

## Experimental Investigation on Compaction and CBR Characteristics of Soils using Brick Dust and Cement as Stabilizing Agents

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**Abstract-** In the present research work, brick dust and cement were mixed with soil to investigate the relative strength gain in terms of compaction characteristics and California Bearing Ratio value. The addition of cement and brick dust was found to improve the engineering properties of soil in stabilized forms specifically strength, workability, and compaction and California Bearing Ratio characteristics. Laboratory tests such as compaction, Atterberg's limits, and California Bearing Ratio were carried out for different percentages of Brick dust, cement and original soil samples. The laboratory tests were conducted as per Indian Standard specifications. The present experimental investigation showed that there is decrease in Optimum moisture content, increase in Maximum Dry Density, decrease in liquid and plastic limit values and also a tremendous increase in the CBR value of the soil treated with brick dust and cement, thus leading to decreased thickness requirements of the sub-base and base courses.

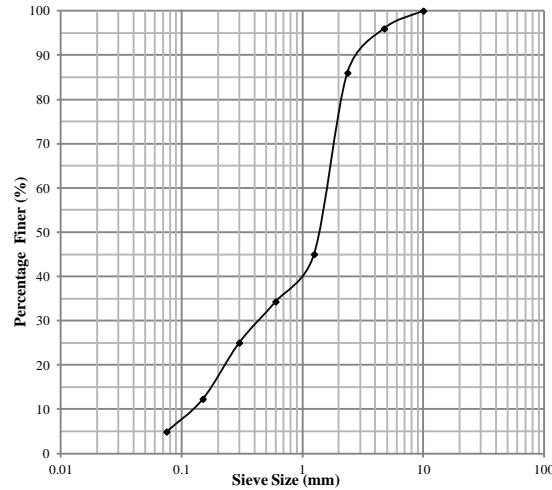
**Key Words:** Cement, Brick Dust, Index Properties, Compaction, CBR, Soil Stabilization.

### INTRODUCTION

The safety of structure depends upon the foundation and the soil around it. For the safety of structure, it's essential to have the proper knowledge regarding the properties and factors which affect the behaviour of soils. The process of soil stabilization is done to enhance the physical properties of soils which improve the load bearing capacity of a sub-grade to support the foundations. The soil stabilisation has emerged as a popular and cost-effective method for soil improvement [1]. The importance of cement and brick dust for the enhancement of Cement stabilization is done by mixing pulverized soil and Portland cement with water and compacting the mix to attain a strong soil [2]. The cement interacts with the silt and clay fractions and reduces their affinity for water. It reduces the swelling characteristics of the soil [3]. The replacement of soil by half of its dry weight by brick dust, gives maximum improvement on the engineering properties of black cotton soil [4]. B The stabilization process of clay and red soil with Brick kiln dust is very effective and increases the CBR value of clay from 0.6% to 6% and that of red soil from 2% to 21% [5]. The kiln ash can improve the engineering properties of tropical lateritic soils [6]. Brick dust is one such by-product or waste material from brick kilns. It has cementitious properties, but in presence of moisture it reacts chemically and forms cementitious compounds and attributes to the improvement of strength and compressibility characteristics of soils [7]. Cement increases the cohesive character of the soil and leads to decrease in permeability and porosity of the soil and Brick dust decreases the affinity of clay and silt particles towards water. On the whole, the CBR value of sub grade and sub base layers will be increased when cement and brick kiln dust are used as a stabilizing agents for pavement materials [8]. In the present experimental investigation cement and brick dust are used together for soil stabilization in order to enhance geotechnical properties of soil. The brick dust and cement are used as a soil stabilizing agents at varying percentages such as 4% and 1%, 8% and 2%, 12% and 3%, 16% and 4% respectively by weight of soil. The present study was conducted with an aim to determine the possibility of using brick dust and cement as stabilizing agents, the effect of brick dust and cement on proctor's density and OMC of clayey soils, and the effect of brick dust and cement on proctor's density and OMC of clayey soils

### Materials and experimental methodology

The brick dust was collected from a local brick kiln near Muradpur, Rajouri J&K. Brick dust obtained was clean and the samples used were sieved through 1.25 mm sieve to remove lumps, gravels and other materials which are deleterious to soil. The cement was procured from the market having 43 grade. The soil in the present research work was collected near polytechnic college within BGSBU campus, Rajouri, Jammu and Kashmir at 33.39549 latitude, 74.34968 longitude and altitude of 3843 ft above sea level. The prototypes for soils were created in the Geotechnical Engineering Laboratory, School of Engineering and Technology, BGSB University, Rajouri, J&K. The various preliminary tests for the index properties and strength properties were done as per IS Specifications [9]. The gradation curve of the soil sample used in the present investigation is presented in figure 1. Compaction characteristics of the soil have been determined by conducting SPT (Light Compaction) as per IS 2720 Part 7-1980 (reaffirmed 2011). The un-soaked samples for CBR testing were prepared at maximum dry density and optimum moisture content as obtained from SPT, as per IS (2720) Part 16-1987. The brick dust and cement were added to the soil at varying percentages such as 4% and 1%, 8% and 2%, 12% and 3%, 16% and 4% respectively by weight of soil. The specific gravity of Brick Dust and Cement was observed to be 2.857 and 3.15 respectively. Table 1 shows the properties of soil used in the present research work.



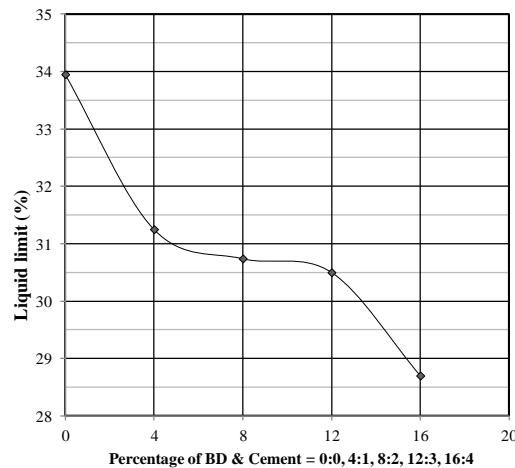
**Figure 1. Gradation curve of soil sample**

**Table 1. Properties of soil**

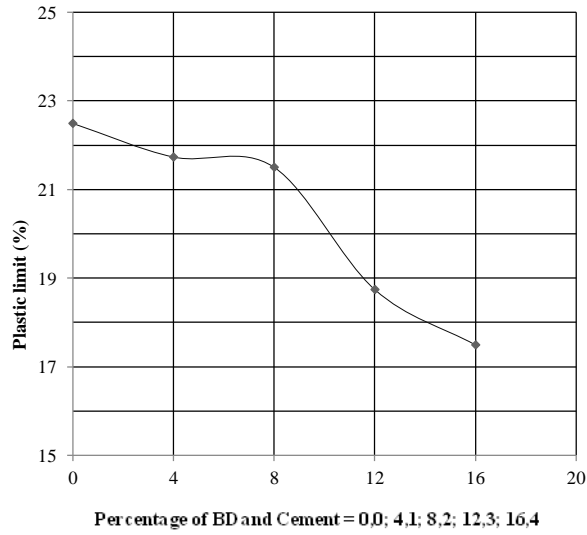
S. No.	Properties of soil	Value
1	Specific gravity	2.664
2	Liquid limit (%)	33.95
3	Plastic limit (%)	22.5
4	Plasticity index (%)	11.45
5	Coefficient of uniformity (Cu)	13.75
6	Coefficient of curvature (Cc)	1.023
7	Classification of soil(According to IS Classification)	SW (Well graded sand with 4.9 percent finer)
8	Maximum dry density ( $kN/m^3$ )	19.3
9	Optimum moisture content (%)	12.7
10	CBR (Soaked)	1.51

### RESULTS AND DISCUSSIONS

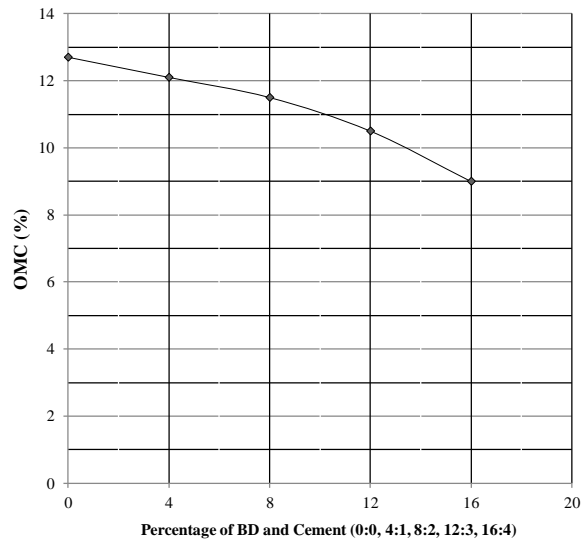
The experimental results reveal that the liquid limit and plastic limit of the soil decreases with addition of brick dust and cement, dry density of soil increased from 1.93 g/cc to 2.17 g/cc by addition of 16% of Brick dust and 4% of cement while as, Optimum Moisture Content decreased from 12.7% to 9%. Also, CBR value of soil increased from 1.51 to 2.01 by the addition of brick dust and cement. The variation of liquid limit, plastic limit, OMC, MDD and CBR with brick dust and cement are present in Figure (2-6).



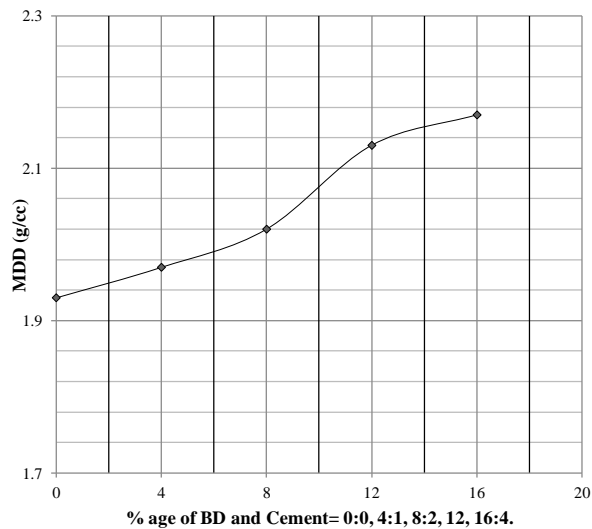
**Figure. 2 Variation of Liquid limit with brick dust and cement**



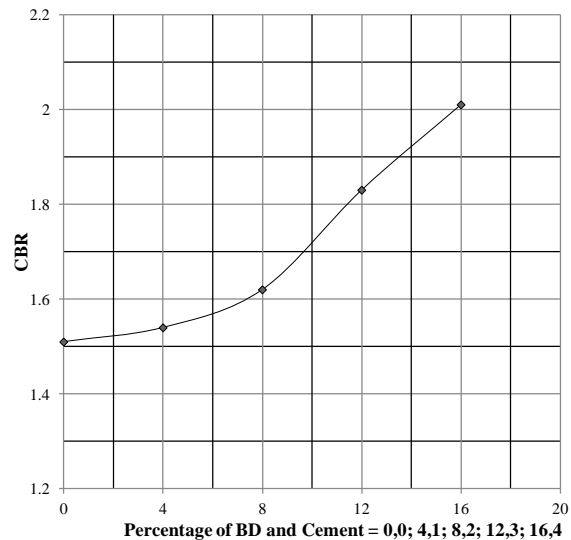
**Figure 3. Variation of Plastic limit of soil with brick dust and cement**



**Figure 4. Variation of OMC of soil with BD and cement**



**Figure 5. Variation of MDD of soil with BD and cement**



**Figure 6. Variation of CBR of soil with BD and cement**

### CONCLUSION

The present research work was carried out with an aim to determine the effect of addition of brick dust and cement on the geotechnical properties of soil. The experimental results reveal that the geotechnical properties of soil improve with the addition of brick dust and cement up to a great extent.

The present experimental study can be summed up as follows:

1. Soil stabilization using brick dust and cement is an effective & economical means for enhancing the geotechnical properties of soil.
2. There is decrease in OMC and increase in MDD with the addition of brick dust and cement and also a tremendous increase in the CBR value of the soil treated with brick dust and cement, thus leading to decreased thickness requirements of the sub-base and base courses for the foundations and pavements.
3. The geotechnical properties of soil increased to maximum level when 16% and 4% of brick dust and cement were added to the soil sample.

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