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Partial Replacement of soil of Newai Reason as Sand in Construction Industry

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Abstract - In our project we use saw dust as a waste material for partial replacement of sand in concrete for modifying its properties. In the concrete mixes sand was replaced at 0%, 10%, 20% 30%,40% & 50% by weight and effects of replacement on concrete is observed. Use of saw dust in concrete permits disposal of waste (saw dust) and make concrete light in weight. Concrete, cubes measuring 150 x 150 x 150 mm, beams of sizes 550 x 100 x 100 mm were cast and their compressive, flexural strength and split tensile strength is evaluated respectively after 7, 14 and 28 days. Metakaolin is use as an admixture which possess cementious properties which provides good bonding between saw dust and ingredient of concrete

The importance of concrete as construction material is increasing every day. Sand as a primary fine aggregate possesses superior adhesion of components in concrete and provides strength. Since a large demand has been placed on building material industry especially in the last decade owing to the increasing population that causes a chronic shortage of building materials, the civil engineers have been challenged to convert the industrial wastes to useful building and construction materials. Our experimental research tries to implicate that sawdust-cement-gravel mix has an equal advantage like the standard mix of cement-sand-gravel. While casting the specimen

e-ISSN: 2348-6848
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Volume 05 Issue 12
April 2018

for checking the compressive strength of concrete, it was observed that the concrete containing sawdust get compacted more efficiently than the normal concrete. Dry porous sawdust could absorb sufficient amount of water that could be an effective mean of internal curing and absorb the excess water in the mix and provide the water required for the hydration of the cement. Since sawdust is already waste , the construction cost will be reduced and also a solution to environmental pollution.

Introduction

The development in the construction industry all over the world is progressing. Attempts have also been made by various researchers to reduce the cost of its constituent and hence total construction cost by investigating and ascertaining the usefulness of material which could be classified as local materials. Some of these local materials are agricultural or industrial waste which includes sawdust, concrete debris, fly ash, coconut shells among others which are produced from milling stations, thermal power station, waste treatment plant and so on. As a result of the increase in the cost of construction materials, especially cement, crushed stone (coarse aggregate), fine sand (fine aggregate); there is the need to investigate the use of alternate building materials which are locally available. In this changing time, sawdust particles might just be one of an infinite number of solutions for low cost housing. The availability of river sand for the preparation of concrete is becoming scarce due to the excessive non scientific methods of mining from the riverbeds, lowering of water table and sinking of the bridge piers among others, are becoming common treats. Sawdust is an industrial waste in the timber industry constitutes a nuisance to both the health and environment when not properly managed. Sawdust can be defined as loose particles or wood chippings obtained as by-products from sawing of timber into standard useable sizes. Generation of wood wastes in sawmill is an unavoidable environmental pollution and hence a great efforts are made in the utilization of such waste .Thus, this research investigates the potential use of wood sawdust wastes to produce a low-cost and lightweight composite for construction and engineering purpose.

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

OBJECTIVE

1 Determine the in situ density of natural or compacted soils using the sand poring .

2 To determine of field density by sand replacement .

Experimental

EXPERIMENTAL WORK

EXPERIMENT CONDUCTED:-

4.1 Sieve analysis.

4.2 Liquid limit taste.

4.3 Compressive strength of cube

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

4.1 SIEVE ANALYSIS:-

A **sieve analysis** (or **gradation test**) is a practice or procedure used (commonly used in civil engineering) to assess the particle size distribution (also called *gradation*) of a granular material.

The size distribution is often of critical importance to the way the material performs in use. A sieve analysis can be performed on any type of non-organic or organic granular materials including sands, crushed rock, clays, granite, feldspars, coal, soil, a wide range of manufactured powders, grain and seeds, down to a minimum size depending on the exact method. Being such a simple technique of particle sizing, it is probably the most common.[1]

Aggregate gradation (sieve analysis) is the distribution of particle sizes expressed as a percent of the total dry weight. Gradation is determined by passing the material through a series of sieves stacked with progressively smaller openings from top to bottom and weighing the material retained on each sieve. Sieve numbers and sizes most often used in grading aggregates for Hydraulic Concrete paving mixtures are as follows:

Fig: 4.1.1

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

SCOPE

2.1 Part I details the necessary steps for sieve analysis of material retained on the 425 μm (No. 40) sieve.

APPARATUS

3.1 Drying oven, maintained at 110 ± 5°C (230 ± 9°F).

3.2 Mechanical sieve shaker.

3.3 Balance, Class G2 in accordance with Tex-901-K, minimum capacity of 15 kg (33 lb.)

3.4 Sample splitter, quartering machine, or quartering cloth.

3.5 Standard U.S. sieves, meeting the requirements of Tex-907-K.

SAMPLES

Fig: 4.1.2

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

4.1 The mass of sample should be sufficient for particle size analysis. The minimum amount required of material retained on the 425 µm (No. 40) sieve depends on the maximum particle size. The size should not be less than the amount shown in Table 1.When the nominal maximum size is between sizes shown, use next larger minimum mass

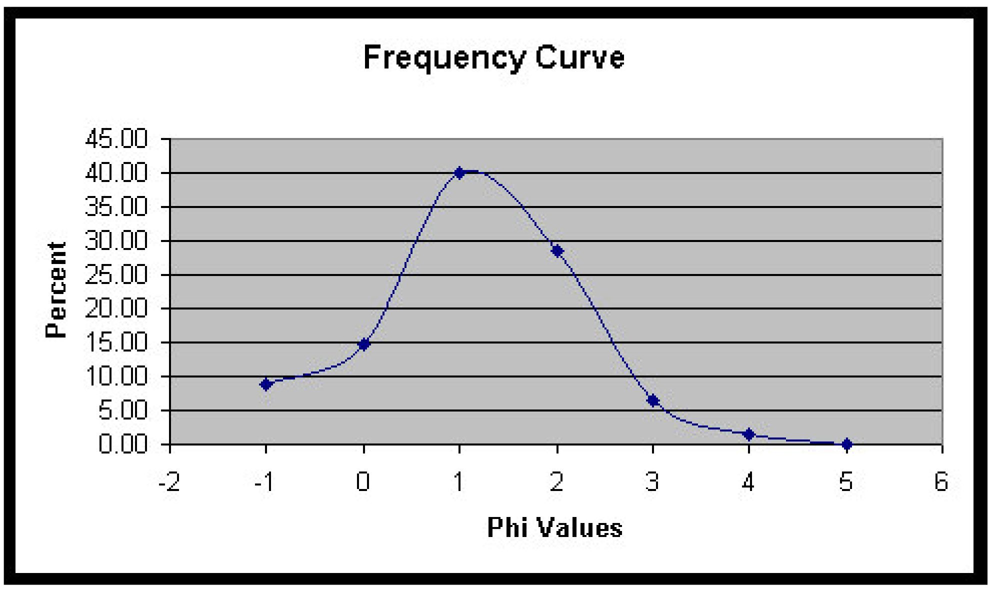
Fig:4.1.3

Fig:4.1.4(sieve analysis)

Sieve Size	Weight retained (gms)	% Weight retained	Cumulative % retained	Cumulative % passing
4.75mm	0	0	0	0
2.36mm	1	0.105	0.105	99.895

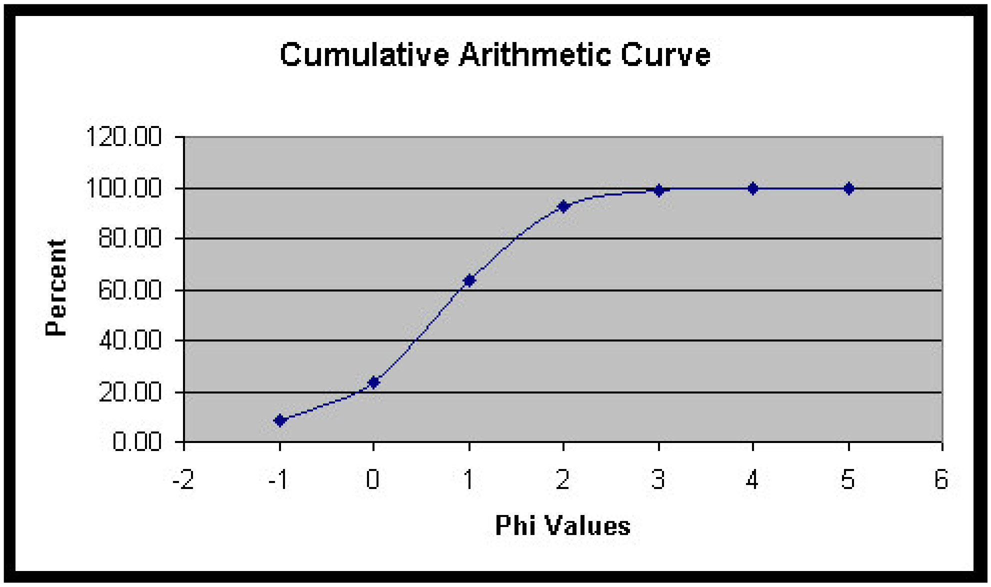
1.18mm	**2**	**0.210**	**0.315**	**99.685**
600ųm	**3**	**0.315**	**0.630**	**99.37**
300ųm	**37**	**3.886**	**4.516**	**95.484**
150ųm	**512**	**53.78**	**58.296**	**41.707**
75micro	**382**	**40.126**	**98.422**	**1.578**
Pan	**15**	**1.575**	**100**	**0**

To Graph this data you will use the Weight Percent for the histogram and the Frequency Curve. The Frequency curve for
this data looks like this.



The Cumulative percent data is used on the Cumulative Arithmetic Curve and the Probability Curve (which is graphed on
probability graph paper). The Cumulative Arithmetic Curve is shown below for this data

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018



RESULT:-

The results are presented in a graph of percent passing versus the sieve size. On the graph the sieve size scale is logarithmic. To find the percent of aggregate passingthrough each sieve, first find the percent retained in each sieve. To do so, the following equation is used,

%Retained =1.684 ×100%

where W_{Sieve} is the weight of aggregate in the sieve and W_{Total} is the total weight of the aggregate. The next step is to find the cumulative percent of aggregate retained in each sieve. To do so, add up the total amount of aggregate that is retained in each sieve and the amount in the previous sieves. The cumulative percent passing of the aggregate is found by subtracting the percent retained from 100%.

%Cumulative Passing = 100% - %Cumulative Retained.

The values are then plotted on a graph with cumulative percent passing on the y axis and logarithmic sieve size on the x axis.[4]

There are two versions of the %Passing equations. the .45 power formula is presented on .45 power gradation chart, whereas the more simple %Passing is presented on a semi-log gradation chart. version of the percent passing graph is shown on .45 power chart and by using the .45 passing formula

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

4.2 LIQUID LIMIT:-

INTRODUCTION

The liquid limit is one of 5 limits developed by A. Atterberg, a swedish scientist. The liquid limit is one of the most commonly performed of the Atterberg Limits along with the plastic limit. These 2 tests are used internationally to classify soil

The liquid limit is defined as the moisture content at which soil begins to behave as a liquid material and begins to flow. The liquid limit is determined in the lab as the moisture content at which the two sides of a groove formed in soil come together and touch for a distance of 2 inch after 25 blows. Since it is very difficult to get this to occur exactly, we will run the test repeatedly until the groove closes 1/2 inch with over 25 blows and under 25 blows. We can plot these results as blow count versus moisture content and interpolate the moisture content .

Sample Preparation Procedure for Liquid Limit

1. Select a 200 to 250 g specimen.
2. Adjust the water content of the specimen by adding distilled water and mixing on a glass plate with a spatula. This specimen should be close to, but not past, the liquid limit of the soil.
3. Place the prepared soil in a container and let the specimen stand for at least 16 h.

Scope

This test method covers the determination of the liquid limit, plastic limit and plasticity index of soils. The liquid and plastic limits of soils are often referred the as the Atterberg limits.

Definitions

Liquid Limit (LL or w_L) - the water content, in percent, of a soil at the arbitrarily defined boundary between the semi-liquid and plastic states.

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

Significance and Use

This testing method is used as an integral part of several engineering classifications systems to characterize the fine-grained fractions of soils and to specify the fine-grained fraction of construction materials. The liquid limit, plastic limit and plasticity index of soils are also used extensively, either individually or together, with other soil properties to correlate with engineering behavior such as compressibility, permeability, compactibility, shrink-swell and shear strength.

Apparatus

Liquid Limit Device - a mechanical device consisting of a brass cup suspended from a carriage designed to control its drop onto a hard rubber base. The device may be operated by either a hand crank or electric motor.

Cup - brass with mass (including cup hanger) of 185 to 215 g.

Cam - designed to raise the cup smoothly and continuously to its maximum height, over a distance of at least 180^{o} of cam rotation, without developing an upward or downward velocity of the cup when the cam follower leaves the cam.

Flat Grooving Tool - a tool made of plastic or non-corroding metal having specified dimensions.

Gage - A metal gage block for adjusting the height of the drop of the cup to 10 mm.

Ground Glass Plate - used for rolling plastic limit threads.

Calibration of Apparatus

Determine that the liquid limit device is clean and in working order. Adjust the height of drop of the cup so that the point of the cup that comes in contact with the base rises to a height of 10 ± 0.2 mm.

EQUIPMENT

Soil sample Metal Mixing Bowl and Small Spatula Liquid Limit Device Water

Working process

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

Fig no:4.2.1(cutting soil)

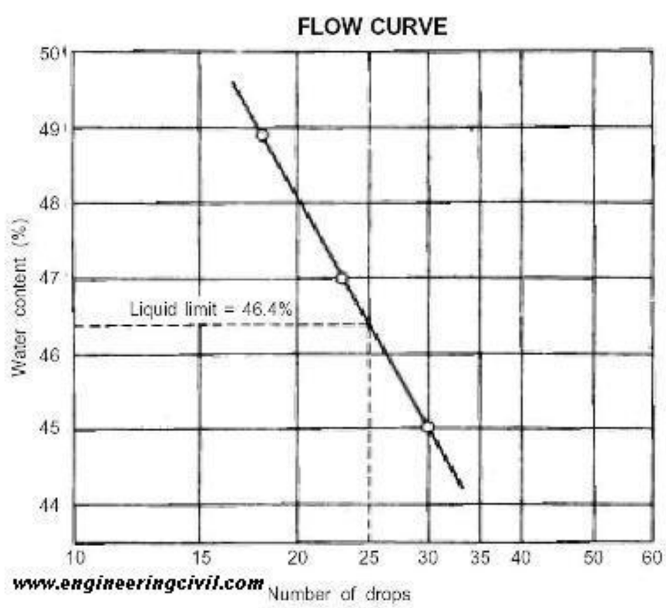
Fig no :4.2.2(opening oven)

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

CALCULATION:-

Observations & Calculations:

Sample number	01	02	03
Container number	24	21	25
Number of Blows	17	25	34
Mass of empty container (M1), gm	44.9	46	44.6
Mass of container + wet soil (M2), gm	78.3	81.3	76.8
Mass of container + dry soil (m^3), gm	70	75.30	74.10
Water content= w = (M2 - m^3/ m^3 - M1) x 100, %	33.07	20.30	10.00



4.0 COMPRESSIVE STRENGTH TEST

Compressive strength or **compression strength** is the capacity of a material or structure to withstand loads tending to reduce size, as opposed to tensile strength, which withstands loads tending to elongate. In other words, compressive strength resists compression (being pushed together), whereas tensile strength resists tension (being pulled apart). In the study of strength of materials, tensile strength, compressive strength, and shear strength can be analyzed independently.

Some materials fracture at their compressive strength limit; others deform irreversibly, so a given amount of deformation may be considered as the limit for compressive load. Compressive strength is a key value for design of structures.

Working process

Fig no :4.4.2(taking a aggregate)

Fig no:4.4.3(taking the reading of compresser)

4.1 SAMPLE RATIO 10-90 (SOIL TO SAND)

- Mix Used – M20
- Ratio of Cement:Sand:Aggregate – 1:1:2
- Water-Cement Ratio – 0.40

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

Fig no: 4.4.4(checking compressive strength of cube)

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International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

Fig no:4.4.5(compression)

Apparatus for Concrete Cube Test

Compression testing machine

Preparation of Concrete Cube Specimen

The proportion and material for making these test specimens are from the same concrete used in the field.

Specimen

6 cubes of 15 cm size Mix. M20 or above

Mixing of Concrete for Cube Test

Mix the concrete either by hand or in a laboratory batch mixer

Hand Mixing

(i)Mix the cement and fine aggregate on a water tight none-absorbent platform until the mixture is thoroughly blended and is of uniform color

(ii)Add the coarse aggregate and mix with cement and fine aggregate until the coarse aggregate is uniformly distributed throughout the batch

(iii)Add water and mix it until the concrete appears to be homogeneous and of the desired consistency

Sampling of Cubes for Test

(i) Clean the mounds and apply oil

(ii) Fill the concrete in the molds in layers approximately 5cm thick

(iii) Compact each layer with not less than 35strokes per layer using a tamping rod (steel bar 16mm diameter and 60cm long, bullet pointed at lower end)

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

(iv) Level the top surface and smoothen it with a trowel

Curing of Cubes

The test specimens are stored in moist air for 24 hours and after this period the specimens are marked and removed from the molds and kept submerged in clear fresh water until taken out prior to test.

Precautions for Tests

The water for curing should be tested every 7 days and the temperature of water must be at 27+-2oC.

Procedure for Cube Test

(I) Remove the specimen from water after specified curing time and wipe out excess water from the surface.

(II) Take the dimension of the specimen to the nearest 0.2m

(III) Clean the bearing surface of the testing machine

(IV) Place the specimen in the machine in such a manner that the load shall be applied to the opposite sides of the cube cast.

(V) Align the specimen centrally on the base plate of the machine.

(VI) Rotate the movable portion gently by hand so that it touches the top surface of the specimen.

(VII) Apply the load gradually without shock and continuously at the rate of 140 kg/cm^2/minute till the specimen fails

(VIII) Record the maximum load and note any unusual features in the type of failure.

Note:

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

Minimum three specimens should be tested at each selected age. If strength of any specimen varies by more than 15 per cent of average strength, results of such specimen should be rejected. Average of three specimens gives the crushing strength of concrete. The strength requirements of concrete.

Reports of Cube Test

a) Identification mark

b) Date of test

c) Age of specimen

d) Curing conditions, including date of manufacture of specimen

f) Appearance of fractured faces of concrete and the type of fracture if they are unusual

Age	Strength per cent
1 day	16%
3 days	40%
7 days	65%
14 days	90%
28 days	99%

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

Result and analysis

5.1 Sieve Analysis Data Calculations

Sample Description and Location : Upper Sand over shelly zone, GA 88, Eocene Sandstone
Weight of Sand and Packet 36.90 grams Weight of Packet 3.38 grams
Weight of Dry Sample before Sieving 33.52 grams

Sieve Size	Weight retained (gms)	% Weight retained	Cumulative % retained	Cumulative % passing
4.75mm	0	0	0	0
2.36mm	1	0.105	0.105	99.895
1.18mm	2	0.210	0.315	99.685
600ųm	3	0.315	0.630	99.37
300ųm	37	3.886	4.516	95.484
150ųm	512	53.78	58.296	41.707
75micro	382	40.126	98.422	1.578
Pan	15	1.575	100	0

Total Weight of Sieve Fractions 33.42 grams Percent of Dry Weight 99.70%

The weight of sand is calculated by subtracting the weight of the beaker empty from the weight of the beaker with sand. So

for o phi data 0-0=0

Cumulative weight is the sum of the weights thus -1 phi value is the starting point and for the 0 phi line the cumulative

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

weight is the weight of the sand from -1 added to the 0 phi weight of sand. So 2.95 + 4.95 = 7.90, and the 1 phi cumulative

weight is 7.90 + 13.36 = 21.26, etc.

Weight percent is the total weight of Sieve Fraction Divided into each weight of the sand fractions. Thus for -1 phi 2.95 is

divided by 33.42 then times 100 = 8.83 %. (times 100 will convert decimal to percent).

Cumulative weight percent is calculated by dividing the total weight of sieve fraction into each of the cumulative weight

values. Thus for -1 phi 2.95 is divide by 33.42 times 100 = 8.83 %, 0 phi 7.90 is divided by 33.42 times 100 = 23.64 %

The Percent of Dry Weight is calculated by dividing the Total weight of Sieve Fractions by the Weight of Dry Sample

before Sieving, times 100. So for our example 33.42/33.52 times 100 = 99.7 %. This gives what percent of the sand you began with you recorded after sieving. A percent lower than 97% means very poor laboratory technique. This number also shows the amount of error in your experimentation process.

Calculate the cumulative percent retained on each sieve. (Answer to the nearest 0.1%) This is determined by the following formula:

Cumulative % Retained: Cumulative Grams Retained X 100

Total Weight of Sample

Weight on the No. 4 sieve = 14.8 grams

Total Dry Weight of Sample = 506.4 grams

%Retained = 14.8 = .029 x 100 = 2.9%

506.4

This is performed for each sieve size and the end ! gures entered in the .Cumulative % Retained. column of the worksheet.

10. **Calculate the percent passing each sieve.** (Answer to the nearest 0.1%). To determine this ! gure, subtract the percent retained on each sieve from 100.

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

Example:

1.) % Retained on 4.75mm sieve = 0

100 - 0 = 100.0% passing 3/8 inch sieve

2.) % Retained on No. 4 sieve = 2.9

100 - 2.9 = 97.1% passing No. 4 sieve

3.) % Retained on No. 8 sieve = 9.4

100 - 9.4 = 90.6% passing No. 8 sieve

This is performed for each sieve and entered in the % Passing Column of the worksheet.

5.2 Liquid limit taste on soil

- Weight of empty container =7gram(B1)

  Weight of soil with container=73gram

  Blow=20

  after oven weight of soil=64

  M.C=(W2-W3)*100/(W3-W1)

  = (73-64)*100/(64-7)

  =15%

M.C=(W2-W3)*100/(W3-W1)

=(80-68)*100/(68-7)

= 20%

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

5.3 Compressive strength of cube

Cross sectional area of cube 150mm*150mm=22500 or 225cm

At 3 days

S.N	percentage%	Weight of cube(kg)	compressive load (kn)	compressive strength(kg/cm)
1	0	7.524	415	188.02
2	10	7.704	465	210.67
3	20	8.120	395	179
4	30	8.027	500	226.53
5	40	7.625	345	156.30
6	50	7.826	392	177.6

Average compressive strength=1138.12/6

=190kg/cm

At 7 days

S.N	**Percentage%**	**Weight of cube(kg)**	**Compressive load**	**Compressive strength(kg/cm)**
1	0	8.210	312	141.35
2	10	8.140	375	170
3	20	8.170	252	114.17
4	30	8.250	268	121.42
5	40	8.10	351	159.02
6	50	8.120	425	192.55

Average compressive strength =998.51/6

=150kg/cm^2

At 14 days

S.N	percentage%	Weight of cube(kg)	compressive load (kn)	compressive strength(kg/cm)
1	0	7.479	393	178.04
2	10	7.730	496	224.71
3	20	7.587	292	132.29
4	30	7.760	315	142.71
5	40	7.782	390	176.69
6	50	7.987	533	214.48

Average compressive strength =1068.92/6

=178.15kg

CONCLUSION

The following inferences have been drawn from the experiments done on ravine soil sample we collected:

We divided the sample into two different testing segments i.e. treating it as fine soil and normal soil, testings done are also divided depending on which of the sample is tested.

When soil is treated as fine:

1. Sieve analysis gave us the result of fineness modulus 1.684. As per IS 875,value should be between 2.2-2.6. This showed that our sample was extremely fine.

2. Specific gravity was found out to be of value 2.418. As per IS 875,value should not exceed 2.67. This proved we had an appropriate result.

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

3. Bulking of soil(treating it as sand) showed us a value of 22.5%. As per IS 875,value can be as much as 40%. This proved we had the right result.

When soil is treated as normal soil following are the testing results:

1. Sieve analysis gave us the result of fineness modulus 5.842. As per IS 875,value should be between 2.9-3.2. This showed that our sample was too coarse.

2. Specific gravity was found out to be of value 2.237. As per IS 875,value should be 2.65. This showed us we were almost identical with the standard value.

3. Plastic limit was 20%. As per IS 875,value should be 23.7%. This was also identical to the standard value.

4. Optimum moisture content turned out to be 16%. Standard value being 14.9%. This showed our nearness to the standard value.

5. Liquid limit was found out to be 26.32%. IS 875 suggests the value to be 23.2%. This is also quiet similar to the standard value.

6. California Bearing Ratio was found out to be 17.5 at 2.5 mm and 24.7 at 5mm. Is 875 suggests 13.44 and 20.6 for 2.5mm and 5mm respectively.

The following inferences have been drawn from the partial replacement of sand by Chambal ravine soil:

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