STABILIZATION OF SOIL BY USING PARTIALLY REPLACEMENT OF CASHEW NUT SHELL ASH, COCONUT SHELL ASH AND SODIUM SILICATE POWDER

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Abstract –Stabilization is a extensive experience for the a variety of approach employed and editing the homes of a soil to enhance its engineering overall performance and used for a range of engineering works. Soil stabilization can be defined as the alterations of the soil residences via chemical (or) bodily imply in orderto beautify the engineering exceptional of the soil. The foremost goal of the soil stabilization is to extend the bearing ability of the soil, its resistance to weathering method and soil permeability. Soil enhancement the usage of the waste fabric like Cashew nut shell ash, Coconut shall ash and Sodium silicate.

***Keywords*: Soil Stabilization, Cashew nut shell ash, Coconut shell ash, Sodium Silicate**.

1. INTRODUCTION :

In a well-organized environment, disposal of waste poses a gorgeous risk as regards the place and how to efficiently dispose the waste fabric except any damaging impact to society. In the current times, utilization of stable waste substances in soil stabilization has received eminence as an nice ability to manage wastes generated from a number of sources. As the soil without delay in contact with the object, it acts as an intermediate of load transmission and therefore, the balance of gentle soil is essential throughout the construction. Soft soils possess very much less shear electricity and low CBR, alternate wetting and drying cycles. Strengthening of soil improves bearing capacity, reduces agreement and helps in lowering the liquefaction impact of soil. Ever due to the fact then substantial achievements have been made in the development and graph of geotechnical constructions such as foundations, embankments, pavements and keeping walls, etc. The necessity of soil stabilization arises due to the a variety of challenges like bad bearing capacity, excessive price of agreement after construction, excavation instability and excessive price of construction; enhance energy of sub-grade on clayey soil. Soil stabilization is the method of improving the engineering traits of soil by means of amalgamating the stabilizers to extend the load carrying capacity, and resistance to weathering. Different stabilizing marketers are used to beautify the engineering houses of tender soil. These are foremost binders (hydraulic) and secondary binders (non-hydraulic) components which when come in contact of pozzolanic minerals and water reacts with it to structure composite of cementitious characteristics. The goal of find out about is to consider how stabilization of soil can be executed by means of the usage of wastes from a range of sources such as agricultural and industries. The a variety of substances are bagasse ash, rice husk ash, fly ash, coir fibres human hair fibres, banana fibres etc.

1.1 STABILIZATION OF SOIL WITH WASTE MATERIALS :

Weak soil is very challenging soil, and it has shrinking and swelling houses which can injury the shape built over it. Waste cloth on the day by day foundation is probably to end up a trouble for disposal. It creates environmental infection and fitness risks. Hence, the utilization of waste fabric in the stabilization of vulnerable soil efficiently minimizes the bad impact on the environment. In this paper, the purpose is to stabilize the susceptible soil the usage of mixtures of waste material. The waste substances used for the learn about are stone dirt and stable waste from silica sand beneficiation plant. Stone dirt is coming from polishing, reducing of stones, and cruising procedure at some stage in rock quarrying activities. Solid waste from silica sand beneficiation plant is a granular material, and it carries quartz and very much less quantity of clay, coal, and different minerals. Stone dirt and strong waste from silica sand beneficiation plant are blended in extraordinary share with vulnerable soil. Geotechnical residences of vulnerable soil for my part and in mixture with various percentage had been investigated. The general Proctor take a look at and the California bearing ratio check have been performed. The consequences of these assessments resemble that the aggregate of stone dirt and strong waste from silica sand beneficiation plant is very fine for stabilizing the susceptible soil.

1.2 METHODSOBJECTIVE:

- **Cashew nut Shell Ash (CSA):**

Chemical Composition	Value
Lignin	29.4%
Pentosam	27.7%
Cellulose	26.6%
Moisture	8%
Solvent Extractives	4.2%
Uronic Anhydrides	3.5%
Ash	0.6%

The cashew tree belongs to the family Anacardiaceae, genus Anacardium, genus Anacardium occidentale. The cashew tree occupies an essential role among tropical fruit trees due to the

growing commercialization of its main products: cashew nut Shellash (CNSA) and cashew nut"apple" (Figure -1.1).

Fig –1.1 : Cashew Nut&Apple(Yellow)

The plant is determined in Central America, Africa, Asia and India, Vietnam and Brazil stand out as the greatest producers of cashew nut (70% of the world production). The cashew way of life is one of the fundamental agronomic things to do in Northeast Brazil; nearly the complete manufacturing is targeted in the states of Ceara, often and additionally Piaui and Rio Grande do Norte. Most of the manufacturing of the cashew nut and CNSA is destined for exportation. The rinds of cashew nut (Wastes of nuts production) are burned again for the duration of the heating system [Fig -1.2], and in boilers, they generate warmness for shelling different nuts. The CNSA is the waste amassed from the boiler grid, resulted from burning of the rind of nuts. This waste is used as composts in plantings of cashew and a little phase of it is dumped in landfill sites.

Fig –1.2 : Cashew Nut Powder

The CNSA represents about 5% of preliminary weight of cashew nut and due to the fact the manufacturing growing in cashew's plants, the technology of ashes may gain 15.000 heaps per year. Until now few researchers had been made with CNSA, even if different targets special from civil building. One of them has used CNSA as stabilizer of soils on the manufacturing of adobes. This research, in accordance to the authors, nevertheless wants in addition study. The ash used in these assessments used to be donated by way of the business enterprise Cione, positioned in Fortaleza, Ceara, Brazil.

- **Coconut shell ash (CSA) :**

Kerala is the land of coconut trees. Coconut timber supply a variety of blessings in which the affect of CSP is noticeable. CSP is utilized as uncooked cloth for activated carbon industries, compound filler for artificial resin glues etc. The chemical residences of CSP are Shown in (Table -1.1).

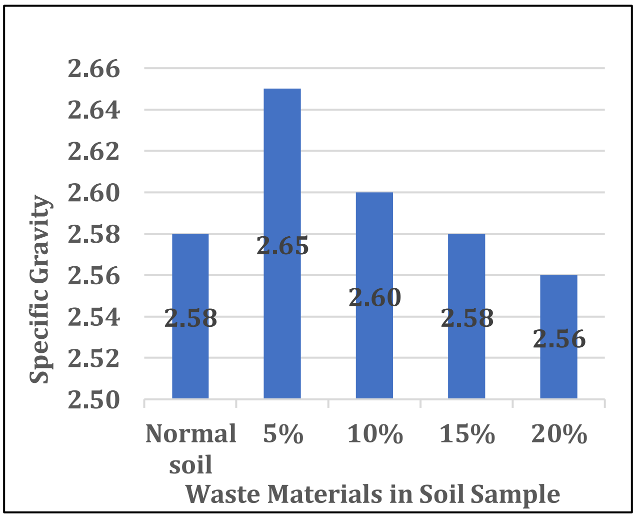
Table – 1.1 : Chemical Properties of CSP

Fig – 1.3 : Coconut shell ash Powder

- **Sodium Silicate Powder (SSP) :**

The compound sodium silicate is belonging to the household of sodium Meta silicate. It is generally skilled as water glass or

S.No	Soil Composition	Specific Gravity
1	Soil	2.65 to 2.85
2	Sand	2.65 to 2.67



Liquid glass. Crystal kingdom of the chemical is normally viewed however aqueous answer is famous in market. Usually the

Powder form of the sodium silicate is used in the stabilization process. The system for the title is given as (Na_2Sio_2).

Table – 1.2: Properties of Sodium Silicate

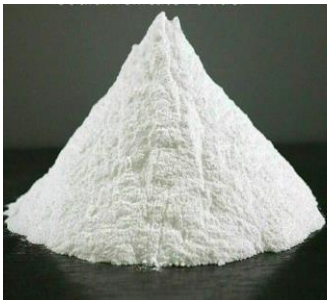
Particulars	Values
Totally Alkaline (Na_2O_3)	11.03%
Silicate (SiO_2)	28.57%
Ratio by weight ($Na_2O_2SiO_2$)3	1 to 2.43%
Molecular ration ($Na_2O_2SiO_2$)	1 to 1.66%

Fig –1.4 : Sodium Silicate Powder

PROPERTIES OF INDEX:

2. SPECIFIC GRAVITY TEST:

Specific gravity of soil measures the unit weight of soil per unit weight of water. The take a look at technique is observed as per



BIS:2720 – 1980 and the values of precise gravity particular to this code exhibit in table.

Table – 1: Standard Specific gravity from BIS:2720 - 1980

The precise gravity of the pattern is discovered to be 2.48. Specific gravity is described as the ratio of the weight of a given quantity of soil solids at a given temperature to the weight of an equal extent of distilled water at that temperature, each weights being taken in air. The Indian widespread particular 27^{0}C as the wellknown temperature for reporting the precise gravity. This textual content is to decide the particular gravity of soil grains.

Fig–1 : Specific gravity test

TABULATION : (SOIL)

Table – 2 : Specific gravity test for Soil

S. No	Weight	Sand	5% WM	10% WM	15% WM	20% WM
1	W_1g	610	610	610	610	610
2	W_2g	910	915	920	925	930
3	W_3g	1765	1773	1774	1774	1776
4	W_4g	1580	1584	1585	1583	1582

Table – 3 : Specific gravity test Result forSoil

S. No	Sample	Specific gravity
1	Normal soil sample	2.58
2	Soil With 5% Waste Material	2.65
3	Soil With 10% Waste Material	2.60
4	Soil With 15% Waste Material	2.58
5	Soil With 20% Waste Material	2.56

Fig – 2: Graph for Specific gravity test for Soil

TABULATION : (SAND)

Table – 4 : Specific gravity test forSand

Table – 5 : Specific gravity test Result for Sand

S. No	Sample	Specific gravity
1	Normal sand sample	2.60
2	Sand With 5% Waste Material	2.58
3	Sand With 10% WasteMaterial	2.56
4	Sand With 15% Waste Material	2.54
5	Sand With 20% Waste Material	2.53

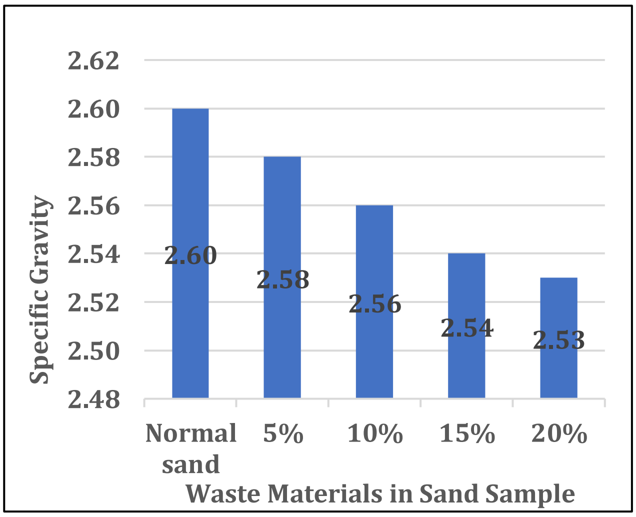


Fig – 3 : Graph for Specific gravity test for Sand

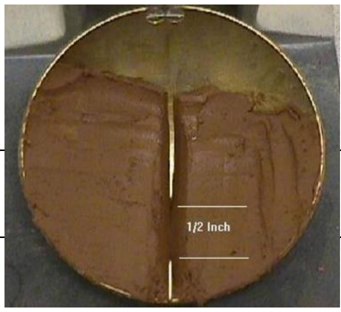
3. LIQUID LIMIT TEST :

Liquid restriction is described as the minimal water content material at which the soil is nevertheless in the liquid kingdom however has a small shearing power in opposition to flowing which can be measured through fashionable on hand capability or weight of the soil, at the boundary is arbitrarily described as the water content material at which two halves of a soil cake will float together, for distance of 12.7 mm alongside the backside of a groove of widespread dimensions setting apart the two halves, when the cup of wellknown liquid restriction equipment is dropped 25 time from a top of 10 mm at the price of two drops/second.

Fig–1 : Liquid limit test

Table –1 : Value of Liquid Limit as per
IS: 2720 (Part 5) – 1985

S. No		Liquid limit(%



S. No	Sample	Liquid limit(%)
1	Normal soil sample	42
2	Soil with 5% waste material	50
3	Soil with 10% waste material	51.9
4	Soil with 15% waste material	54.1
5	Soil with 20% waste material	40.3

TABULATION : (SOIL)

S.No	Liquid limit	Compressibility of the soil
1	<35	Low
2	35-50	Medium
3	>50	High

Table – 2:Liquid limit for Normal Soil

Liquid limit for Normal soil sample = 42%

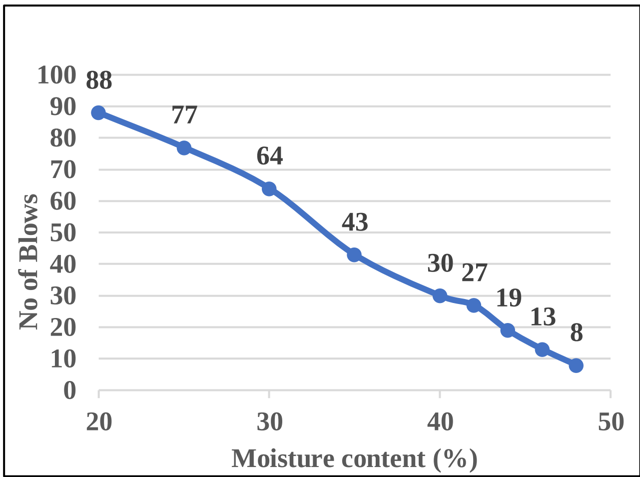
Fig – 2 : Graph for Liquid limit test for Normal Soil
Table – 3:Liquid limit test Result for Soil

Fig – 3 : Graph for Liquid limit test forSoil

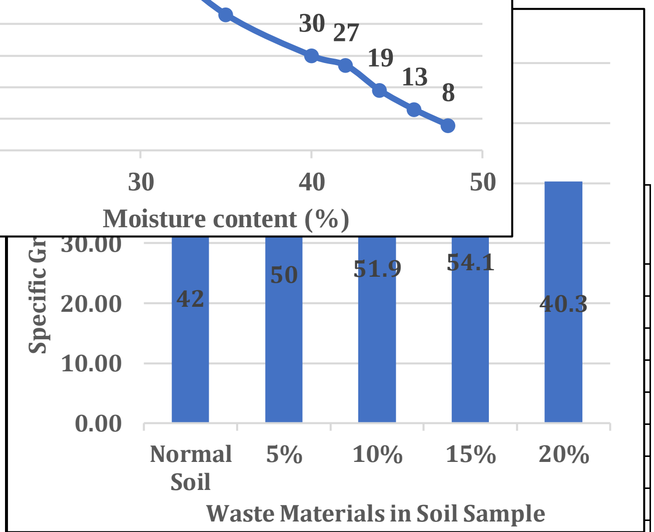
TABULATION : (SAND)

Table – 4 : Liquid limit for Normal Sand

S.No	Moisture content (%)	Number of blows
1	20	88
2	25	77
3	30	64
4	35	43
5	40	30
6	42	27
7	44	19
8	46	13
9	48	8



Liquid limit for



9	48	4

Normal sand sample = 40%

Fig – 4 : Graph for Liquid limit test for Normal Sand

Table – 5 : Liquid limit test Result for Sand

		)
1	Normal sand sample	40
2	Sand with 5% waste material	50
3	Sand with 10% waste material	52.1
4	Sand with 15% waste material	54.3
5	Sand with 20% waste material	40.3

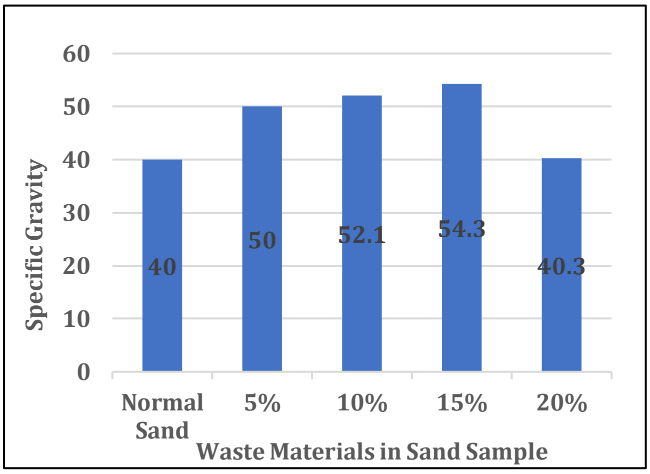
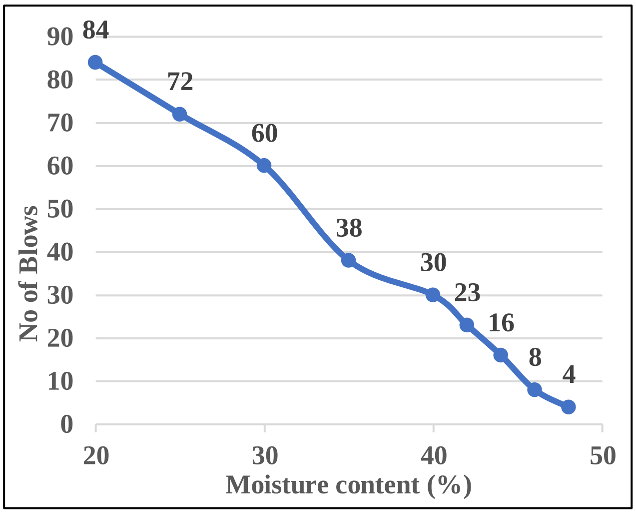


Fig –5 : Graph for Liquid limit test for Sand



4.PLASTIC LIMIT TEST :

Plastic restriction refers to the minimal water content material at which soil will simply start to disintegrate when rolled into a thread about 3mm in diameter the use of a floor glass plate or different appropriate surface. It is the water content material corresponding to an arbitrary restrict between plastic and semisolid states of consistency of soils. The plastic restriction check is carried out on the a range of soil samples and the effects are tabulated below.

Fig – 1 : Plastic limit test

TABULATION : (SOIL)

Table – 1 : Plastic limit for Normal Soil

Weight of the plate (W_0) (gm)	63
Weight of the wet soil + plate (W_1) (gm)	70
Weight of the dry soil with plate (W_2) (gm)	68
Weight of the water (W_1-W_2) (gm)	2
Weight of the dry soil (W_2-W_0) (gm)	5

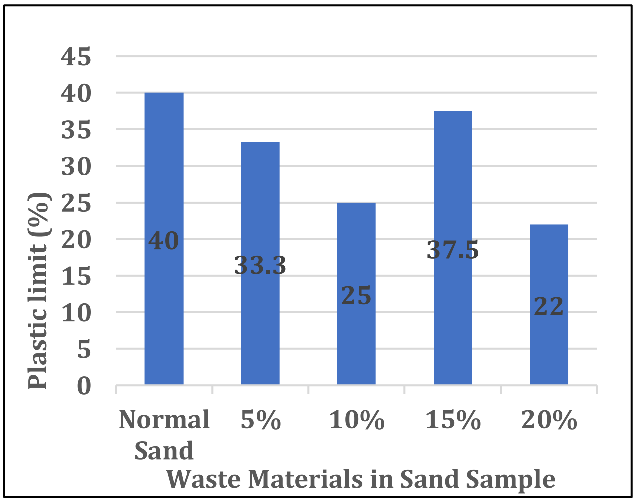
S. No	Sample	Plastic limit(%)
1	Normal sand sample	40
2	Sand with 5% waste material	33.3
3	Sand with 10% waste material	25
4	Sand with 15% waste material	37.5
5	Sand with 20% waste material	22

Table – 2 : Plastic limit test Result forSoil
Fig –2 : Graph for Plastic limit test forSoil

TABULATION : (SAND)

Table – 3 : Plastic limit for Normal Sand

Table – 4 : Plastic limit test Result for Sand



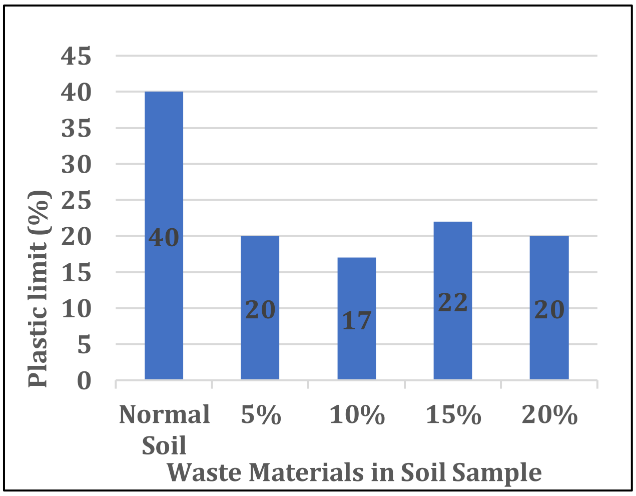


Fig –3 : Graph for Liquid limit test forSand

5. SIEVE ANALYSIS TEST :

Sieve evaluation is the approach of dividing a pattern of aggregates into a variety of fractions every consisting of particles of identical size. The sieve evaluation is carried out to decide the particle dimension distribution in a pattern of aggregate, which we name gradation. The combination fraction from 4.75 to 75 micron is referred to as nice aggregates. Grading sample of a pattern is located out by means of sieving a pattern successively via the whole sieve set installed one over the different in order of size, with greatest sieve on the top. The fabric retained on every sieve after shaking, represents the fraction of aggregates coarser than the

S. No	Sample	Plastic limit(%)
1	Normal soil sample	40
2	Soil with 5% waste material	20
3	Soil with 10% waste material	17
4	Soil with 15% waste material	22
5	Soil with 20% waste material	20

beneath sieve. Sieving can be executed both manually and mechanically. Fineness modulus is simply a numerical index cost of fin

Fig – 1: Sieve Analysis test

f particles in the complete physique of aggregates. Determination of fineness modulus can also be viewed as a approach of standardization of the grading of aggregates. It is calculated with the aid of sieving a recognised mass of given aggregates on a set of preferred sieves and through including the cumulative percentages of mass of cloth retained on all the sieves and divide the the total percentage by 100.

BULATION : (SOIL)

S. No	Sample	Sieve Retained	Sieve size
1	Normal sand sample	400	300mic
2	Sand With 5% Waste Material	140	150mic
3	Sand With 10% Waste Material	450	300mic
4	Sand With 15% Waste Material	398	300mic
5	Sand With 20% Waste Material	390	600mic

Table – 1 : Sieve Analysis test for Soil

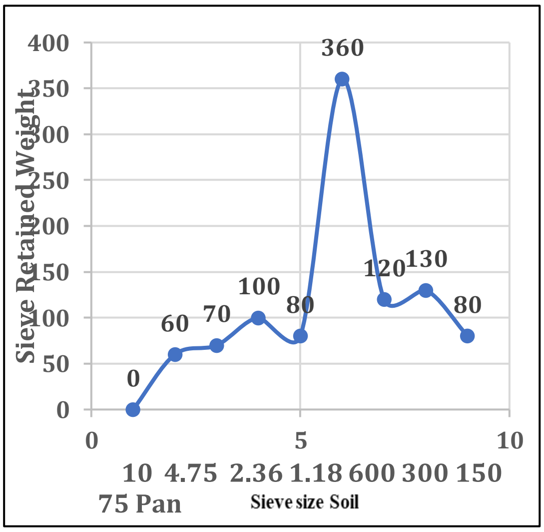
Analysis test for Normal Soi

Table – 2 : Sieve Analysis test Result for Soil

S. No	Sieve Size	Soil	5% WM	10% WM	15% WM	20% WM
1	10mm	0	0	0	0	0
2	4.75mm	60	50	54	58	63
3	2.36mm	70	85	78	110	68
4	1.18mm	100	110	80	310	75
5	600mic	80	100	130	180	450
6	300mic	360	70	180	84	180
7	150mic	120	410	350	160	100
8	75mic	130	110	80	70	50
9	Pan	80	65	48	28	14

Weight of the plate (W_o) (gm)	63
Weight of the wet sand + plate (W_1) (gm)	70
Weight of the dry sand with plate (W_2) (gm)	68
Weight of the water (W_1-W_2) (gm)	2
Weight of the dry sand (W_2-W_0) (gm)	5

Fig – 2 : Graph for Sieve



S. No	Sample	Sieve Retained	Sieve size
1	Normal soil sample	360	300mic
2	Soil With 5% Waste Material	410	150mic
3	Soil With 10% Waste Material	350	150mic
4	Soil With 15% Waste Material	310	1.18mm
5	Soil With 20% Waste Material	450	600mic

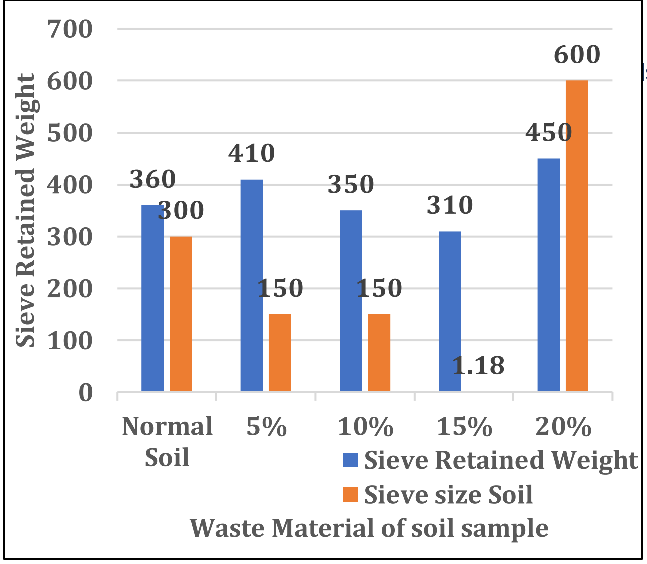
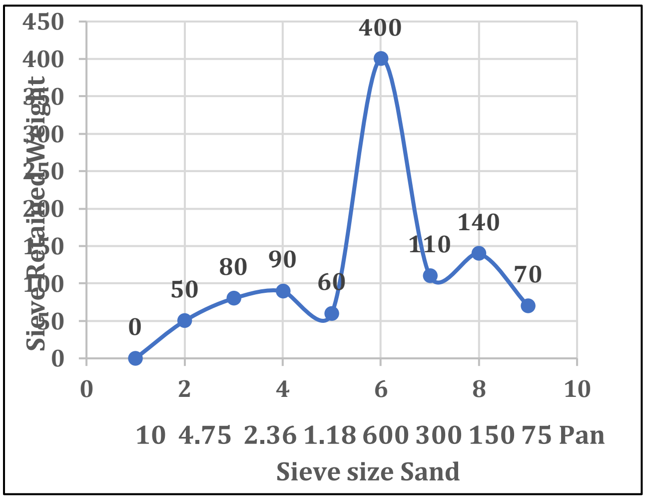


Fig –3 : Graph for Sieve Analysis test forSoil



TABULATION : (SAND)

Table – 3: Sieve Analysis test for Sand

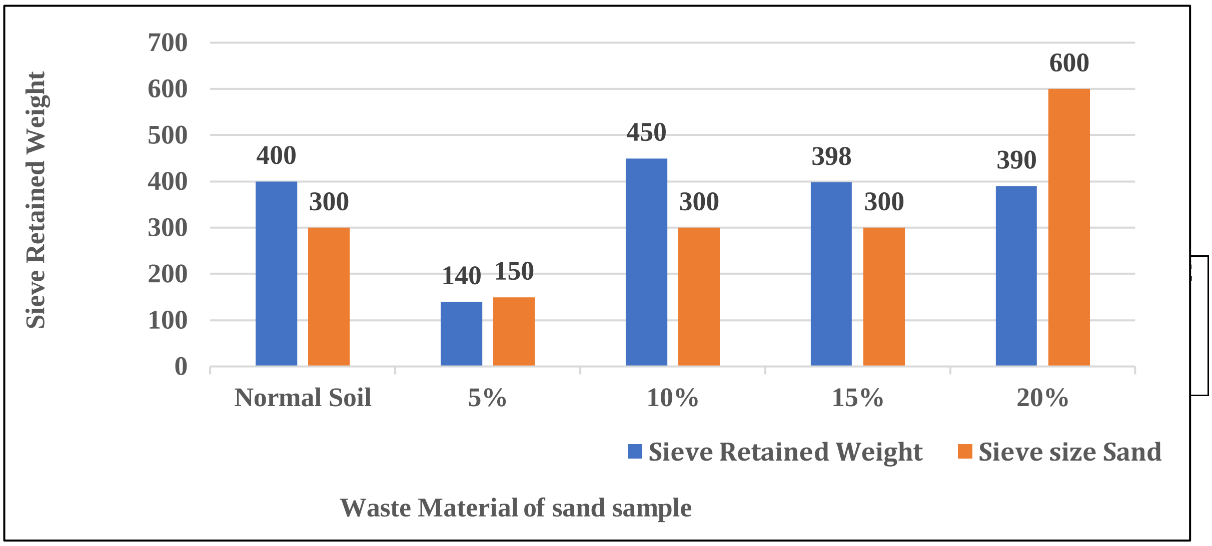
S. No	Sieve Size	Sand	5% WM	10% WM	15% WM	20% WM
1	10mm	0	0	0	0	0
2	4.75mm	50	51	52	57	60
3	2.36mm	80	75	72	69	65
4	1.18mm	90	80	92	120	70
5	600mic	60	57	70	130	390
6	300mic	400	48	450	398	230
7	150mic	110	140	170	150	133
8	75mic	140	109	70	60	40
9	Pan	70	40	24	16	12

Fig – 4 : Graph for Sieve Analysis test for NormalSand

Table – 4 : Sieve Analysis test Result for Sand

Fig –5 : Graph for Sieve Analysis test forSand

6. PROCTORS COMPACTION TEST:



From the widespread proctor check we are analyzing that the most desirable moisture content material at which a given soil kind will grow to be most dense and attain its most dry density of the soil sample. There are a quantity of elements which have an impact on the density acquired by means of compaction. Those of major significance are : a) the moisture content material of the soil, b) the traits of the soil, c) the kind and degree of the compaction effort. The compaction traits of soils are normally mentioned in phrases of their moisture-density relations. Such a curve truely shows that the density available for a given soil and compaction effort is based on the moisture content material at time of compaction.As the water content material will increase from a low level, soil particles boost large and large water movies round them, which have a tendency to lubricate the particles and enable them to slide, one particle in opposition to another, to produce a denser packing. At this point, water starts offevolved to displace soil particles and the density decreases. Thus, the curve develops a extra or much less nicely described top which suggests ideal moisture content material at which a most dry density may additionally be bought for every kind of soil and compaction effort.

Fig – 1 : Proctors Compaction Test

TABULATION: (SOIL)

S. No	Water content (%)	Wt. of mould with base + soil (w_2)	Weight of bottom ash (W_2-W_1)	Wet (Υ_{wet})	Dry (Υ_{dry})
1	14	5.810	1.900	2.19	1.92
2	16	5.832	1.930	2.23	1.93
3	18	5.859	1.957	2.30	1.95
4	20	5.836	1.934	2.22	1.90
5	22	5.790	1.888	2.18	1.87

Table – 1 : Proctors Compaction test for Normal Soil

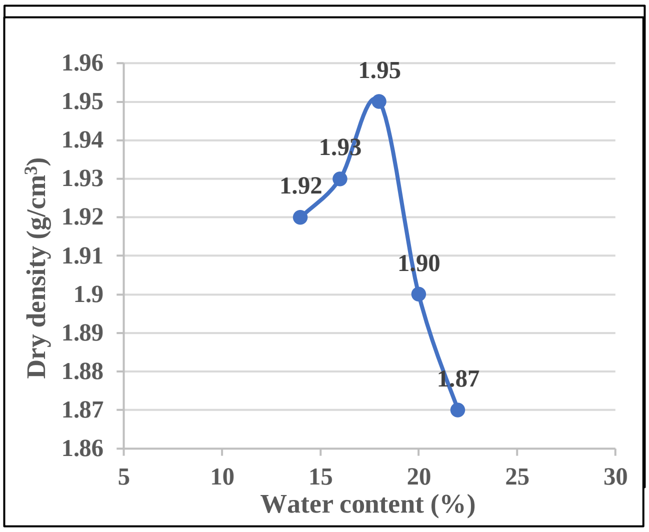
Fig – 2 : Graph for Proctors Compaction for Normal Soil

Table – 2 : Proctors Compaction test Result for Soil

Fig –3 : Graph for Proctors Compaction test forSoil

TABULATION: (SAND)

Table – 3 : Proctors Compaction test for Normal Sand



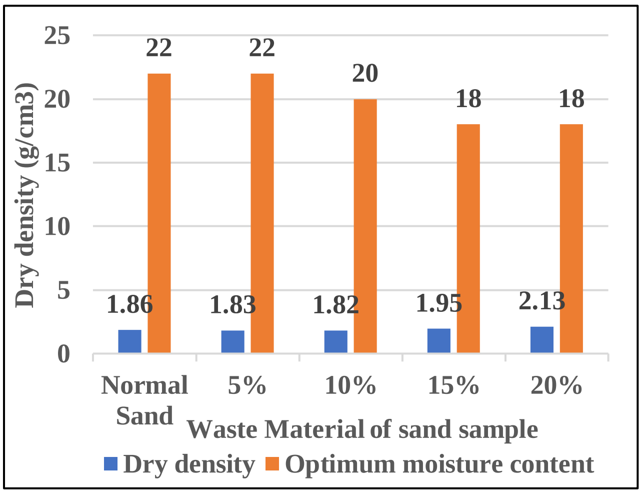
1	Normal soil sample	1.95	18
2	Soil With 5% Waste Material	2.07	18
3	Soil With 10% Waste Material	2.13	20
4	Soil With 15% Waste Material	2.20	18
5	Soil With 20% Waste Material	2.05	18

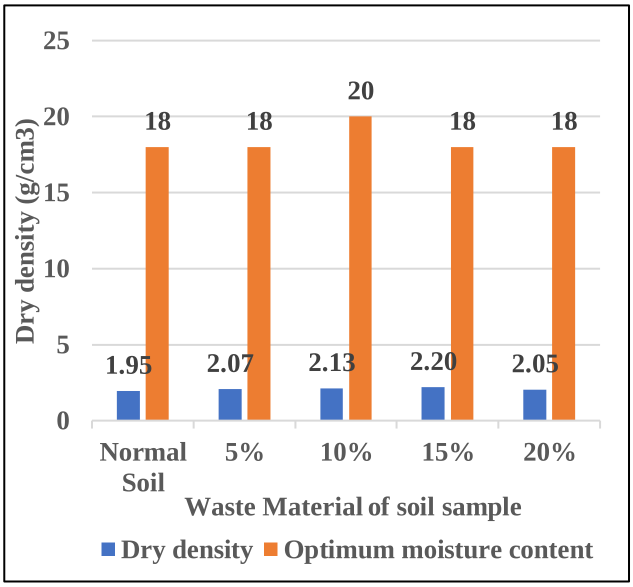
Fig – 4 : Graph for Proctors Compaction for Normal Sand

Table – 4 : Proctors Compaction test Result for Sand

Fig –5 : Graph for Proctors Compaction test forSand

S. No	Sample	Maximum Dry Density (g/cm^3)	OMC (%)
1	Normal sand sample	1.86	22
2	Sand With 5% Waste Material	1.83	22
3	Sand With 10% Waste Material	1.82	20
4	Sand With 15% Waste Material	1.95	18
5	Sand With 20% Waste Material	2.13	18





7. DIRECT SHEARTEST:

This takea look at is performed to locate the perspective of shearing resistance of the soils sample. Standard takea look at approach for Direct Shear Test of Soils below Consolidated Drained Conditions supplied in ASTM D 3080-90 used to be used.

This take a look at approach covers the willpower of the consolidated drained shear electricity of a soil cloth in direct shear. The check is performed with the aid of deforming a specimen in a managed stress price on or close to a single shear aircraft decided by using the configuration of the apparatus. Generally, three or greater specimens are tested, every below a one-of-a-kind ordinary load, to decide the results upon shear resistance and displacement, and electricity homes such as Mohr energy envelops. The energy parameter of granular soil is the perspective of interior friction or, preferably, perspective of shearing resistance. It has an vital bearing on examining the balance of slopes and embankments; it considerably influences the bearing potential of a foundation; and governs the lateral stress a backfill exerts in opposition to a preserving structure. The attitude of shearing resistance additionally impacts the magnitude of the earth load on underground constructions such as culverts and sewers.Besides; it circuitously impacts different traits of a material, such as modulus of subgrade reaction. The grain power of soils is typically enough that the grains themselves do no longer fail till extraordinarily excessive stresses are reached. Therefore, failure of such soils requires the grains to slide towards every other. In this case, the perspective of shearing resistance is analogous to the perspective of sliding friction between two sliding blocks. However, in addition to the mineral-to-mineral friction resistance, the interlocking of the soil grains contributes considerably to the shear resistance of brotherly love much less soils. In general, the elements that have an impact on the attitude of shearing resistance of a soil are numerousand can be divided into two groups. The first crew consists of these elements that have an effect on the attitude of shearing resistance of a given soil. These are void ratio or relative density of the soil, the confining stress, the kind of take a look at used in the willpower of the angle, criterion for failure, and the fee of load application. These are attain dimension distribution, and the size, shape, and floor texture of the particles making up the soil. Among all of these factors, void ratio is possibly the most vital single parameter that influences the perspective of shearing resistance. A larger perspective of shearing resistance can be received in well-graded substances than in uniformly graded substances due to the fact greater density can be completed in the well-graded material. Angular particles can be equipped collectively in a very dense circumstance which effects in a excessive diploma of interlocking, whereas rounded or spherical particles can't be so fitted. Particle dimension influences the shearing resistance by way of influencing the quantity of shearing displacement required to overcome interlocking and to deliver the grains to free sliding position. For a coarse material, the quantity of motion required for this cause is, of course, larger than that for a finer material.

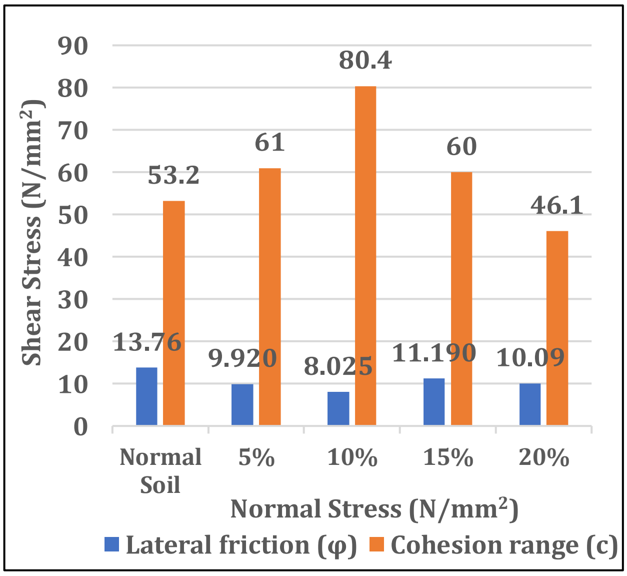


Fig – 1 : Direct Shear Test

S. No	Normal load (1 kg = 0.0098kN) (kN)	Normal Stress (σ) (N/mm^2)	Shear force at failure (kN)	Ultimate shear stress in (τ) (N/mm^2)
1	51.02	0.013	20.05	0.556
2	102.04	0.027	29.43	0.815
3	153.06	0.041	39.24	1.090
4	204.08	0.055	42.34	1.176

TABULATION : (SOIL)

Table – 1 : Proctors Compaction test for Normal Soil

Fig – 2 : Graph for Direct Shearfor Normal Soil

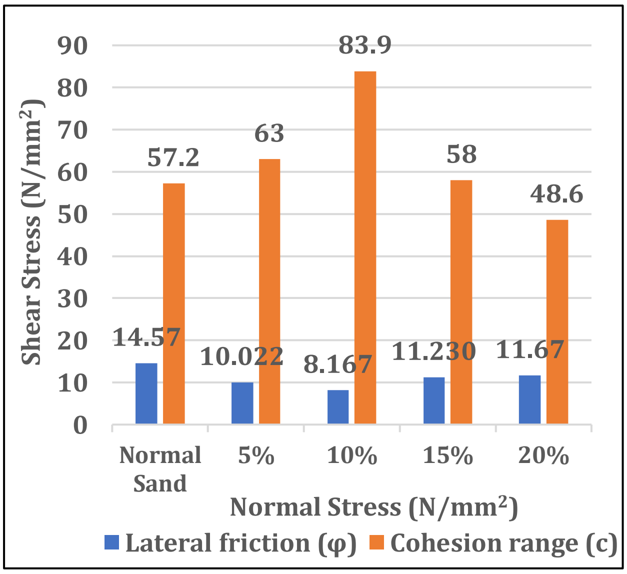
Table – 2 : Direct Shear test Result for Soil

Fig –3 : Graph for Proctors Compaction test forSoil

TABULATION : (SAND)

Fig – 4 : Graph for Direct Shear for Normal Sand

Table – 4 : Direct Shear test Result for Sand



S. No	Sample	Lateral friction (φ)	Cohesion range (c) (kN/m^2)
1	Normal soil sample	13.76	53.2
2	Soil with 5% waste material	9.920	61
3	Soil with 10% waste material	8.025	80.4
4	Soil with 15% waste material	11.190	60
5	Soil with 20% waste material	10.09	46.1

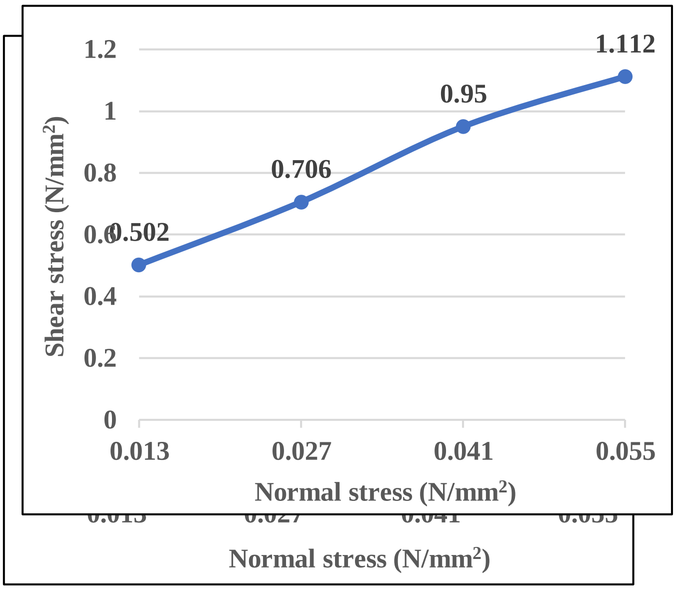


Fig –5 : Graph for Direct Sheartest forSand

8. UNCONFINED COMPRESSION TEST :

This take a look at is to decide the shear parameters of the soil. The main 6T55M cause of this check is to decide the unconfined compressive strength. The unconfined power and cohesive electricity is received through conducting Unconfined Compressive Strength. The take a look at is carried out as per IS : 2720 (part 10) – 1991 and the values distinct to this code is (Table – 1).

Fig – 1 : Unconfined Compressive test

S. No	Consistency	Consistency index	UCS (kN/m^2)
1	Very soft	<0.25	<25

S. No	Deformation		Loading		Ac = A / [1-e] Mm^2	UCS kN/m^2
	div	mm	div	N		
1	0	0	0	0	1017.8	0
2	50	0.5	0.1	1.245	1024.9	1.395
3	100	1	0.3	3.735	1032.2	4.215
4	150	1.5	0.5	6.225	1039.4	6.229
5	200	2	1.1	13.695	1046.9	14.221
6	250	2.5	1.2	14.94	1054.4	15.189
7	300	3	1.2	14.94	1062.1	15.097
8	350	3.5	1.2	14.94	1069.8	14.212
9	400	4	1.2	14.94	1077.8	14.335
10	450	4.5	1.2	14.94	1085.7	14.424
11	500	5	1.1	13.695	1093.7	13.342
12	550	5.5	1.1	13.695	1102.0	13.238

2	Soft	0.25 – 0.50	25 – 50
3	Medium (firm)	0.50 – 0.75	50 – 100
4	Stiff	0.75 – 1.0	100 – 200
5	Very stiff	>1.0	200 – 400
6	Hard	>1.0	>400

S. No	Normal load (1 kg = 0.0098kN) (kN)	Normal Stress (σ) (N/mm^2)	Shear force at failure (kN)	Ultimate shear stress in (τ) (N/mm^2)
1	51.02	0.013	18.09	0.502
2	102.04	0.027	25.43	0.706
3	153.06	0.041	34.20	0.950
4	204.08	0.055	40.32	1.112

Table – 1: Values of UCS as Per IS: 2720 (Part 10) - 1991

TABULATION : (SOIL)

Table – 2: Unconfined Compressiontest for Normal Soil

Fig –2: Graph for Unconfined Compressiontest forNormal Soil

TABULATION : (SAND)

Table – 3: Unconfined Compression test for Normal Sand

Fig –3: Graph for Unconfined Compressiontest for Normal Sand

9. CALIFORNIA BEARING RATIO (CBR) TEST :

The take a look at is an empirical check which offers an indication of the shear electricity of a soil. The brilliant cost of this take a look at it is comparatively effortless to function and due to the fact of its large use at some stage in the world, there is a enormous quantity of statistics to help with the interpretation of result. The CBR check is truly a laboratory take a look at however in some cases the check is carried out on the soil in-situ. The laboratory CBR take a look at consists in reality of making ready a pattern of soil in a cylindrical metal mold and then forcing a cylindrical metal plunger, of nominal diameter 50mm, into the pattern at a managed rate, at the same time as measuring the pressure required to penetrate the sample.

Fig – 1 : California Bearing Ratio (CBR) Test

The following table gives the standard loads adopted for different penetration for the standard material with a C.B.R Value of 100%.

Table – 1 : California Bearing Ratio Test

Penetration of plunger (mm)	Standard load (kg)
2.5	1370
5.0	2055
7.5	2630
10.0	3180
12.5	3600

TABULATION : (SOIL)

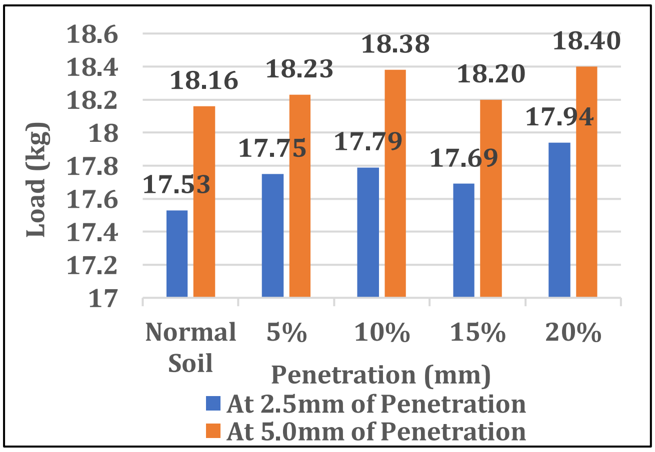
Penetration (Div)	Penetration (mm)	Proving ring reading (Div)	Load (kg)
50	0.5	0.2	4.58
100	1.0	1.0	22.9
150	1.5	4.3	98.47
200	2.0	8.0	183.2
250	2.5	10.5	240.45
300	3.0	12.3	281.67
350	3.5	13.0	297.78
400	4.0	14.2	325.18
450	4.5	15.5	354.27
500	5.0	16.3	373.27
550	5.5	17.5	400.74
600	6.0	18.2	416.78

Table – 2 : California Bearing Ratio Test for Normal Soil

Fig –2 : Graph for CBRtest for Normal Soil

S. No	Sample	At 2.5mm	At 5.0mm
1	Normal soil sample	17.53	18.16
2	Soil with 5% waste material	17.75	18.23
3	Soil with 10% wastematerial	17.79	18.38
4	Soil with 15% waste material	17.69	18.20
5	Soil with 20% waste material	17.94	18.40

Table – 3 : California Bearing Ratio test Result for Soil



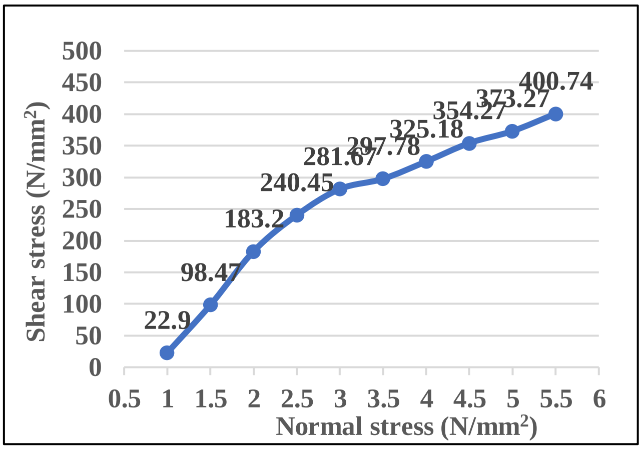


Fig –3 : Graph for California Bearing Ratio test forSoil

Penetration (Div)	Penetration (mm)	Proving ringreading (Div)	Load (kg)
50	0.5	0.2	4.98
100	1.0	1.0	23.80
150	1.5	4.3	97.54

200	2.0	8.0	184.31
250	2.5	10.5	241.51
300	3.0	12.3	283.86
350	3.5	13.0	298.43
400	4.0	14.2	326.81
450	4.5	15.5	356.08
500	5.0	16.3	374.01
550	5.5	17.5	402.25

TABULATION : (SAND)

Table – 4 : California Bearing Ratio Test for Normal Sand

Fig –4 : Graph for California Bearing Ratio test for Normal Sand

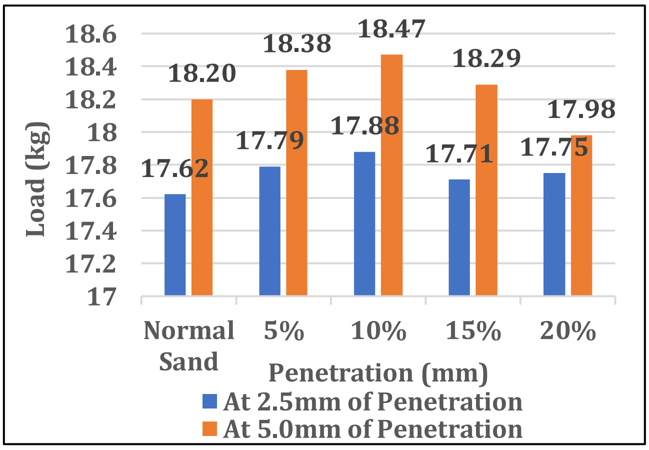
Table – 5 : California Bearing Ratio test Result for Sand

Fig –5 : Graph for California Bearing Ratio test forSand

S. No	Sample	At 2.5mm	At 5.0mm
1	Normal sand sample	17.62	18.20
2	Sand with 5% waste material	17.79	18.38
3	Sand with 10% wastematerial	17.88	18.47
4	Sand with 15% waste material	17.71	18.29
5	Sand with 20% waste material	17.75	17.98

10. VOIDS IN BULK DENSITYTEST :

Bulk density of mixture is described as the mass over a unit extent of bulk mixture material, in which the quantity consists of the quantity of the man or woman particles barring voids and the



extent of the man or woman particles with voids between the particles. Expressed in (kg/m3).

Fig – 1 : Void in Bulk Density Test

TABULATION : (SOIL)

Table – 1 : Void in Bulk Density test for Soil

S. No	Sample	Bulk density (ϒ)	(%) of voids in soil
1	Normal soil sample	1.59	38.5
2	Soil With 5% WasteMaterial	1.58	39
3	Soil With 10% Waste Material	1.57	39.6
4	Soil With 15% Waste Material	1.55	40.3
5	Soil With 20% Waste Material	1.52	41.5

S. No	Type of Sample	Pure Soil&Sand	5% WM	10% WM	15% WM	20% WM
1	Soil	2.58	2.65	2.60	2.58	2.56

Typ e	Pure Soil & Sand	5% WM	10% WM	15% WM

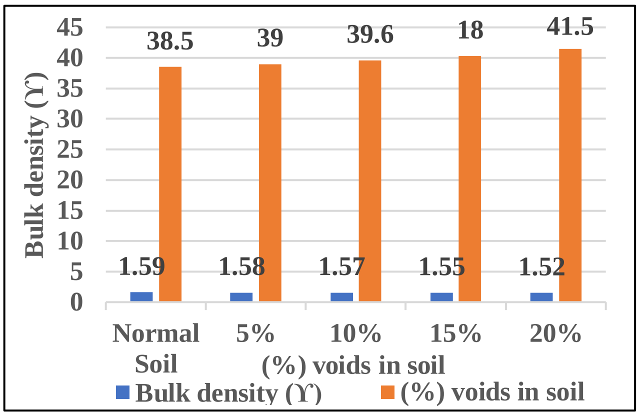


Table – 2 : Void in Bulk Density testResult for Soil

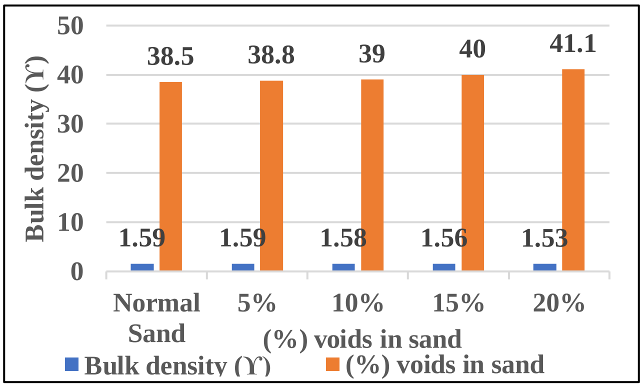
Fig –2 : Graph for Void in Bulk Densitytest forSoil

TABULATION : (SAND)

Table – 3 : Void in Bulk Density test for Sand

Table – 4 : Void in Bulk Density test Result for Sand

S. No	Weight	Sand	5% WM	10% WM	15% WM	20% WM
1	W_1g	610	610	610	610	610
2	W_2g	2160	2157	2145	2125	2100
3	W_3g	1580	1582	1581	1580	1582



PLASTIC LIMIT TEST:

SIEVE ANALYSISTEST:

PROCTORS COMPACTION TEST :

DIRECT SHEAR TEST :

CALIFORNIA BEARING RATIO TEST :VOIDS IN BULK DENSITY TEST :

2	Sand	2.60	2.58	2.56	2.54	2.53

Typ e	Pure Soil & Sand		5% WM		10% WM		15% WM	
	At 2.5 mm	At 5.0 m m	At 2.5 mm	At 5.0 m m	At 2.5 mm	At 5.0 m m	At 2.5 mm	At 5.0 mm
San d	17.5 3	18. 1	17.7 5	18. 2	17.7 9	18. 3	17.6 9	18.2 0
Soil	17.6 2	18. 2	17.7 9	18. 3	17.8 8	18. 4	17,7 1	18.2 9

S. No	Type of Sample	Pure Soil&Sand	5% WM	10% WM	15% WM	20% WM
1	Soil	42	50	51.9	54.1	40.3
2	Sand	40	50	52.1	54.3	40.3

Fig –3 : Graph for Void in Bulk Densitytest forSand

11. RESULT:

SPECIFIC GRAVITY TEST:

LIQUID LIMIT TEST:

S. No	Sample	Bulk density (ϒ)	(%) of voids in soil
1	Normal sand sample	1.59	38.5
2	Sand With 5% WasteMaterial	1.59	38.8
3	Sand With 10% Waste Material	1.58	39
4	Sand With 15% Waste Material	1.56	40
5	Sand With 20% Waste Material	1.53	41.1

	(φ)	(c)	(φ)	(c)	(φ)	(c)	(φ)	(c)
Soil	13.76	53.2	9.920	61	8.025	80.4	11.19	60
Sand	14.57	57.2	10.02	63	8.167	83.9	11.23	58

S. No	Type	Pure Soil & Sand	5% WM	10% WM	15% WM

S. No	Type of Sample	Pure Soil&Sand	5% WM	10% WM	15% WM	20% WM
1	Soil	40	20	17	22	20
2	Sand	40	33.3	25	37.5	22

S. No	Type	Pure Soil & Sand		5% WM		10% WM		15% WM	
		Max dry	OMC (%)	Max dry	OMC (%)	Max dry	OMC (%)	Max dry	OMC (%)
1	Soil	1.95	18	2.07	18	2.13	20	2.20	18
2	Sand	1.86	22	1.83	22	1.82	20	1.95	18

3. CONCLUSIONS:

The smooth soil is having bad bearing potential which make it unfit for construction. This learn about cautioned low priced and advantageous substances for stabilization of the soil. This learn about indicated that use of waste as a stabilizer, get to the bottom of the disaster of waste disposal and in addition facilitate in improving the engineering houses of gentle soil and minimizing the fee of development in assessment to different kind of stabilizing agents.

		Weight	Size	Weight	Size	Weight	Size	Weight	Size
1	Soil	360	300 mic	410	150 mic	350	150 mic	310	1.18mm
2	Sand	400	300 mic	140	150 mic	450	300 mic	398	300mic

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