# Experimental Study of Coarse Sand Kerawa Soil Mixture

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**ABSTRACT**

Soil is the fundamental element of all civil engineering structures acting as support to bear all incoming loads of all kinds safely. For the stability and durability of all structures ,the underlying soil should be sound and not undergo behavioral changes like excessive swelling and shrinkage, decomposition of organic matter , volume changes which all lead to loss of shear strength, excessive settlement. To overcome the above problems, the advanced technology has made a serious concern to control the unpredictable behavior of soil. The focus of the present study is to investigate the effect of addition of coarse sand in different percentages by weight to karewa soils taken from Awantipora AIIMS site. Which leads to the changes on engineering behavior of soil. The inputs of the study is the addition of coarse sand in the different %'s by weight to soil and the suitable soil samples were made under standard conditions of curing and testing strictly under IS – codal provisions. From the analysis and discussion of results, the results for shear strength parameters (c and φ), CBR %, UCS (kg/m$^2$) and compaction characteristics (OMC and MDD) were finalized and analyzed. The analysis of these results shows the improvement of 'c' from 32.72 kPa to 43.50 kPa ,φ value changes from 10.15 to 26.65$^{0,}$ CBR value changes from 2.57 to 9.14 and UCS value changes from 100.062kPa to 186.3 kPa for untreated to treated sample.

**Keywords:** Coarse sand, California Bearing Ratio (CBR), Unconfined Compression strength (UCS), Optimum moisture content (OMC), Maximum dry density (MDD), Shear strength.

## 1. INTRODUCTION

From the beginning of construction work, the necessity of enhancing soil properties has come to the light. Ancient civilizations of the Chinese, Romans and Incas utilized various methods to improve soil strength etc., some of these methods were so effective that their buildings and roads still exist.

In India, the modern era of soil improvement began in early 1970's, with a general shortage of petroleum and aggregates, it became necessary for the engineers to look at means to improve soil other than replacing the poor soil at the building site. Soil improvement was used but due to the use of obsolete methods and also due to the absence of proper technique, soil stabilization lost favor. In recent times, with the increase in the demand for infrastructure, raw materials and fuel, soil improvement has started to take a new shape.

Stabilization, etc. Generally, modification of the soil properties can be done by blending it with different materials such as lime, cement and fly powder or by reinforcing the soil. Real challenge in front of civil engineers is to lay the substructure over poor soil like clay. Stabilization of the soil is one of the conventional and most preferable ways to improve the properties of the kind of soil. Shear strengths of the stabilized soil with different fiber combinations is determined by conducting series of Unconfined Compression (UCC) tests. California Bearing Ratio (CBR) tests are also conducted on stabilized soil to determine the suitability of the best fibre reinforcement. The natural fibers used as reinforcement are coconut coir fibre and Rice husk powder whereas the synthetic fibers used as reinforcement are nylon fiber and glass fiber. The results obtained are compared and inferences are drawn towards the usability and effectiveness of best fiber reinforcement which improves the strength of the soil. In the present study, clay soil is satisfied using combination of coarse sand natural fibers. Studies have already been carried out by many researches to stabilize clay using natural or synthetic fibers. Here the best combination of fiber is found to effectively stabilize the soil.

Here, in this project, soil improvement has been done with the help of coarse sand. The improvement in the bearing capacity and shear strength parameters have been stressed upon and comparative studies have been carried out using different methods of shear resistance measurement.

**Objectives**

1. To study the effects of coarse sand on shear strength of clayey soil using DST and CBR.
2. To enhance the CBR of soil by increasing the coarse sand content.
3. To investigate the Atterberg's limits and the in-situ water content and the unit weight of soil.
4. To evaluate the OMC of the sample by carrying out Standard Proctor Test.
5. To study the effect on ultimate bearing capacity of Karewa soil by the addition of coarse content in definite percentages by weight.

**Material used**

**Karewa soil:** It is an intermountain valley fill, comprising of unconsolidated gravel and mud. A succession of plateaus is present above the Plains of Jhelum and its tributaries. These plateau-like terraces are called 'Karewas' or 'Vudr' in the local language.

**Coarse sand:** Sand is a granular material composed of finely divided rock and mineral particles. It is defined by size, being finer than gravel and coarser than silt. Coarse sand which passes through a sieve of 2 mm & is retained on a sieve of 0.425 mm was used as an additive.

## 2. EXPERMENTAL WORK

The experimental work consists of the following steps:

1. Determination of Specific gravity of soil.
2. Determination of soil index properties (Atterberg Limits).
   i) Liquid limit by Casagrande's apparatus.
   ii) Plastic limit.
3. Classification of soil as per indian standard classification system.
4. Determination of the maximum dry density (MDD) and the corresponding optimum moisture content (OMC) of the soil by Proctor compaction test.
5. Determination of the shear strength by:
   i) Direct shear test (DST)
   ii) Unconfined compression test (UCS).
6. Determination of CBR values of different samples
7. Determination of ultimate bearing capacity of karewa soil at different percentages of coarse content added.

## 3. RESULTS AND DISCUSSION

**Specific gravity:** Specific gravity of soil solids at room temperature in accordance with IS: 2720-1980(Part-3) was determined with pycnometer and was recorded as **2.68**.

**Liquid and Plastic limit:** Liquid & Plastic limit in accordance with IS: 2720-1985(Part-5). Liquid & plastic limit tests were conducted on the obtained samples and was recorded as **33.58%** and **25.34%** respectively.

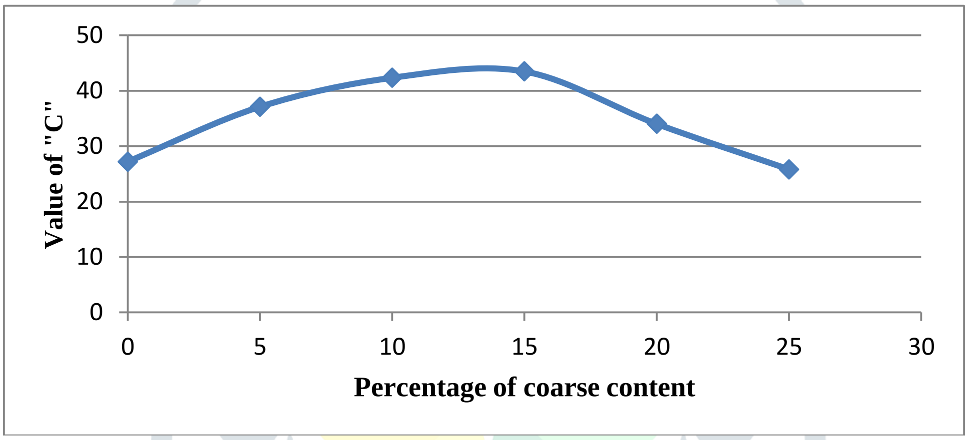
**Classification of soil as per Indian Standard Classification (ISC) system:** More than 50% of soil passes through 75micron sieve, the soil is fine grained. Also plasticity index is 8.24%.But from equation of A-Line plasticity index is 9.91%. Hence our soil falls below A-Line and having liquid limit between 20-35%, thus our soil is **"ML" type i.e. "silt of low compressibility" / "clayey silt".**

**Standard Proctor Compaction Test:** From light compaction proctor test optimum moisture content and maximum dry density was recorded as **17.5%** and **1806 kg/m$^3$.**

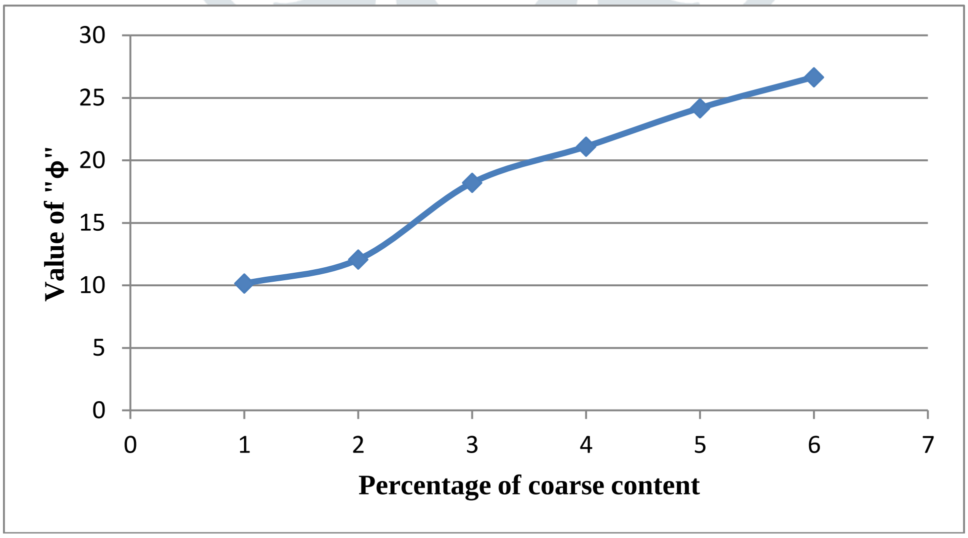
**Direct Shear Test:** Direct shear test as per IS: 2720-1975(Part-29), three soil samples were sheared under three vertical load conditions & the maximum shear stress was determined in each case. From the maximum shear-vs- normal stress plot, the strength parameters, namely cohesion (c) & angle of internal friction (φ) were calculated.

## SUMMARY OF DIRECT SHEAR TEST

| S. NO | Percentage of coarse content | Value of "C" (KPa) | Value of "φ" |
|---|---|---|---|
| 1 | Pure sample | 27.2 | 10.15˚ |
| 2 | 5% | 37.11 | 12.08˚ |
| 3 | 10% | 42.36 | 18.21˚ |
| 4 | 15% | 43.50 | 21.1˚ |
| 5 | 20% | 34.03 | 24.18˚ |
| 6 | 25% | 25.82 | 26.65˚ |




Graph between percentage coarse content & "C" value

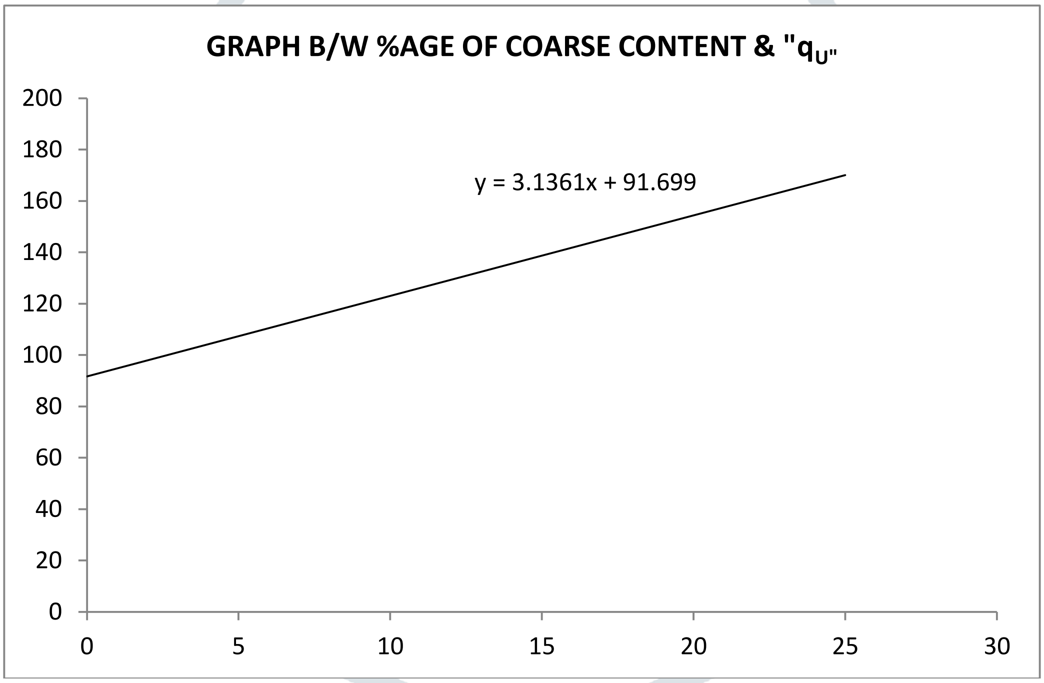



Graph between percentage coarse content & "φ" value

**Unconfined Compression Strength Test:**As per IS specifications, unconfined compression test was performed on the soil samples with different percentage of coarse content ranging from 0 to 25%.The results recorded are summarized as;

**SUMMARY OF UCT**

| S No. | %age of coarse content | $q_u$ (KPa) | C (KPa) |
|---|---|---|---|
| **1** | 0 | 100.062 | 50.031 |
| **2** | 5 | 109.774 | 54.887 |
| **3** | 10 | 117.524 | 58.762 |
| **4** | 15 | 125.372 | 62.686 |
| **5** | 20 | 146.365 | 73.183 |
| **6** | 25 | 186.3 | 93.146 |

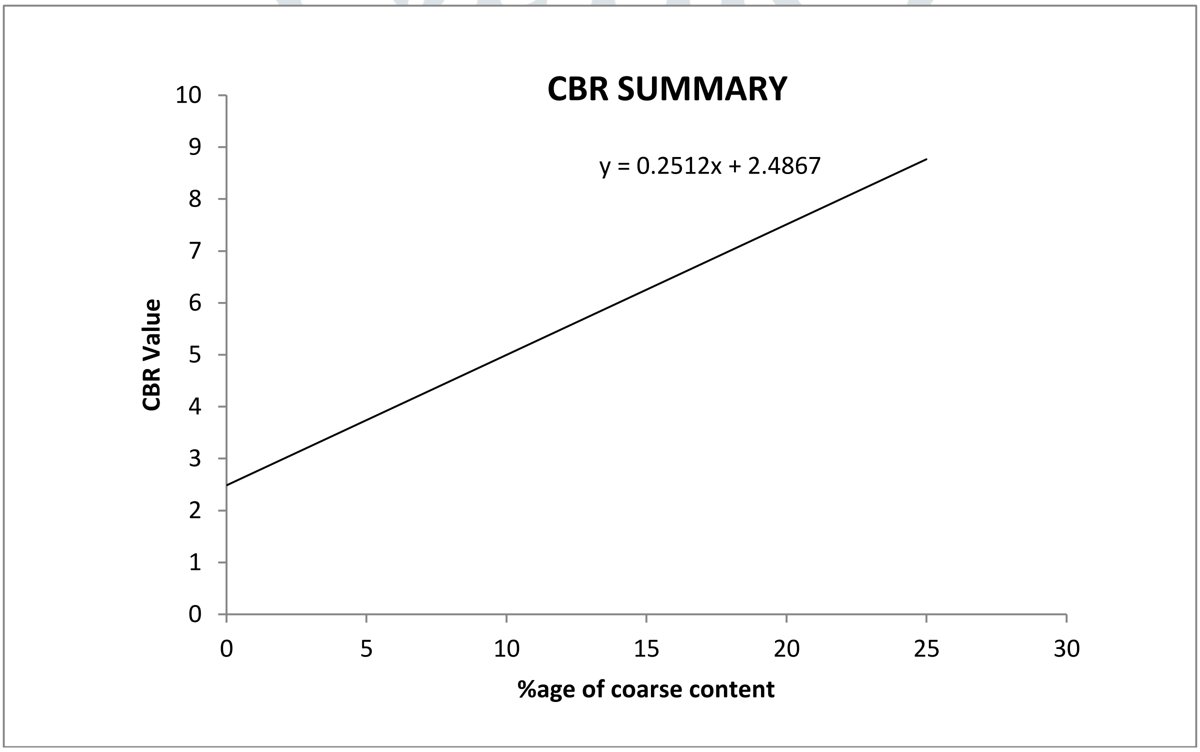



<u>**Graph between %age of coarse content & “$q_u$”**</u>

**California Bearing Ratio Test:** The CBR test has been conducted for an unsoaked soil sample with coarse content varing from 0 to 25%. The results recorded are summarized as;

**SUMMARY OF CBR**

| S.NO | %AGE OF COARSE CONTENT | CBR VALUE |
|---|---|---|
| **1** | 0 | 2.57 |
| **2** | 5 | 4.27 |
| **3** | 10 | 4.43 |
| **4** | 15 | 5.85 |
| **5** | 20 | 7.5 |
| **6** | 25 | 9.14 |




**Graph between CBR value & %age of coarse content.**

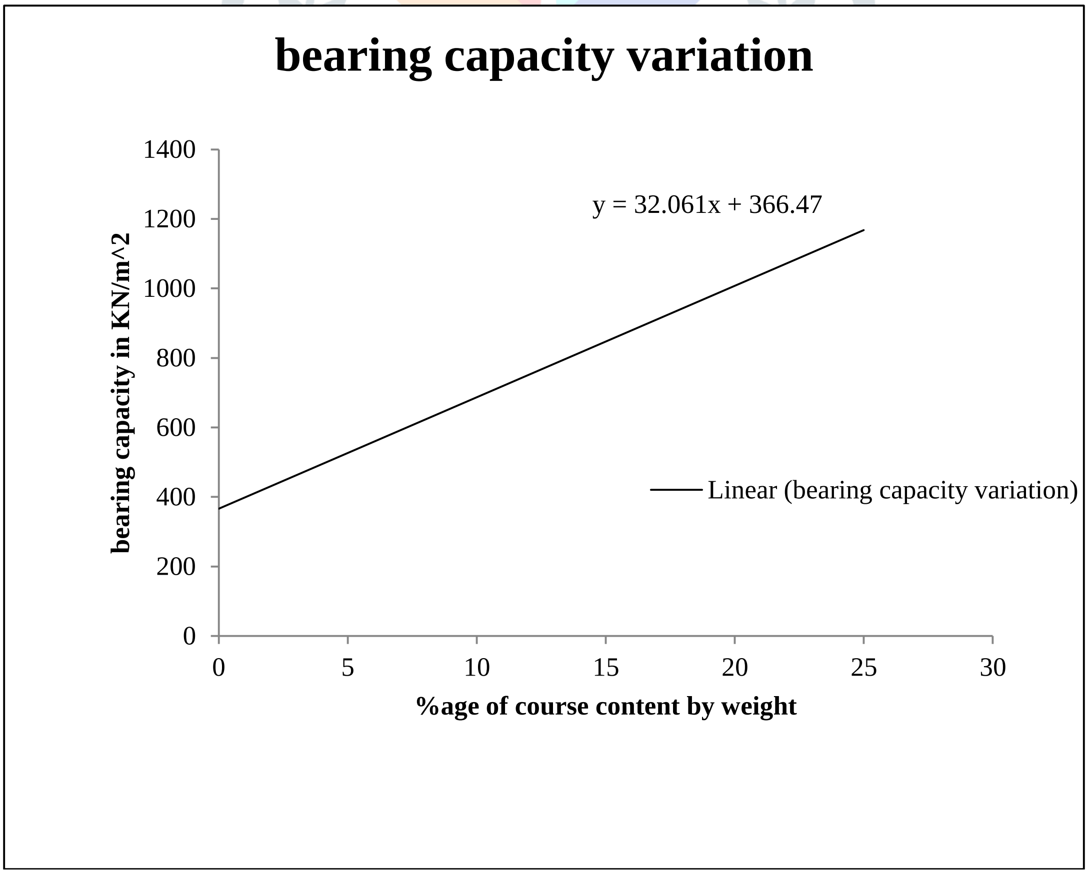
**Ultimate Bearing Capacity:** The ultimate bearing capacity is calculated by using Terzaghi's analysis which is given as;

$q_u = c\,N_c + \gamma\,D_f\,N_q + .5\,\gamma\,B\,N_\gamma$

Where "B" is assumed as 1m & depth of foundation "$D_f$" as 0.3m

**Variation of ultimate bearing capacity w.r.t different %age of coarse content**

| **% of coarse content** | **ø** | **$N_C$** | **$N_q$** | **"$N_\gamma$"** | **"C"** | **ultimate bearing capacity $q_u$ (KN/m$^2$)** |
|---|---|---|---|---|---|---|
| **0** | 10.51 | 9.699 | 2.751 | 1.239 | 27.72 | **306.840** |
| **5** | 12.08 | 10.973 | 3.407 | 1.741 | 37.11 | **456.964** |
| **10** | 18.21 | 15.98 | 6.326 | 4.105 | 42.36 | **780.766** |
| **15** | 21.1 | 19.328 | 8.566 | 6.034 | 43.5 | **987.644** |
| **20** | 24.18 | 23.886 | 11.831 | 8.929 | 34.03 | **1023.523** |
| **25** | 26.65 | 29.09 | 15.934 | 13 | 25.82 | **1047.660** |




## 4. CONCLUSION

The following conclusions are drawn, based on the present experimental study:

- Based on the direct shear test on the soil sample- with a coarse content of 5 percent, 10 percent & 15 percent, the cohesion increase was found to be 13.4 percent, 14.14 percent & 2.69 percent respectively, but the cohesion was seen to decrease dramatically when adding more coarse material. The rise in the internal friction angle (φ) was found to be 19.01%, 50.74% & 15.87% respectively.

- The results of the UCS test shows continuous increase in unconfined compression strength with the increase in coarse content. It was seen that $q_u$ value increases from 100.063kpa to 186.3kpa by changing coarse content from 0 to 25%.
- Based on CBR test on soil sample with coarse content varying from of 5% to 25%, the CBR value increases continuously from 2.57 to 9.14.
- Based on Tergazhi's Bearing capacity analysis for soil sample with coarse content varying from of 5% to 25%, the ultimate bearing capacity increases continuously from 306.8 KN/$m^2$ to 1047.6 KN/$m^2$.

## 5. REFRENCES

**1**. Ranjan Gopal, and Rao, A.S.R, "Basic and applied soil mechanics", New Age International Publishers.

**2**. Arora.K.R, "Soil Mechanics and Foundation Engineering", Standard Publishers.

**3**. R. Salgado (2000). Shear Strength and Stiffness of Silty Sand. Journal of Geotechnical and Geoenvironmental Engineering, ASCE, Vol.126, May. No.5, 451- 462.

**4**. H. Mastuoka, S. Liu, D. Sun, and U.Nishikata,"Development of New In-Situ Direct Shear Test," Geotechnical Testing Journal 24,no. 1(2001)

**5**. MM.Monkul ,G.Ozden ,"Compressional behavior of clayey sand and transition fines content" Engineering Gelogy volume -96 (2007)

**6**. Dr.Robert , M.Books," Soil stabilization with fly ash and rice husk ash". International journal of research and reviews of applied science, volume 1, Issunce 3 (December 2009)

**7.** Grytan Sarkr, Md.Rafiqul Islam,"Interpretation of rice husk ash on Geotechnical properties of cohesive soil". Journal of research in engineering. [s.1] v.12n (Feb. 2012)

**8.** Srilatha N, igs,"Stabilization of soil using rice husk ash and fly ash". International journal of research and review in applied science. (2013).

**9.** Md.Nuruzzman and Dr.Md Akhtar Hossian,"Effect of soda lime glass dust on properties of clayey soil".Global journal inc (USA) volume 14 Issue 5,version 1, year 2014.

**10.** A Modarres, YM Nosoundy,"Clay stabilization using coal waste and lime",Applied clay science. 2015 Elsevier.

**11.** P Dahale, P Nagarnaik,"Effect of fly ash and lime on stabilization of expansive soil". (2016)

**12.** M.Y.Shah and B.A.Mir, "Role of gliment as an additive on the CBR behavior of Kerewa soils". Indian geotechnical conference 2017.

**13.** Arif ur Rehman, Adeeb khan,Muhammad Hasnain. "Stabilization of subgrade by using additives (cement,lime)".Global scientific journal.volume 7,issue 4,April 2019.