash, it keeps decreasing.
- Unconfined compressive strength of soil with 8% fly ash increased as compared to virgin soil from 2.154 kg/cm2 to 2.38 kg/cm2. It was maximum as 4.80kg/cm2 when 24 % Paper mill sludge ash was added. After there was decrement in UCS when 26 % paper mill sludge ash was added.
- The soil with 8 % fly ash was further blended with variable percentage of rice husk ash (4%,8%, 12%,16%&20%). The major improvement in CBR occurred at 8% fly ash mixed with 12% rice husk ash and thereafter, further addition of rice husk ash is causing gradual change in CBR values. The peak soaked CBR value is 8.9 %.

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