Experimental Analysis of Concrete with Partial Replacement by Coconut Components

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Abstract— As now days the cost of construction materials are very high so it is necessary to find out some alternative materials in the construction field. In this research work we are using coconut shell ash as cement and coconut shell as coarse aggregate with some percentage of replacement, along with this coconut fiber is also used to improve the split tensile strength of concrete. In this study M 20 grade of concrete is prepared in which cement is partially replaced by 0, 5, 10, 15 & 20 percent with coconut shell ash, coarse aggregate is partially replaced by 0, 5, 10, 15 & 20 percent with coconut shell and adding fiber content to be 4 percent (by weight of cement). A total of 30 cubes, 20 cylinders and 30 cubes with 16mm bar were made and cured by immersing them in water for seven and twenty eight days. And these specimens are tested for Compressive Strength, Split Tensile Strength, Bond Strength and density of concrete is also tested. The density test is conducted for analyzing the light weight property of the concrete.

Key words: Concrete, Coconut Components, Partial Replacement

I. INTRODUCTION

The traditional growth in population, the number and kind of waste materials have enhanced consequently. Many of the non-decaying waste materials can stay within the surroundings for hundreds, maybe thousands of years. The non-decaying waste materials cause a waste disposal crisis, thereby tributary to the environmental issues. The environmental impact will be reduced by making a lot of sustainable use of this waste; this is often called the Waste Hierarchy. Its aim is to cut back, reuse, or recycle waste, the latter being the well-liked possibility of waste disposal. Coconut waste is available in large quantity around the world so its constituents can be used in concrete in different forms which are coconut shell ash, coconut shell, coir (coconut fiber).

II. FORMULATION OF WORK

In the initial segment of work cement is somewhat supplanted by coconut shell powder and coarse aggregates are halfway supplanted by Coconut Shell in various rates as appeared in the table beneath. 5 mixes are set up in various extents. Cubes and Cylinders are thrown for deciding Compressive Strength, Split Tensile qualities and Bond Stress separately at 7 and 28 days. 30 cubes, 20 Cylinders and 30 cubes with 16 mm bar in focal point of the 3D square are threw in complete 5 mixes. The coconut fiber is additionally included by 4% of the weight of the cement.

B	Cement (%)	Coconut Shell Ash (%)	Coconut Shell (%)	Coconut Fiber (%)	Sand (%)	Natural Coarse Aggregates (%)
1	100	0	20	4	100	80
2	95	5	15	4	100	85
3	90	10	10	4	100	90
4	85	15	5	4	100	95
5	80	20	0	4	100	100

Table 1: Formulation of Work

In the second part of work density of concrete of all five types of mixes is also calculated & checked whether it is considered as light weight concrete or not. Density of light weight concrete is less than 2000 Kg/m3. Cubes are casted for determining Density of different mixes respectively at 7 & 28 days and tested.

III. RESULTS & OBSERVATIONS

As work is done in two sections, consequence of section 1 is exhibited in graphical form. Tests are performed on cubes, cubes with bars and cylinders and their 7 days and 28 days qualities have been resolved. An examination in light of quality of various blend extents is done. A correlation of qualities for 7 days and 28 days are likewise figured.

A. Compressive Strength

Compressive strength test is performed on 3 cubes of each clump blend for 7 days and 28 days. There are 5 bunch blends and every one having 6 shapes. Of these 6 cubes, 3 cubes are tried for 7 days and 28 days each. A normal of 3 esteems as organized in subhead results, are considered for exchanges.

S.NO.	COMBINATION	AVG COMPRESSIVE STRENGTH (7 Days) (N/mm^2)	AVG COMPRESSIVE STRENGTH (28 Days) (N/mm^2)
Mix-01	C+S+NCA(80%)+CF(4%)+CS(20%)	13.61	21.62
Mix-02	C(95%)+CSA(5%)+S+NCA(85%)+CS(15%)+ CF(4%)	16.55	25.41
Mix-03	C(90%)+CSA(10%)+S+NCA(90%)+CS(10%)+ CF(4%)	17.37	25.8
Mix-04	C(85%)+CSA(15%)+S+NCA(95%)+CS(5%)+ CF (4%)	16.90	25.8
Mix-05	C80%)+CSA(20%)+S+NCA+ CF (4%)	12.99	21.6

Table 2: Compressive Strength Result for 7 & 28 days

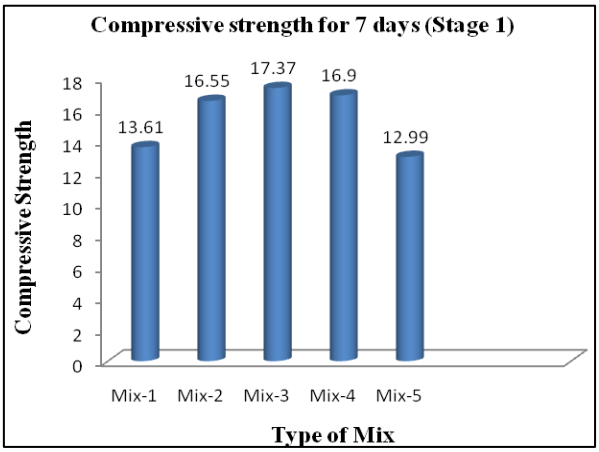

Chart 1: Compressive Strength at 7 days (Stage-1)

As shown in the chart: 1 (7 days strength), when cement is partially replaced 10% by CSA, compressive strength is increased by 21.74%. Afterwards when addition of % of CSA is replaced, strength starts decreasing, a minimum strength is achieved.

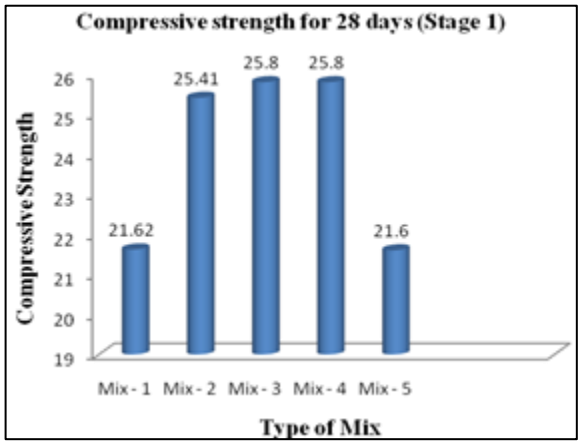

Chart 2: Compressive Strength at 28 days (Stage-1)

28 days strength in chart: 2 show an increment of 16.85% of strength of 10% replacement of CSA as compared with conventional concrete. Again strength is decreased when addition of percentage of CSA increase.

B. Split Tensile Strength

Split Tensile Strength is performed on 2 cylinders of each bunch blend for 7 days and 28 days. There are 5 cluster blends and every one having 4 cylinders. Of these 4 cylinders, 2 cylinders are tried for 7 days and 28 days each. A normal of 2 esteems as arranged in subhead results, are considered for talks.

S.NO.	COMBINATION	AVG TENSILE STRENGTH (7 Days) (N/mm^2)	AVG TENSILE STRENGTH (28 Days) (N/mm^2)
Mix-01	C+S+NCA(80%)+CF(4%)+CS(20%)	2.74	4.01
Mix-02	C(95%)+CSA(5%)+S+NCA(85%)+CS(15%)+ CF(4%)	2.56	3.71
Mix-03	C(90%)+CSA(10%)+S+NCA(90%)+CS(10%)+ CF(4%)	2.35	3.38
Mix-04	C(85%)+CSA(15%)+S+NCA(95%)+CS(5%)+ CF (4%)	2.92	4.01
Mix-05	C80%)+CSA(20%)+S+NCA+ CF (4%)	2.70	3.74

Table 3: Split Strength Result for 7 & 28 Days

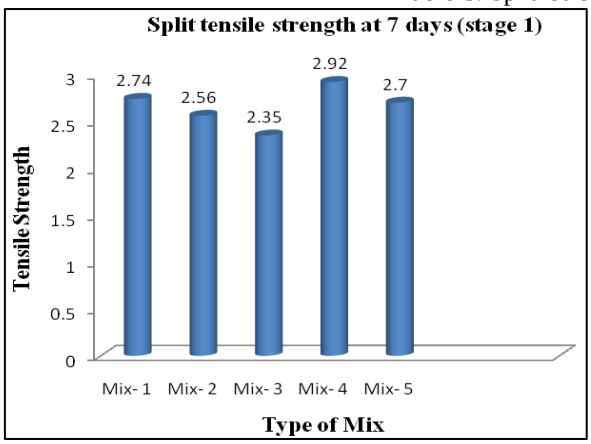

Chart 3: Split Tensile Strength at 7 (Days) (Stage-1)

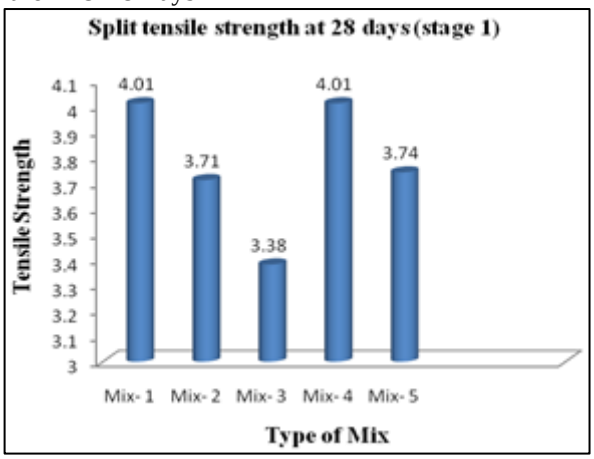

Chart 4: Split Tensile Strength at 28 (Days) (Stage-1)

As shown in the chart: 3 (7 days strength), when cement is partially replaced 15% by CSA i.e., Split Tensile strength is increased by 25%. Afterwards when % of CSA is increased the strength starts decreasing.

28 days strength in chart: 4 shows and increment of 35% of strength of 15% replacement of CSA as compared with conventional concrete. Again strength is decreased when % of CSA is increased.

C. Bond Strength

Bond Strength is performed on 2cubes of each clump blend for 7 days and 28 days. There are 5 bunch blends and every one having 4 cubes. Of these 4 cubes, 2 cubes are tried for 7 days and 28 days each. A normal of 2 esteems as classified in subhead results, are considered for discourses.

S.NO.	COMBINATION	AVG BOND STRENGTH (7 Days) (N/mm^2)	AVG BOND STRENGTH (28 Days) (N/mm^2)
Mix-01	C+S+NCA(80%)+CF(4%)+CS(20%)	3.45	5.05
Mix-02	C(95%)+CSA(5%)+S+NCA(85%)+CS(15%)+ CF(4%)	3.6	4.95
Mix-03	C(90%)+CSA(10%)+S+NCA(90%)+CS(10%)+ CF(4%)	4.05	5.8
Mix-04	C(85%)+CSA(15%)+S+NCA(95%)+CS(5%)+ CF (4%)	4	5
Mix-05	C80%)+CSA(20%)+S+NCA+ CF (4%)	3.25	5.25

Table 4: Bond Strength Result for 7 & 28 days

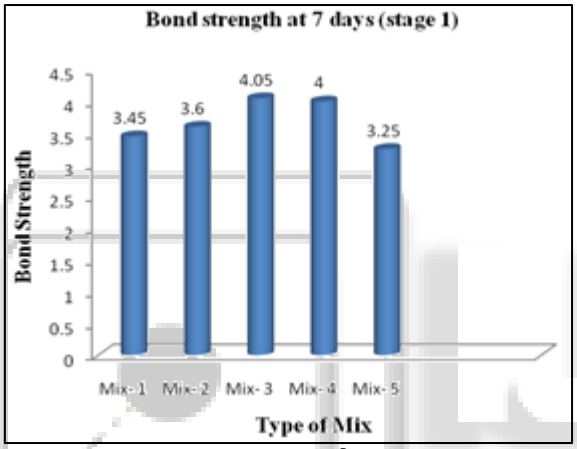

Chart 5: Bond Strength in N/mm^2 at 7 (Days) (Stage-1)

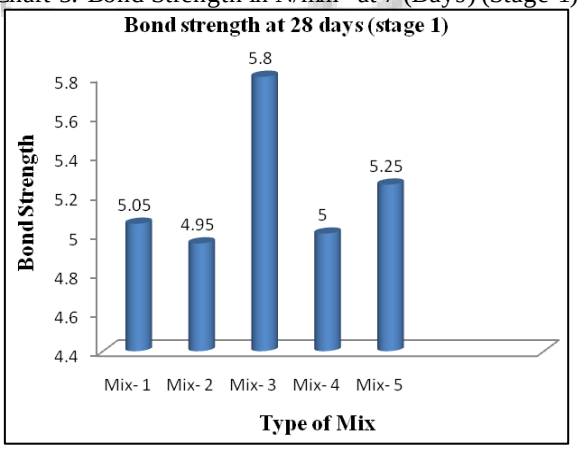

Chart 6: Bond Strength in N/mm^2 at 28 (Days) (Stage-1)

As shown in the chart: 5 (7 days strength), when cement is partially replaced 10% by CSA i.e., Split Tensile strength is increased by 23%. Afterwards when % of CSA is increased the strength starts decreasing.

28 days strength in chart: 6 shows and increment of 29% of strength of 10% replacement of CSA as compared with conventional concrete. Again strength is decreased when % of CSA is increased.

D. Density

Density of concrete of each of the five kinds of blends is likewise computed and checked whether it is considered as light weight concrete or not.

Thickness of light weight concrete is under 2000 kg/m3. Cubes are thrown for deciding Density of various blends individually at 7 and 28 days.

S.NO.	TYPE OF MIX	CURING AGE (Days)	DENSITY (kg/m3)	AVG DENSITY (kg/m3)
1	Mix - 01	7	1915	1909
		28	1903	
2	Mix - 02	7	1930	1928
		28	1926	
3	Mix - 03	7	2106	2051.5
		28	1997	
4	Mix - 04	7	2202	2207.5
		28	2213	
5	Mix - 05	7	2310	2312.5
		28	2315	

Table 5: Density of Concrete for 7 & 28 days

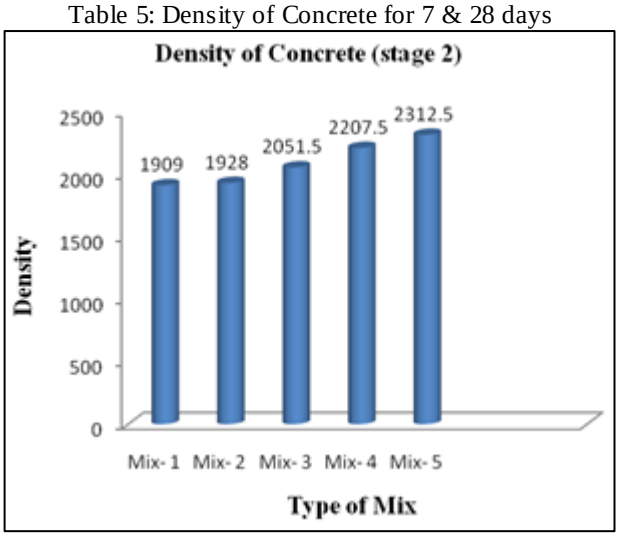

Chart 7: Density of Concrete in Kg/m^3 (Stage-2)

As shown in the chart: 7 when coarse aggregate is partially replaced by 20% CS i.e., Density of concrete is decreased to 1909 Kg/m3. Afterwards when % of CS is decreased the density starts increasing.

IV. CONCLUSIONS

In the wake of playing out every one of the tests and investigating their outcome, the accompanying ends can be inferred:

1) Maximum increase in compressive strength of concrete occurred when 10% cement and 10% coarse aggregate replacement was done with coconut shell ash and coconut shell.
2) Maximum increase in bond strength of concrete occurred when 10% cement and 10% coarse aggregate replacement was done with coconut shell ash and coconut shell.
3) Split tensile strength is maximum when 0% cement and 20% coarse aggregate & 15% cement and 5% coarse aggregate replacement was done with coconut shell ash and coconut shell with addition of 4% coconut fiber by weight of cement.
4) Concrete is considered as light weight concrete when 0% cement and 20% coarse aggregate & 5% cement and 15% coarse aggregate replacement was done with coconut shell ash and coconut shell, as density of these two types of concrete mixes is less than 2000 kg/m3.

Utilizing the coconut shell slag as cement and coconut shell as aggregate in concrete can lessen the material expense in development due to the minimal effort and bounteous farming waste. This kind of concrete we named "Coco Concrete" can be utilized in rustic regions and spots where coconut is copious and may likewise be utilized where cement and aggregates are expensive. In this manner, economy can be accomplished in development. Coco concrete is additionally delegated auxiliary lightweight concrete. By fortifying the concrete with coconut filaments which are unreservedly accessible, we can diminish the natural waste and split tensile strength increments if there should arise an occurrence of 4% fiber blend.

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