STUDY ON STABILIZATION OF SOIL USING BURNT BRICK

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ABSTRACT - *Burnt bricks can be obtained from brick kiln extensively used in all building constructional activities similar to that of common burnt clay bricks. The burnt brick ash is comparatively lighter in weight and stronger than common clay bricks. Since burnt brick ash is being accumulated as waste material in large quantity near brick kiln.*

The waste product removed from brick kiln which can be used as soil stabilizer. The appropriate use of waste product gives the stability and also gives strength to soil.

The Burnt Brick Bat is easily available and which can be generally obtained at very cheaper rate.

The object of this project is to represent the information regarding Burnt bricks properties and their uses in a most concise, compact and to the point manner. And also, in this project various laboratory experiments were carried out on burnt bricks samples. Some of them are CBR Test, Standard Proctor Test etc.

Key Words: *Soil Stabilisation, Burnt Brick Bat, Bearing Capacity, Fly-ash, etc.*

1. INTRODUCTION

Soil stabilization is the alternation of soil to enhance their physical properties stabilization can increase the shear strength on a soil and control shrink swell properties of a soil. Thus, improving the load bearing capacity of sub grade to support pavement and foundation. Soil stabilization is performed in much the same manner as full depth reclamation. A redaiming machine first pulverizes the soil material. Additive is then placed on top of these materials. This additive is mixed and remixed with the soil until the desired properties are achieved. For any land-based structure, the foundation is very important and has to be strong to support the entire structure. In order for the foundation to be strong, the soil around it plays a very critical role. So, to work with soils, we need to have proper knowledge about their properties and factors which affect their behaviour. The process of soil stabilization helps to achieve the required properties in a soil needed for the construction work.

Soil is highly Complex, Heterogeneous and Unpredictable material which has been subjected to vagaries of nature, without any control. The properties of soil change not only from one place to other but also at the place with depth and with a change in the environmental, loading and type, drainage and the conditions under which it exists. In comparison to other construction materials such as concrete or steel, it is not economically feasible to transport the soils from one place to other, because a huge quantity of soil is involved and it is not opened to inspect at greater depth for foundations of different structures. Sometimes, Civil Engineers are forced to construct structure at site selected for reasons other than soil conditions. Thus, it is increasingly important for the engineer to know the degree to which the engineering properties of the soil may improve or other alternatives that can be thought off for the construction of intended structure at the stipulated site. If unsuitable soil conditions are encountered at the site of proposed structure, unsuitable soil can be passed by means of deep foundation extended to a suitable bearing material, poor material can be removed and replaced by a suitable material, or soil in-place can be treated by using any suitable ground improvement methods to improve its engineering properties. Therefore, to work at the selected site, we need to have proper knowledge about their properties and factors which affect their behaviour. Hence, from the beginning of construction work, the necessity of enhancing the soil properties has come to the light and the process of soil stabilization helps us to achieve the required properties in a soil needed for the construction work.

Advantages of soil stabilization

1) Stabilized soil functions as a working platform for the project

2) Stabilization waterproofs the soil

3) Stabilization improves soil strength

4) Stabilization helps reduce soil volume change due to temperature or moisture

5) Stabilization improves soil workability

6) Stabilization reduces dust in work environment

7) Stabilization upgrades marginal materials

8) Stabilization improves durability

9) Stabilization dries wet soils

10) Stabilization conserves aggregate materials

11) Stabilization reduces cost

1.1. Materials used:

In this experimental study, an attempt is made to observe the effectiveness of stabilizing agents burnt brick alone and combination of in improving various engineering properties of soil like Liquid Limit, Plastic Limit, and Plasticity Index.

1.1.1. Soil:

Table 1: Determination of Classification of Black Cotton Soil Depending on the Index Properties

Sr. No.	Properties of soil sample	Value of properties
1.	Liquid limit	45%
2.	Plastic limit	33%
3.	Plasticity index(IP)	12%
4.	Type of soil as per:1498	BC
5.	Specific Gravity	2.62

The various engineering properties of the plain soil have been determined and are tabulated as given below:

Table 2: Values of Engineering Properties of the Black Cotton Soil

Sr. No.	Engineering Property of the Plain Soil Sample	Observed Value
1.	**Compressibility (MDD)** Maximum Dry Density, (Υd_{max}) Optimum Water Content, (w)	 1.4 g/cc 25 %
2.	**Direct Shear Strength (DSS)** Angle of Internal Friction (Φ) Cohesion (c)	 20° 0.29
3	**U7nconfined Compressive Strength, (UCS)**	2.14 KN/m^2

1.1.2. Various stabilizing material:

Soil stabilization has been carried out with cement, lime, fibre, fly ash etc. Adding some percentage of burnt brick powder in soil which can't be used in construction works may increase the stability of the soil.

1.1.3. Stabilizing Agents:

These are hydraulic (primary binders) or non-hydraulic (secondary binders) materials that when in contact with water or in the presence of pozzolanic minerals reacts with water to form cementations composite materials. The commonly used binders are:

1. Cement
2. Fibre
3. Fly-Ash

1.2. Necessities

i) Design load and function of the structure.

ii) Type of foundation to be used.

iii) Bearing capacity of subsoil.

In the past, the third criteria played a major role in decision making on site selection and once the bearing capacity of the soil was poor, the following were options:

i) Change the design to suit site condition.

ii) Remove and Replace the in-situ soil.

iii) Abandon the site.

Abandoned sites due to undesirable soil bearing capacities dramatically increased, and the outcome of this was the scarcity of land and increased demand for natural resources. Affected areas include those which were susceptible to

Liquefaction and those covered with soft clay and organic soils. Other areas were those in a landslide and contaminated land. However, in most geotechnical projects, it is not possible to obtain a construction site that will meet the design

Requirements without ground modification. The current practice is to modify the engineering properties of the native problematic soils to meet the design specifications. Nowadays, soils such as, soft clays and organic soils can be improved to the civil engineering requirements. This state of the art review focuses on soil stabilization method which is one of the several methods of soil improvement. Soil stabilization aims at improving soil strength and increasing resistance to softening by water through bonding the soil particles together, water proofing the particles or combination of the two (Sherwood, 1993). Usually, the technology provides an alternative provision structural solution to a practical problem. The simplest stabilization processes are compaction and drainage (if water drains out of wet soil it becomes stronger). The other process is by improving gradation of particle size and further improvement can be achieved by adding binders to the weak soils (Rogers et al, 1996). Soil stabilization can be accomplished by several methods. All these methods fall into two broad categories namely.

1.3 Burnt Brick Bat:

Burnt bricks are the wastage which is removed from burnt kiln.

We are trying the burnt brick sample for increasing the bearing capacity of soil and strength of soil.

We are trying to use the powder form of burnt brick for the liquid limit and plastic limit test.

1.4. Needs and Advantages

Soil properties vary a great deal and construction of structures depends a lot on the bearing capacity of the soil, hence, we need to stabilize the soil which makes it easier to predict the load bearing capacity of the soil and even improve the load bearing capacity. The gradation of the soil is also a very important property to keep in mind while working with soils. The soils may be well-graded which is desirable as it has less number of voids or uniformly graded which though sounds stable but has more voids. Thus, it is better to mix different types of soils together to improve the soil strength properties. It is very expensive to replace the inferior soil entirely soil and hence, soil stabilization is the thing to look for in these cases.

It improves the strength of the soil, thus, increasing the soil bearing capacity.

It is more economical both in terms of cost and energy to increase the bearing capacity of the soil rather than going for deep foundation or raft foundation.

It is also used to provide more stability to the soil in slopes or other such places.

Sometimes soil stabilization is also used to prevent soil erosion or formation of dust, which is very useful especially in dry and arid weather.

It helps in reducing the soil volume change due to change in temperature or moisture content. Stabilization is also done for soil water-proofing; this prevents water from entering into the soil and hence helps the soil from losing its strength.

Stabilization improves the workability and the durability of the soil.

1.5. Mechanical Stabilization

Under this category, soil stabilization can be achieved through physical process by altering the physical nature of native soil particles by either induced vibration or compaction or by incorporating other physical properties such as barriers and nailing. Mechanical stabilization is not the main subject of this review and will not be further discussed.

1.5.1 Properties of fly ash

Liquid limit (%)	40.0
Maximum dry density (MDD), g/cc	1.164
Optimum moisture content (OMC),	32.0
Soaked CBR (%)	1.94
Specific gravity	1.9-2.55

1.6. Chemical Composition of Ash:

It is also known as "Pulverised fuel ash" in the United Kingdom, is one of the coal combustion products, composed of the fine particles that are driven out of the boiler with the flue gases. Ash that falls in the bottom of the boiler is called bottom ash. Depending upon the source and makeup of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial amounts of silicon dioxide (SiO_2) (both amorphous and crystalline), aluminium oxide (Al_2O_3) and calcium oxide (CaO), the main mineral compounds in coal-bearing rock strata.

Constituents depend upon the specific coal bed makeup but may include one or more of the following elements or substances found in trace concentrations (up to hundreds ppm): arsenic, beryllium, boron, cadmium, chromium, hexavalent chromium, cobalt, lead, manganese, mercury, molybdenum, selenium, strontium, thallium, and vanadium, along with very small concentrations of dioxins and PAH compounds.

In the past, fly ash was generally released into the atmosphere, but air pollution control standards now require that it be captured prior to release by fitting pollution control equipment. In the US, fly ash is generally stored at coal power plants or placed in landfills. About 43% is recycled, often used as a pozzolana to produce hydraulic cement or hydraulic plaster and a replacement or partial replacement for Portland cement in concrete production. Pozzolana ensures the setting of concrete and plaster and provide concrete with more protection from wet conditions and chemical attack. In the cases that fly or bottom ash is not produced from coal, for example when solid waste is used to produce electricity in an incinerator this kind of ash may contain higher levels of contaminants than coal ash. In that case the ash produced is often classified as hazardous waste.

Chemical Composition	Proportion (%)
Silica (Sio2)	55.69
Alumina (Al2o3)	26.33
Calcium oxide (Cao)	3.43
Iron oxide (Fe2O3)	6.90
Potassium Oxide (K2O)	0.98
Sulphur (SO3)	0.45
Magnesium Oxide (MgO)	0.62

1.7. Effect of Fly-Ash on Soil:

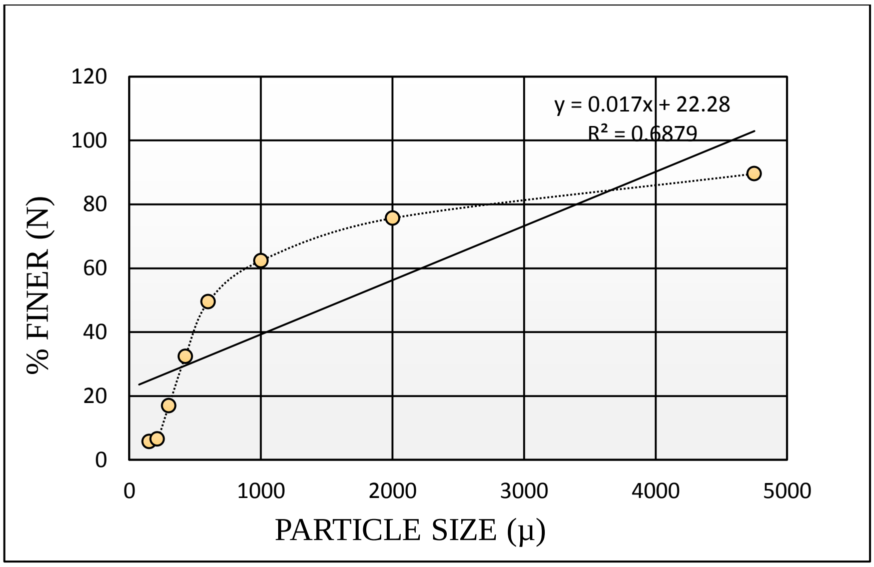
Fly ash is a waste produced from the burning of coal in thermal power stations. The staggering increase in the production of fly ash and its disposal in an environmentally friendly manner is increasingly becoming a matter of global concern. Efforts are underway to improve the use of fly ash in several ways, with the geotechnical utilization also forming an important aspect of these efforts. An experimental program was undertaken to investigate the effects of multifilament and fibrillated polypropylene fibre on the compaction and strength behaviour of soil with fly ash in different proportions. The soil samples were prepared at two different percentages of fibre content. A series of test be conducted and effect of a fibre and the fly-ash on the soil is studied.

2. PERFORMANCE ANALYSIS

2.1 PARTICLE SIZE DISTRIBUTION:

Table 2.a: Particle Size Distribution

No	IS Sieve	Particle Size	Mass retained (g)	% Retain	Cumulative % age	% Finer
01	4.75mm	4.75mm	41.70	10.43%	10.43	89.58
02	2mm	2mm	55.61	13.90%	24.33	75.67
03	1mm	1mm	53.30	13.334%	37.65	62.35
04	600 µ	0.600mm	51.60	12.90%	50.55	49.45
05	425 µ	0.425mm	68.60	17.15%	67.70	32.30
06	300 µ	0.300mm	61.60	15.40%	83.10	16.90
07	212 µ	0.212mm	41.80	10.45%	93.55	6.45
08	150 µ	0.150mm	3.00	0.75%	94.30	5.70
09	75 µ	0.75mm	4.40	1.10%	95.40	4.60
10	Pan	-	18.39	4.60	100.00	0.00



Graph 2.a: Particle size distribution

- **The Values Corresponding to D10, D30, D60**

Unconformity coefficient C_u

$$C_u = \frac{D_{60}}{D_{10}}$$

= (900\250)

= 3.6

Coefficient of Curvature c_c

$$C_c = \frac{(D_{30})^2}{D_{60}.D_{10}}$$

= (410^2/900x250)

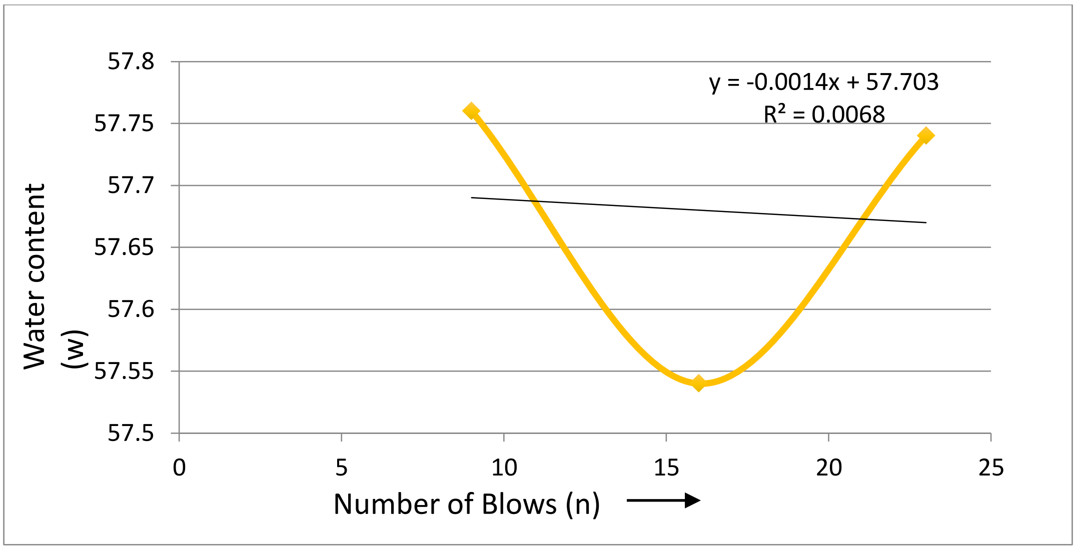
= 0.7

- C_c **between 1 and 3** also indicate a well-graded soil.
- Hence, we found the soil is well graded soil means that a soil which has a distribution of particles over a wide size range.
- C_u **< 3** indicates a **uniform soil**, i.e. a soil which has a very narrow particle size range

2.2 LIQUID LIMIT TEST (PLAIN SOIL)

Table 2.b: Liquid Limit Test (Plain Soil)

DETERMINATION NO	NOTATION	I	II	III
Container Number		15	17	16
Number of Blows		09	16	23
Weight of Container	W_0 (grams)	12.18	11.84	12.34
Weight of Container + Wet Soil	W_1 (grams)	14.72	14.66	16.11
Weight Of 1Container + Oven-dry Soil	W_2 (grams)	13.79	13.63	14.73
Weight of Water	W_1-W_2 (grams)	0.93	1.03	1.38
Weight of Oven-dry soil	W_2-W_0 (grams)	1.61	1.79	2.39
Water Content (as a percentage)	$W = \left[\frac{W1 - W2}{W2 - W0}\right] X\, 100$	57.76	57.54	57.74



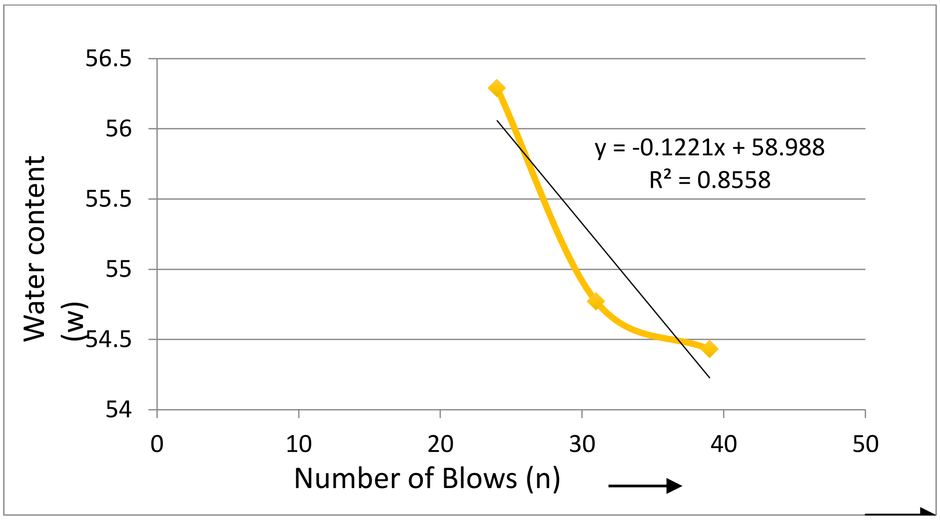
Graph 2.b: Liquid Limit Test (Plain Soil)

AVERAGE WATER CONTENT: W = 57.68 %

2.3 LIQUID LIMIT TEST (PLAIN SOIL+3% ASH)

Table 2.c: Liquid Limit Test (Plain Soil+3% Ash)

DETERMINATION NO	NOTATION	I	II	III
Container Number		93	06	19
Number of Blows		39	31	24
Weight of Container	W_0 (grams)	12.25	12.29	11.86
Weight of Container + Wet Soil	W_1 (grams)	14.61	14.72	14.30
Weight Of 1Container + Oven-dry Soil	W_2 (grams)	13.76	13.86	13.44
Weight of Water	W_1-W_2 (grams)	0.85	0.86	0.86
Weight of Oven-dry soil	W_2-W_0 (grams)	1.51	1.57	1.58
Water Content (as a percentage)	$W = \left[\frac{W1 - W2}{W2 - W0}\right] X\ 100$	56.29	54.77	54.43



Graph 2.c: Liquid Limit Test (Plain Soil+3% Ash)

AVERAGE WATER CONTENT: W = 55.16 %

2.4 PLASTIC LIMIT TEST (PLAIN SOIL)

Table 2.d: Plastic Limit Test (Plain Soil)

DETERMINATION NO	NOTATION	I	II
Container Number		89	90
Weight of Container	W_0 (grams)	11.66	12.17
Weight of Container + Wet Soil	W_1 (grams)	12.66	12.83
Weight of Container + Oven-dry Soil	W_2 (grams)	12.37	12.63
Weight of Water	W_1-W_2 (grams)	0.29	0.20
Weight of Oven-dry soil	W_2-W_0 (grams)	0.71	0.46
Water Content (as a percentage)	$W = \left[\frac{W1 - W2}{W2 - W0}\right] X\ 100$	40.84	43.47

Graph 2.d: Plastic Limit Test (Plain Soil)

PLASTIC LIMIT: W_P = 42.15 %

PLASTICITY INDEX:

PLASTICITY INDEX = LIQUID LIMIT – PLASTIC LIMIT

PLASTICITY INDEX = 15.53%

2.5 PLASTIC LIMIT TEST (PLAIN SOIL+3% ASH)

Table 2.e: Plastic Limit Test (Plain Soil+3% Ash)

DETERMINATION NO	NOTATION	I	II
Container Number		13	05
Weight of Container	W_0 (grams)	11.96	11.66
Weight of Container + Wet Soil	W_1 (grams)	12.440	12.163
Weight of Container + Oven-dry Soil	W_2 (grams)	12.29	12.01
Weight of Water	W_1-W_2 (grams)	0.15	0.153
Weight of Oven-dry soil	W_2-W_0 (grams)	0.33	0.35
Water Content (as a percentage)	$W = \left[\frac{W1 - W2}{W2 - W0}\right] X\ 100$	45.45	43.81

Graph 2.e: Plastic Limit Test (Plain Soil+3% Ash)

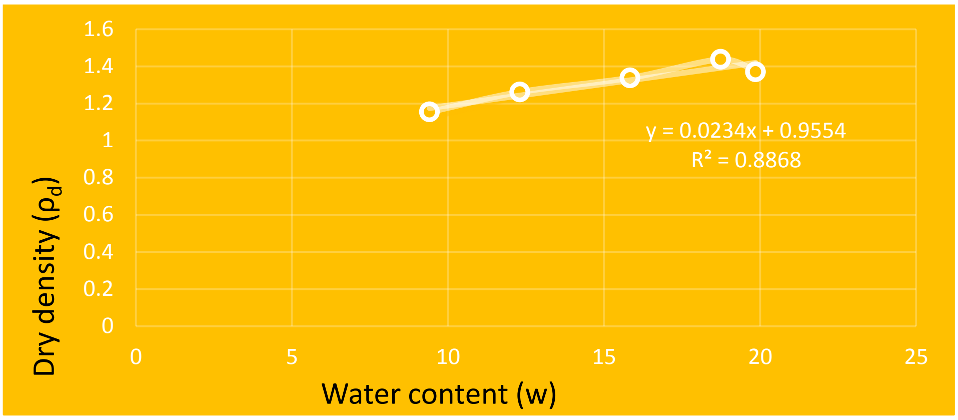
PLASTIC LIMIT: W_P = 44.63 %

PLASTICITY INDEX:
PLASTICITY INDEX = LIQUID LIMIT – PLASTIC LIMIT
PLASTICITY INDEX = 10.53%

2.6 STANDARD PROCTOR TEST (PLAIN SOIL)

Table 2.f: Standard Proctor Test (Plain Soil)

Trial Number	NOTATION	I	II	III	IV	V
Weight of Soil		2.5kg	2.5kg	2.5kg	2.5kg	2.5kg
Weight of mould (without collar)		3.675kg	3.675kg	3.675kg	3.675kg	3.675kg
Weight of mould +soil		5.916	6.485	7.130	7.805	7.508
Container Number		06	19	13	05	15
Weight of Container	W_0 (grams)	12.29	11.86	11.96	11.65	12.31
Weight of Container + Wet Soil	W_1 (grams)	36.82	38.9	38.53	39.69	39.47
Weight of Container + Oven-dry Soil	W_2 (grams)	34.71	35.94	34.9	35.36	34.97
Weight of Water	W_1-W_2 (grams)	2.11	2.96	3.63	4.33	4.50
Weight of Oven-dry soil	W_2-W_0 (grams)	22.42	24.08	22.94	23.11	22.66
Density		2.24	2.81	3.45	4.13	3.94
Water Content (%)	$W = \left[\frac{W1 - W2}{W2 - W0}\right] X\ 100$	9.41	12.30	15.83	18.74	19.86
DRY DENSITY	M/V 1+w	1.153	1.261	1.337	1.436	1.369



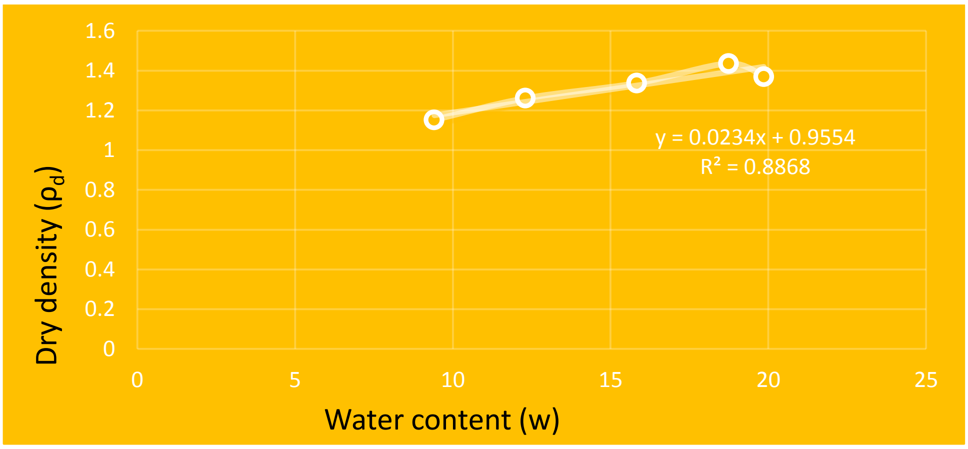
Graph 2.f: Standard Proctor Test (Plain Soil)

The maximum dry density of soil is 1.44 at 18.8 % of water content

2.7 STANDARD PROCTOR TEST OF SOIL SAMPLE WITH 3% ASH

Table 2.g: Standard Proctor Test (Plain Soil+3% Ash)

Trial Number	NOTATION	I	II	III	IV	V
Weight of Soil		2.5kg	2.5kg	2.5kg	2.5kg	2.5kg
Weight of mould (without collar)		3.675kg	3.675kg	3.675kg	3.675kg	3.675kg
Weight of mould +soil		5.955	6.535	7.185	7.825	7.735
Container Number		03	06	07	17	04
Weight of Container	W_0 (grams)	11.94	12.28	11.90	12.43	12.24
Weight of Container + Wet Soil	W_1 (grams)	36.81	38.7	38.54	39.42	39.27
Weight of Container + Oven-dry Soil	W_2 (grams)	34.71	35.94	34.9	35.36	34.97
Weight of Water	W_1-W_2 (grams)	2.10	2.76	3.64	4.06	4.30
Weight of Oven-dry soil	W_2-W_0 (grams)	21.84	22.14	22.89	23.15	22.53
Density		2.28	2.86	3.51	4.15	4.06
Water Content (%)	$W = \left[\frac{W1 - W2}{W2 - W0}\right] X\ 100$	9.63	12.47	15.90	17.57	19.07
DRY DENSITY	M/V 1+w	1.165	1.276	1.358	1.507	1.398



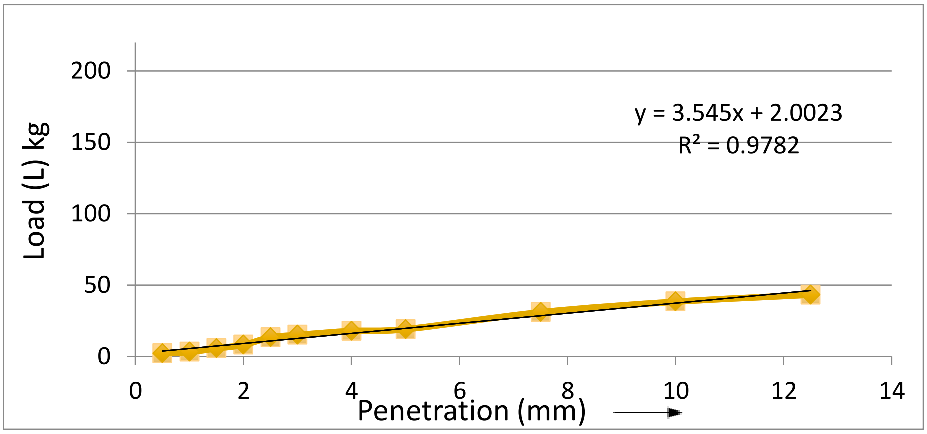
Graph 2.g: Standard Proctor Test (Plain Soil+3% Ash)

The maximum dry density of soil is 1.509 at 17.61 % of water content.

2.8 UNSOAKED C.B.R. TEST (PLAIN SOIL)

Table 2.h: Unsoaked C.B.R. Test (Plain Soil)

Sr. No	PENETRATION(mm)	DIAL READING
1	0.5	2.2
2	1	3.2
3	1.5	5.7
4	2	8.2
5	**2.5**	**13.4**
6	3	15.1
7	4	17.9
8	**5**	**19.1**
9	7.5	31.0
10	10	38.4
11	12.5	43.3



Graph 2.h: Unsoaked C.B.R. Test (Plain Soil)

1. THE CBR VALUE AT 2.5 MM = 5.23%

2. THE CBR VALUE AT 5 MM = 4.97 %

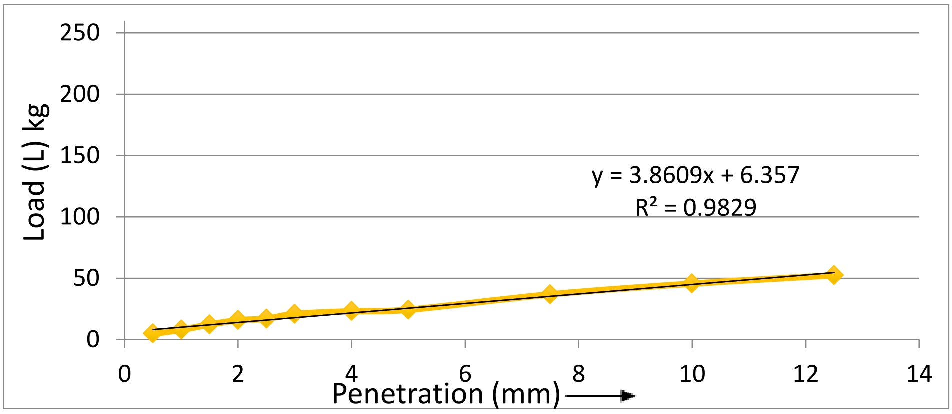
THE CBR VALUE OF SOIL = 5.23%

2.9 UNSOAKED C.B.R. (PLAIN SOIL+3% ASH)

Table 2.i: Unsoaked C.B.R. (Plain Soil+3% Ash)

Sr. No	PENETRATION(mm)	DIAL READING
1	0.5	4.8
2	1	7.9
3	1.5	12.3
4	2	15.7
5	**2.5**	**17.0**
6	3	20.8
7	4	23.

8	**5**	**24.3**
9	7.5	36.8
10	10	45.5
11	12.5	52.4



Graph 2.i: Unsoaked C.B.R. (Plain Soil+3% Ash)

1. THE CBR VALUE AT 2.5 MM = 6.63 %

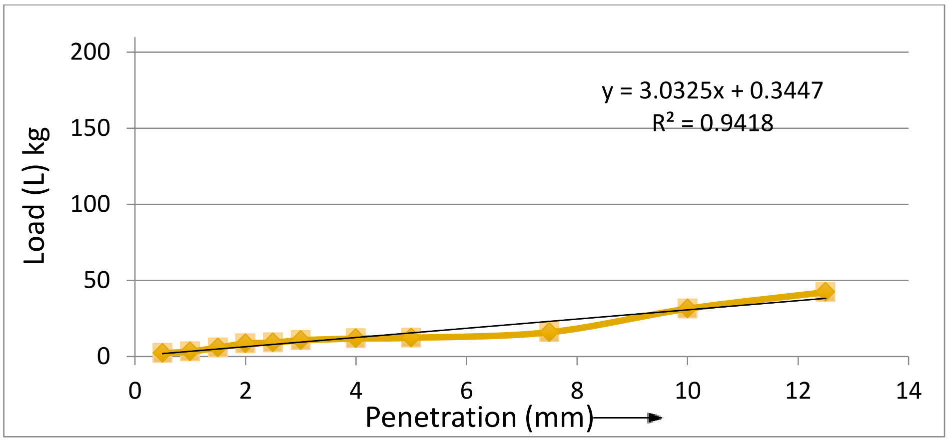
2. THE CBR VALUE AT 5 MM = 6.32 %

THE CBR VALUE OF SOIL = 6.63 %

2.10 SOAKED C.B.R. TEST (PLAIN SOIL)

Table 2.j: Soaked C.B.R. Test (Plain Soil)

Sr. No	PENETRATION(mm)	DIAL READING
1	0.5	2.2
2	1	3.3
3	1.5	5.8
4	2	8.6
5	**2.5**	**9.1**
6	3	10.7
7	4	11.8
8	**5**	**12.3**
9	7.5	15.9
10	10	31.4
11	12.5	42.3



Graph 2.j: Soaked C.B.R. Test (Plain Soil)

1. THE CBR VALUE AT 2.5 MM = 3.55%

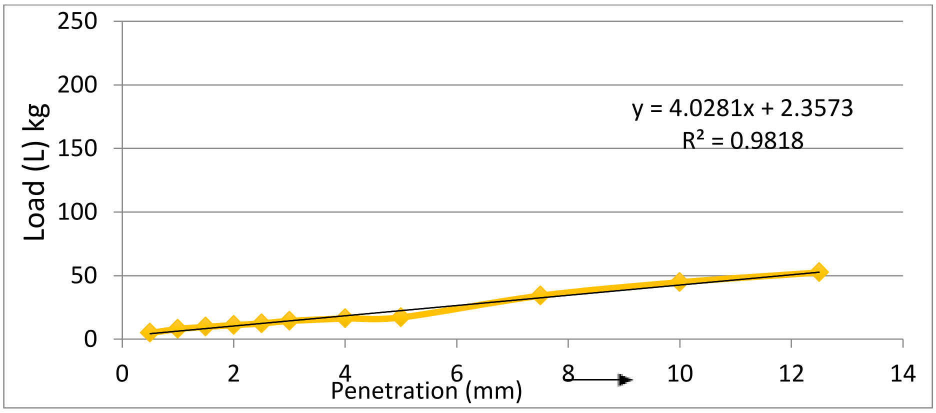
2. THE CBR VALUE AT 5 MM = 3.20 %

THE CBR VALUE OF SOIL = 3.55%

2.11 SOAKED C.B.R. (PLAIN SOIL+3% ASH)

Table 2.k: Soaked C.B.R. (Plain Soil+3% Ash)

Sr. No	PENETRATION(mm)	DIAL READING
1	0.5	4.9
2	1	8.0
3	1.5	9.6
4	2	11.0
5	**2.5**	**12.3**
6	3	14.3
7	4	16.2
8	**5**	**17.1**
9	7.5	34.2
10	10	44.1
11	12.5	51.8



Graph 2.k: Soaked C.B.R. (Plain Soil+3% Ash)

1. THE CBR VALUE AT 2.5 MM = 4.80 %

2. THE CBR VALUE AT 5 MM = 4.45 %

THE CBR VALUE OF SOIL= 4.80 %

3. CONCLUSION

The following are the soil conclusions. The conclusion is based on the test carried out on soil selected for the study.

- The waste product removed from brick kiln which can be used as soil stabilizer.
- The appropriate use of waste product gives the stability and also gives strength to soil.
- The Burnt Brick Bat is easily available and which can be generally obtained at very cheaper rate.
- Sometimes Burnt Brick can be brought free of cost from neighboring brick kiln.
- It has been observed that CBR value increases with ASH content 1.0-3.0%, for black cotton soil.
- It is observed that value increases significantly after addition of 1.0% ASH content.
- In earth soils Burnt Brick Bat can be used as a soil stabilizer enhanced the Engineering properties of the soil.
- As the strength of soil increases with an addition of ASH, the quality, strength of soil will be more as compare to plain soil.

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REFERENCES

[1] Tiza Michael, Sitesh Kumar Singh, Anand Kumar (2016) has studied on expansive soil stabilization using industrial solid wastes.

[2] Prabakar and Sridhar (2015) carried out a laboratory study about the reinforcing of a non-expansive soil with fibre and found and important improvement in the failure deviator stress and shear strength parameters.

[3] Prof. S.S Razvi (May 2015) studied on stabilization of soil using RBI Grade 8.1. Their study deals with the complete analysis of the improvement of soil properties and its stabilization using RBI Grade 8.1

[4] Rakesh Kumar Dutta (2012) Found that addition of randomly distributed polypropylene fibres enhances the properties of soil studied the effective use of fibres on unconfined compressive strength of clay.

[5] Mona Malekzadeh (2012) Eastern Mediterranean University The most commonly used synthetic material, polypropylene fibre is used in this study.

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