EVALUATION OF SUSTAINABLE GREEN CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT BY RICE HUSK ASH AND PARTIAL REPLACEMENT OF COARSE AGGREGATE BY CRUSHED CATTLE BONES

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Abstract: Point of this proposition is to diminish the CO2 emanation by lessening the bond utilization and coarse totals in development industry there by making a natural neighborly reasonable green concrete for present day development world. At the point when rice husk ash is legitimately singed, it has high silica content and can be utilized as an admixture in mortar and cement. Crushed cattle Bones rich in calcium content enhances the binding property of cementitious substances with aggregate in this manner enhances the bond strength between cement phase and aggregate phase. An expansive number of concrete cubes of size 150×150×150 mm with various rates by weight of ordinary aggregate to crushed cattle bones as coarse aggregate and rice husk ash remains as cement were thrown, tried. Common portland cement was partial supplant with rice husk ash remains in the proportions of 0%, 5%, 10% and 15% and coarse aggregate was partial supplant with crushed cattle bones in the proportions of 0%, 10%,20% and 30%. Compressive strength test on harden concrete of M40 review of concrete is directed and the strength is around 34.106 and 45.405 for 28days. While the strength as been expanded by 20-30% contrasted with normal concrete.

Keywords: Animal bones, rice husk ash, compressive strength, tensile strength, flexural strength, conventional concrete.

1. INTRODUCTION:

The concrete is made with concrete wastes which are eco-accommodating purported as Green concrete. Concrete that utilizations less vitality in its creation and delivers less carbon dioxide than ordinary concrete is green concrete. Green concrete is exceptionally tough, needs negligible support, and has a long life expectancy which prompts bring down life cycle costs. Green Concrete as the name recommends is eco neighborly and spares nature by utilizing waste items produced by society. Rice husk is a rural deposit generally accessible in significant rice delivering nations. The husk encompasses the paddy grain. Amid processing procedure of paddy grains around 78 % of weight is gotten as rice, broken rice and wheat. Remaining 22 % of the heaviness of paddy is gotten as husk. This husk is utilized as fuel in the different factories to create steam for the parboiling procedure. This husk contains around 75 % natural unpredictable matter and the rest 25 % of the heaviness of this husk is changed over into ash amid the terminating procedure, this Ash is known as rice husk cinder. This RHA contains around 85 % - 90% indistinct silica. RHA has two parts in solid fabricate, as a substitute for Portland cement, decreasing the cost of concrete in the generation of minimal effort building squares, and as an admixture in the creation of high strength concrete. Correspondingly, Cattle bones are additionally dumped in huge amounts in transfer yards and makes terrible scent consequently makes air contamination and sicknesses. Crushed Cattle Bones, rich in calcium content enhances the binding property of cementitious substances with aggregate in this way enhances the concrete strength between cement stage and aggregate stage. Some of these waste bones are recently tossed in junk canisters and pits making uncleanness the earth .Therefore is a need to investigate in what capacity can the bones can be used advantageously in making concrete that can offer great quality developments. In this review, bones were gathered from transfers, cleaned then dried they were made into coarse aggregates measure. To the extent bone is concerned, it is a light and hard material made out of a cell segment and an extracellular network. Other than being light and hard, bone does not fall apart effortlessly. The remaining parts of animal(bones) are uncovered even following many years [Archaeological Survey of India (ASI)] giving an indispensable hint that the rotting time of bones is sufficient to be utilized as a part of concrete works.

1.2 SELECTION OF MATERIALS:

1.2.1Cement:

Ordinary Portland Cement (OPC) locally available in bangalore (the BIRLA SUPER CEMENT Brand Name) in 50kg bags was used for the experiment.

Table -1: Chemical composition of cement:

Oxide	Percent content
Cao	60.81%
Sio_2	19.50%
Al_2O_3	4.12%
Fe_2O_3	6.06%
MgO	1.52%
Alkalies are K_2O Na_2O	0.28% 0.05%
SO_3	2.48%

Physical properties of cement:

Normal consistency = 28%
Intial setting time = 50 min
Final setting time = 10 hrs
Specific gravity = 3.06

1.2.2Fine Aggregate:

The aggregate size is lesser than 4.75 mm is considered as fine total. The sand particles ought to be free from any earth or inorganic materials and observed to be hard and concrete. It was put away in open space free from tidy and water. It adjusts to IS 383-1970 goes under zone II.
Specific gravity = 2.64
Fineness modulus = 3.85
Water absorption = 1.39%

1.2.3 Coarse Aggregate:

The aggregate size greater than 4.75 mm, is considered as coarse total. It can be found from unique bed rocks. Coarse aggregate are accessible fit as a fiddle like adjusted, Irregular or incompletely adjusted Angular, Flaky. It ought to be free from any natural polluting influences and the earth substance was immaterial.
Specific gravity = 2.72
Fineness modulus = 8.5
Water absorption = 0.43%

1.2.4 Crushed cattle bones:

The CCB aggregate was machine pounded in the size scope of 10-20mm and underneath. The CCB aggregate is calcareous in nature and can predicament effortlessly with concrete items. Being natural in nature, the properties of CCB aggregate very vary from the traditional aggregate.
Physical properties of CCB:
Specific gravity = 1.4
Fineness modulus = 6.45

Fig 1: crushed cattle bones

Table -2: chemical composition of crushed cattle bones:

Oxide	Percent content
Carbonate	0.94
Iron	0.25
Aluminum oxide	0.019
Calcium	51.70
Magnesium	0.32
Sulphur	1.57
Potassium	0.043

1.2.5 Rice husk ash:

Rice husk is a horticultural buildup generally accessible in significant rice delivering nations. Rice husk ash (RHA) is acquired by consuming of rice husk in a controlled way. At the point when legitimately consumed, it has high silica content and can be utilized as an admixture in mortar and cement.
Physical properties of RHA:
Specific gravity = 2.08

Fig 2: rice husk ash

Table- 3: chemical composition of rice husk ash:

Oxide	Percent content
Cao	60.81%
Sio_2	74.0%
Al_2O_3	1.32%
Fe_2O_3	0.88%
MgO	0.32%
Alkalies are K_2O Na_2O	1.65% 0.5%
P_2O_3	0.61%

1.2.6 Water:

Water is a vital element of concrete as it effectively partakes in the concoction response with cement. Since it frames the strength giving cement gel, the amount and nature of water is required to be investigated precisely. Blending water ought not contain undesirable natural substances or inorganic constituents in unreasonable extents. In this venture clean consumable water is utilized.

1.2.7 Admixture:

The Super plasticizer utilized as a part of cement is Conplast SP430. It depends on Sulphonated Napthalene Polymers and provided as a dark colored fluid immediately dispersible in water. Conplast SP430 has been uniquely detailed to surrender high water diminishments to 25% without loss of workability or to deliver top notch cement of lessened penetrability. The measurements of Super plasticizer was 0.5 to 1.5 liters for each 100kg of cement. The properties of super plasticizer are organized in table.

Table -4: physical properties of super plasticizer:

Sl. No	Description	Test results
1	Type	Conplast SP430
2	Appearance	Brown liquid
3	Specific gravity	1.21
4	Dosage	0.5-1.5L/kg

2.Mix design for M-40 Grade Concrete:

Design Stipulations:

Characteristic Compressive Strength required at the end of 28 days: 40 N/mm2
Maximum size of Aggregate: 20mm
Type of Exposure: Severe
Degree of Quality Control: Good

Test Data for Materials

Specific Gravity of Cement: 3.06
Specific Gravity of Coarse Aggregate: 2.64
Specific Gravity of Fine Aggregate: 2.72

Target Mean Strength of Concrete:

For a tolerance factor of 1.65, the obtained target means strength for the given grade of concrete = 40 + 5 x 1.65 = 48.25 N/mm2

Selection of Water Cement Ratio:

The free water cement ratio for the obtained target mean strength is 0.4.This is equal to the value prescribed for Moderate conditions in IS 456-2000.

Mix proportion:

Cement: 400 kg/m^3
Coarse aggregate: 1106.10 kg/m^3
Fine aggregate: 790.26 kg/m^3
Water : 157.6 kg/m^3
Admixture : 7.20 kg/m^3

3.METHODS:

3.1 Batching and mixing of materials:

Batching of materials was finished by weight. The rate substitutions of Ordinary Portland concrete (OPC) by Rice Husk Ash (RHA) were 0%, 5%, 10%, and 15%. The 0% substitution was to fill in as control for different specimens. The rate substitutions of coarse aggregates by crushed cattle bones were 0%, 10%, 20% and 30%.

3.2 Concrete Mix Design:

The concrete utilized as a part of this examination work was made utilizing cement, Sand and Gravel. The concrete mix proportion was 1:1.97:2.76 by weight.

3.3 Casting of samples:

Cubic samples of concrete with size 150 x 150 x 150 mm were thrown for assurance of all estimations. Six mixes were readied utilizing distinctive rates of 0, 5, 10, 15 and 20 RHA and 0%, 10%, 20% and 30% of CCB. The concrete was

blended, set and compacted in three layers. The specimens were demoulded following 24 hours and kept in a curing tank for 7 and 28 days as required. The Compacting Factor mechanical assembly was additionally used to decide the compacting variable estimations of the new concrete as per BS 1881: Part 103 (1983).

3.4Testing of samples:

RHA were included cement at 0%, 5%, 10% and 15%. replacement with cement. CCB were included concrete at 0%, 10%, 20% and 30% supplanting with coarse aggregate. Seven different mix proportion were arrived to be specific N1, N2, N3, N4, N5, N6 and N7. The blend extent points of interest are arranged in table. Concrete cubes, cylinders and prism are threw in individual forms and are de-moulded following 1 day interim. The de-moulded samples are placed in water tank for curing. Last strength of concrete cubes, cylinders and prisms are tested following 28 days. Compressive strength test and split tensile test are tried utilizing pressure testing machine. The devastating burdens were noted and normal compressive strength and tensile for three samples is resolved individually. The flexural strength test has been done on prism of size 150 x 150 x 500mm by flexural testing machine. This was finished by single point load test having an end direction of 50mm from each support. The crushed cattle bones (goat or sheep bones) are dried in the outdoors to get out the soil and to lessen the scent and dampness content. The CCB was as a matter of first importance separated to our coarse aggregate sizes deliberately. The extent of these bones should be as coarse aggregate sizes. These CCB aggregates were utilized as incomplete substitution of customary coarse aggregate in concrete cubes, cylinders, and prisms samples up to 30%. The samples are made for M40 review concrete. concrete blend proportion of with a water/concrete proportion of 0.4 individually has been utilized as a part of the review.

Table -5 : designations of rice husk ash and crushed cattle bones:

Sl. No	% of replacement	Mix name
1	0% replacement	N
2	5% RHA	N1
3	10% RHA	N2
4	15% RHA	N3
5	10% CCB	N4
6	20% CCB	N5
7	30% CCB	N6
8	10% RHA and 10% CCB	N7

%RHA: Percentage of rice husk ash
%CCB: Percentage of crushed cattle bones

3.5 Compressive strength test:

The compressive strength of concrete is tried utilizing compression testing machine. The exploratory outcomes are contrasted with standard control concrete planned with yield a normal compressive strength of 40MPa at 28 days. Moulds were threw for the blends to be specific N1, N2, N3 and N4. These threw moulds are tried for its compressive strength following 7, and 28 days curing period. The test outcomes are classified in table.
Compressive strength (MPa) = Failure load / cross sectional area

Table- 6: compressive strength for 7 and 28 days

Compressive strength	N	N1	N2	N3	N4	N5	N6	N7
Compressive Strength at 7 days	28.44	31.55	33.14	30.01	32.36	31.07	30.51	34.10
Compressive Strength at 28 days	42.25	43.81	45.02	41.95	45.55	44.35	43.27	45.40

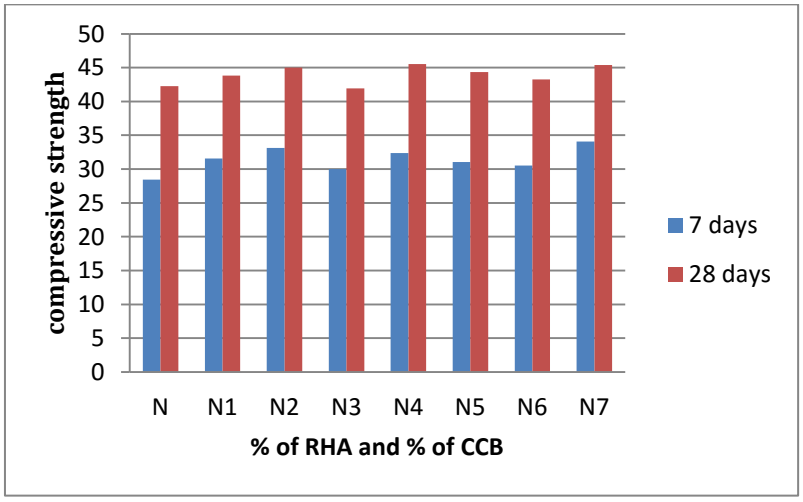

Chart-1 : compressive strength

3.6 Split tensile strength test:

Cylinders were threw for the samples N1, N2, N3, were tried following 7 and 14 days curing. The load is connected consistently along the length of the chamber and the load is connected until disappointment of the cylinder, along the vertical distance across. The test outcomes are organized in table. Split elasticity was figured as takes after:

Spilt Tensile strength (MPa) = $2P / \pi DL$

Where, P = Failure Load (KN)

D = Diameter of Specimen (150 mm)

L = Length of Specimen (300 mm)

Table- 7: tensile strength for 7 and 28 days

Tensile Strength	N	N1	N2	N3	N4	N5	N6	N7
Tensile Strength at 7 days	3.12	3.66	3.94	3.49	3.78	3.56	3.62	4.03
Tensile Strength at 28 days	4.06	4.32	4.48	4.25	4.53	4.35	4.08	4.62

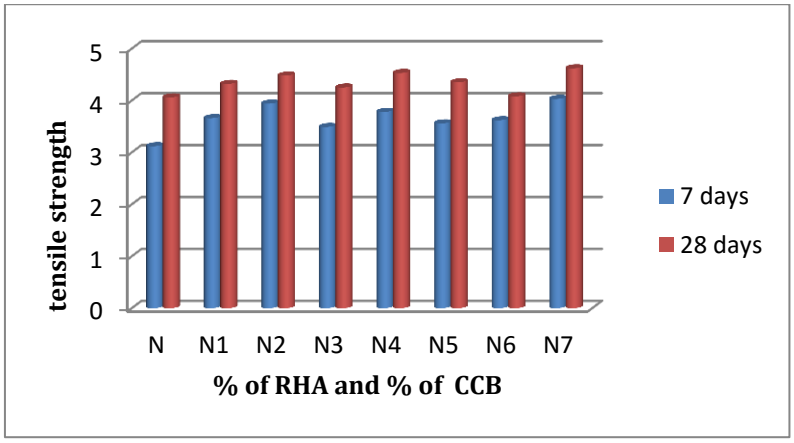

Chart-2: tensile strength

3.7 Flexural strength test:

The prism of size 100mm x 100mm x 500mm is utilized for deciding the flexural strength. The samples are tried toward the finish of 7 and 28 days curing utilizing flexural testing machine Prisms were threw for every one of the samples from N1 to N7. The load is expanded until the sample comes up short and the most extreme load connected to the sample amid the test is recorded. The test results are classified in table and plotted in figure. The Flexural strength is computed by utilizing the recipe

$\sigma = P\ l / bh2$

Where, P = load in Newton

l = length of rectangular prism in mm

b = breadth of rectangular prism in mm

h = height of rectangular prism in mm

Table- 8: flexural strength for 7 and 28 days

Flexural strength	N	N1	N2	N3	N4	N5	N6	N7
Flexural Strength at 7 days	6.05	6.54	6.71	6.37	6.83	6.69	6.45	7.12
Flexural Strength at 28 days	6.94	7.53	7.62	7.36	7.70	7.50	7.42	8.08

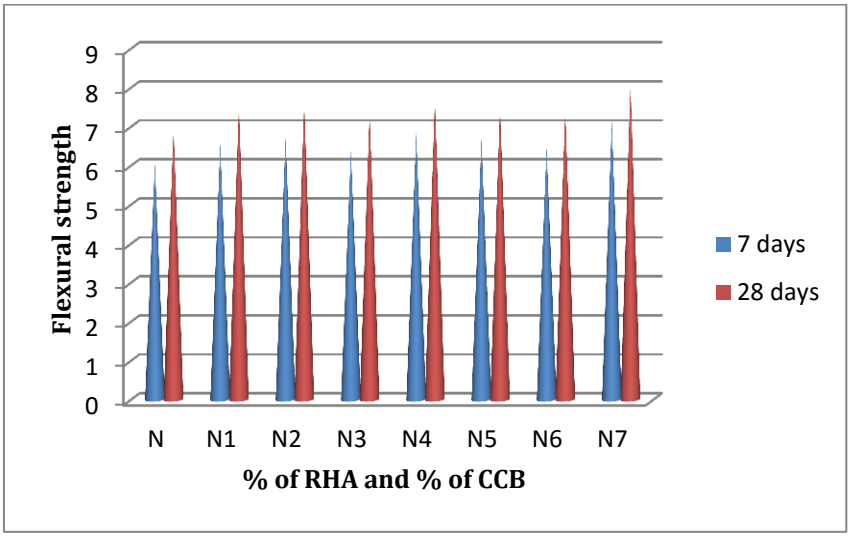

Chart-3: flexural strength

4. CONCLUSION:

- As substitution level of RHA builds the compressive strength decreases and also on account of crushed cattle bones as substitution level increments compressive strength reduces.
- From the compressive strength, split tensile and flexural strength test outcomes, (RHA 10% and CCB 10%) blend is recognized as optimized concrete. The optimized concrete as a higher strength contrasted with the conventional concrete.
- Using RHA as substitution of OPC in cement, the emanation of greenhouse gasses can be diminished up to a more greater extent.
- Effective usage of RHA and CCB in concrete can spare natural resources and henceforth can keep our condition safe and furthermore decreases the utilization of cement and coarse aggregates.
- On Whole it is reasoned that both RHA and CCB can be used in concrete at 10% supplanting of RHA with cement and 10% supplanting of CCB with coarse aggregate.

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