A Study on the Behavior of Concrete made by using PPC, Surkhi, Coconut Shells as a Partial Replacement for Cement, Fine Aggregate and Coarse Aggregate and Coconut Coir as an Admixture

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Abstract:

India is a developing country, it always tries to show its development through construction field. In order to construct the large structures like dams, reservoirs multistorey buildings, we used to store the raw materials in temporary sheds and sometimes these sheds are used as an accommodation for labour we used to construct work houses, temporary work sheds etc., but the cost of construction for these sheds is high, in order to reduce this cost the concrete made by using Coconut Shells, Surkhi, and PPC are used as a partial replacement for cement, coarse aggregate and fine aggregate. This concrete can be used for constructing light weight buildings, and constructions like load bearing walls and thick slabs at a low cost. And this concrete is also used for constructing public buildings, house hold, small shopping complexes etc., In this study an equal percentages of all the materials for replacement of conventional concrete starting from 10%, 20%, 25%, 30%, 40%, 50% of the test materials by weight to the conventional concrete materials. A series of compression tests and tensile tests are conducted on the casted cubes for 3days, 7 days, 14 days, 28 days, and 56 days. In this test M30 grade mix design is used. The test results grow on increasing of strength up to 25% and started to shows a decrease in strength after 50% replacement of materials. And the strength increased from 3 days to 56 days, because the materials used for replacement gives long term strength.

Keywords: *Surkhi, PPC, Coconut Shells, Coconut Coir, Compression Test, Tension Test, Conventional Concrete.*

INTRODUCTION:

Concrete is a material composed of cement, coarse aggregates, fine aggregates and water. This concrete is called as conventional concrete. The cost of this conventional concrete is high when comapred with this replaced concrete. There are different types of cements which are in use thet are the high alkali cement, low heat cement, quicksetting

cement etc., they are used basesd on the purpose of construction. Based on the amount of cement and other materials the strength of concrete will be varied. And all these raw materials are added in proportions for giving the strength the proportioning of different materials of concrete is called as mix design. In this present study M30 grade cocncrete is used. Thre are different types of concretes they are the high density concrete, light weight concrete, aerated concrete, mass concrete, glass reinforced concrete, fiber reinforced concrete, polymer concrete etc., all these concretes are used based upon the type of construction.

2. REVIEW OF LITERATURE :

In this present study the materials used are coconut coir, surkhi, cocnut shells and ppc, all these materials can be called as admixtures but in some areas of India, surkhi is used as a replacement for sand during cocnstruction. And coconut shells are used as a replacement for coarse aggregates. And coconut coir is used as an admixture. An admixture is defined as an exteranal material which is added to cement durig the time of its mixing with water. There are different types of admixtures, they are the plasticizers, super plasticizers, accelerating admixtures, retarding admixtures air-etrainers, air-detrainers and mineral admixtures like fly ash, surkhi etc.,

3. METHODOLOGY:

All the materials used in this study are abun dantly available and cheap and these materials give long term strength to concrete. Coconut coir resiststhe alakali nature of cement and surkhiand PPC gives long term strength to cocncrete and reduces the heat of hydration of cement in concrete. Coocnut shells used in this concrete produces high bulk volume and light in weight structures can be developed but the water absorption for cocnut shells is high whe compared with general aggregates.

4. EXPERIMENTAL STUDY:

There are different tests which are conducted on the materials used for making of concrete. They are the fineness modulus test for OPC, PPC, coarse aggregate, sand,surkhi, coconut shells. Specific gravity tests for OPC, PPC, coarse aggregate, sand,surkhi, coconut shells water absorption test for coarse aggregate, coconut shells and bulking test for sand, surkhi, normal consistency test, initial and final setting time tests for OPC, PPC.

4.1 Table-1 Tests For Basic Materials

S.NO	NAME OF THE TEST	RESULT
Specific Gravity	1. OPC	3.1
	2. PPC	2.94
	3. Coarse aggregate	2.61
	4. Coconut shell	1.11
	5. Sand	2.73
	6. Surkhi	2.41
Fineness Modulus	1.OPC	2%

	2. PPC 3. Coarse aggregate 4. Coconut shell 5. Sand 6. Surkhi	7% 7.56% 3.76% 3.96% 3.91%
Normal Consistency Test	1. OPC 2. PPC	29% 28.33%
Initial Setting Time Test	1. OPC 2. PPC	65 minutes 71 minutes
Final Setting Time Test	1. OPC 2. PPC	490 minutes 550 minutes
Water Absorption Test	1. Coarse aggregate 2. Coconut shell	2.89% 28.6%
Bulking Test	1. Sand 2. Surkhi	66 at 10%moisture content 56 at 22%moisture content

4.2 MIX DESIGN:
DESIGN OFMIX FOR M30 GRADECONCRETE:

4.2.1. GENERAL

The grade of cement taken in this study as 53 grade and the grade of PPC was 43. And the mix implemented is M30. This mix is selected based on the strength criteria and taken for severe environmental condition. The proportions of cement, coarse aggregate and fine aggregate are calculated by using the IS codes and the equations for calculations are taken from IS:10262-2009 and those equations are as given below. The proportions which are obtained during mix design are strictly implemented throughout the study. Concrete cubes and cylinders are casted and are cured for 56 days and are kept in sun a day before testing. And the cubes are tested for compressive strength and split tensile strength at 3, 7,14, 28, 56 days respectively for the mix proportions. And slump cone test is also conducted for every mix in order to check the workability of concrete.

4.4.2. MIX DESIGN- M30 OF CONVENTIONAL CONCRETE:
A-I STIPULATIONS FOR PROPORTIONING:

a) Grade designation : M30
b) Type of cement : OPC53 Grade cement
c) Maximum nominal size of aggregate : 20mm
d) Minimum cement content : 220Kg/m3
e) Maximum water-cement ratio: 0.42
f) Workability : good
g) Exposure condition : severe
h) Degree of supervision : good
i) Type of aggregate : Crushed angular aggregate
j) Maximum cement content : 310Kg/m3

A-2 TEST DATA FOR MATERIALS:

a) Cement used : OPC 53 grade

b) Specific gravity of cement :3.10

c) Specific gravity of

1) Coarse aggregate : 2.67

2) Fine aggregate : 2.73

d) Water absorption

1) Coarse aggregate : 2.89

2) Fine aggregate : 1.0

f) Sieve analysis

1) Coarse aggregate : Confirming to table-2 0f IS 383

2) Fine aggregate : Confirming to zone-2 of table-4 of IS383

A-3 TARGET STRENGTH FOR MIX PROPORTIONING:

f'ck = fck + 1.65 swheref'ck = target average compressive strength at 28 days, fck = characteristic compressive strength at 28 days, and

s = standard deviation. From Table I, standard deviation, s = 5.0N/mm2 Therefore, target strength = 30 + 1.65 x 5.0= 38.25 N/mm2

A·4 SELECTION OF WATER-CEMENT RATIO:

From Table 5 of IS 456, maximum water-cement ratio = 0.45 Adopt water-cement ratio as 0.42.

0.42<0.45, hence O.K.

A-5 SELECTION OF WATER CONTENT:

From Table 2, maximum water content =186 litre (for 25 to 50 mm slump range) for 20 mm aggregate

Estimated water content= 186Kg/m3

A-6 CALCULATION OF CEMENT CONTENT:

Water-cement ratio= 0.42

Cement content = 186 = 443Kg/m3

From Table 5 of IS 456, minimum cement content for ‘severe' exposure condition = 320 kg/m3

443 kg/m3 > 320 kg/m3, hence, O.K.

A·7 PROPORTION OF VOLUME OF COARSE AGGREGATE AND FINE AGGREGATE CONTENT:

From Table 3, volume of coarse aggregate corresponding to 20 mm size aggregate and fine aggregate (Zone 2) for water-cement ratio of 0.50 - 0.60. In the present case water-cement ratio is 0.42. Therefore, volume of coarse aggregate is required to be increased to decrease the fine aggregate content. The proportion of volume of coarse aggregate is increased by

0.04 (at the rate of -/+ 0.01 for every ± 0.05 change in water-cement ratio). Therefore, corrected proportion of volume of coarse aggregate for the water-cement ratio of 0.42 = 0.636.

Volume of fine aggregate content= 1 - 0.636 = 0.364.

A-8 MIX CALCULATIONS:

The mix calculations per unit volume of concrete shall be as follows:

a) Volume of concrete = 1m3

a) Volume of cement = $\frac{\text{Mass of cement}}{\text{Specific gravity of cement}} \times \frac{1}{1000}$

= 443/3.10* 1/1000

=0.142m^3

b) Volume of water = $\frac{\text{Mass of water}}{\text{Specific gravity of water}} \times \frac{1}{1000}$

= $\frac{186}{1} \times \frac{1}{1000}$

= 0.186m^3

c) Volume of all in aggregate = [a-(b +c)]

=[1-(0.142+0.186)]

= 0.672m^3

a) Mass of coarse aggregate = d x volume of coarse aggregate x specific gravity of coarse aggregate x 1000

= 0.672 x 0.636 x 2.67 x 1000

= 1141.13Kg

b) Mass of fine aggregate = d x volume of fine aggregate x specific gravity of fine aggregate x 1000

= 0.672 x 0.364 x 2.73 x 1000

= 667.78Kg

A-9 MIX PROPORTIONS:

Cement = 443Kg/ m^3

Water = 186Kg/ m^3

Fine aggregate = 667.78Kg/ m^3

Coarse aggregate = 1141.13Kg/ m^3

Water-cement ratio = 0.42

4.2.2 Ratio of Mix Proportions:

Table 2- Ratio of Conventional Concrete Proportions

Grade designation	Cement	Fine aggregates	Coarse aggregates	W/c ratio
M_{30}	1	1.51	2.58	0.42
M_{30}	50 kg	75.5 kg	129 kg	21 kg

Table-3 Ratio of Replacement Mix Proportion

S.No	Mix designation	% Of replacement Of materials	Weight of ppc in kg for one bag cement	Weightof surkhi in kg for 75.5 kg of sand	Weight of coconut shells in kilogram for 129 kg of aggregate
1	M_1	10%	5 Kg	7.55	12.9
2	M_2	20%	10 kg	15.1	25.8
3	M_3	25%	12.5kg	18.875	32.25
4	M_4	30%	15kg	22.65	38.7
5	M_5	40%	20Kg	30.2Kg	51.6
6	M_6	50%	25 Kg	37.75Kg	64.5

5. RESULTS AND DISCUSSIONS:

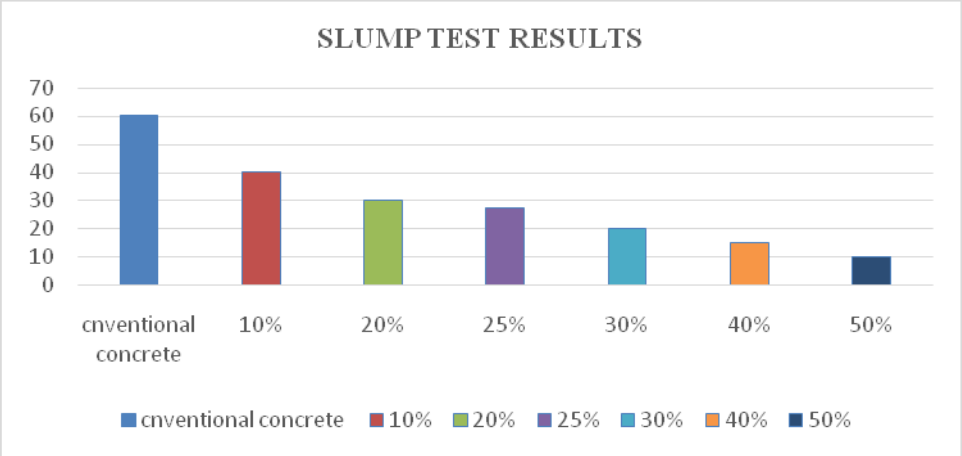
There are number of tests conducted on concrete before and after the castinf of cubes, casted by using conventional cocncrete and replacement concrete, they are the slump cone test which is conducted to test the workability of fresh concrete and compressive tests and split tensile test are conducted after concrete.

5.1 SLUMP CONE TEST:

5.1.1 Table: 4 Results For Slump Cone Test :

Type of concrete (or) % of replacement	Workability in mm
Conventional concrete	60mm
10%	40mm
20%	30mm
25%	27.5mm
30	20 mm
40	15 mm
50%	10mm

GRAPH :1 SLUMP CONE TEST:



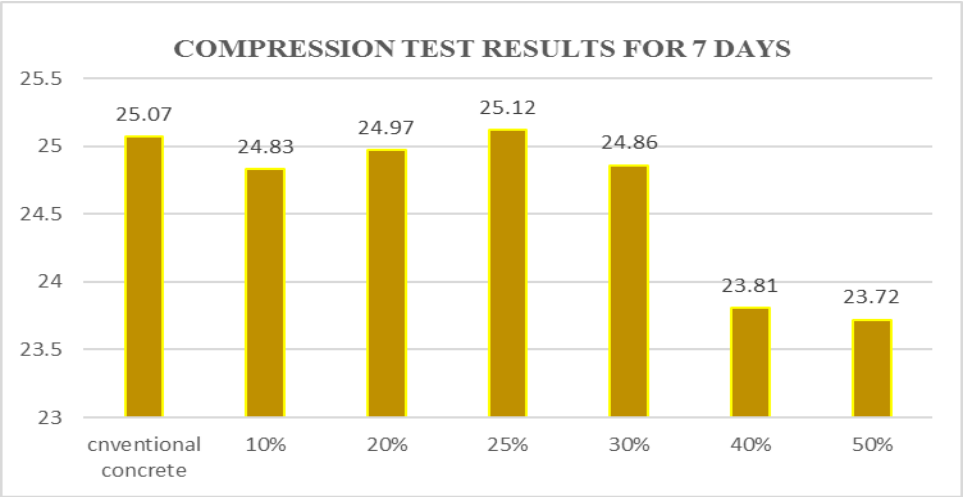
5.2 COMPRESSIVE STRENGTH RESULTS:

S. No	Concrete mix type (or) percentage	3 days (N/mm^2)	7 days (N/mm^2)	14 days (N/mm^2)	28 days (N/mm^2)	56 days (N/mm^2)
1	Conventional concrete	15.37	25.07	35.13	40.62	41.28
2	10	14.98	24.83	34.77	39.95	40.12
3	20	15.01	24.97	34.98	40.23	40.86
4	25	15.41	25.12	35.21	40.89	41.73
5	30	14.86	24.86	34.58	39.86	40.31
6	40	14.28	23.81	33.91	38.27	38.89
7	50	13.26	23.72	33.14	37.62	38.45

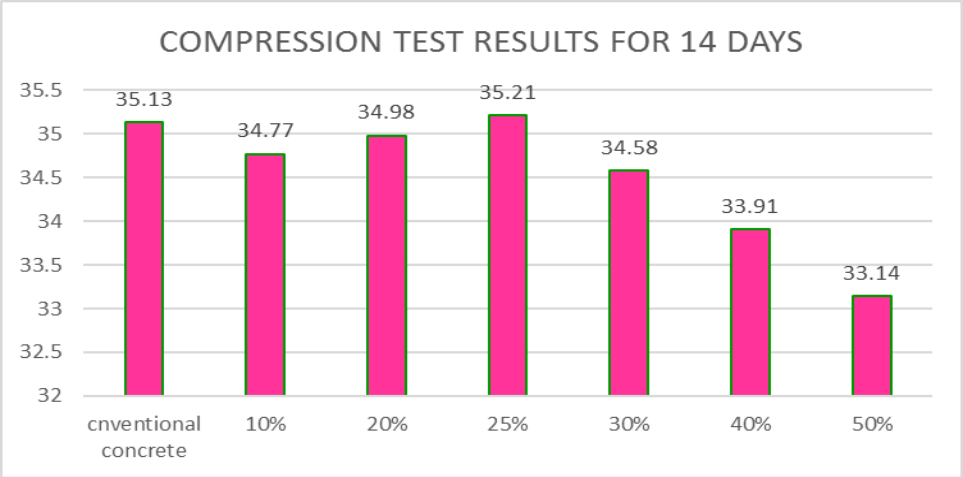
5.21 Compressive strength test results for concrete:

Graph 2- For 3 Days:

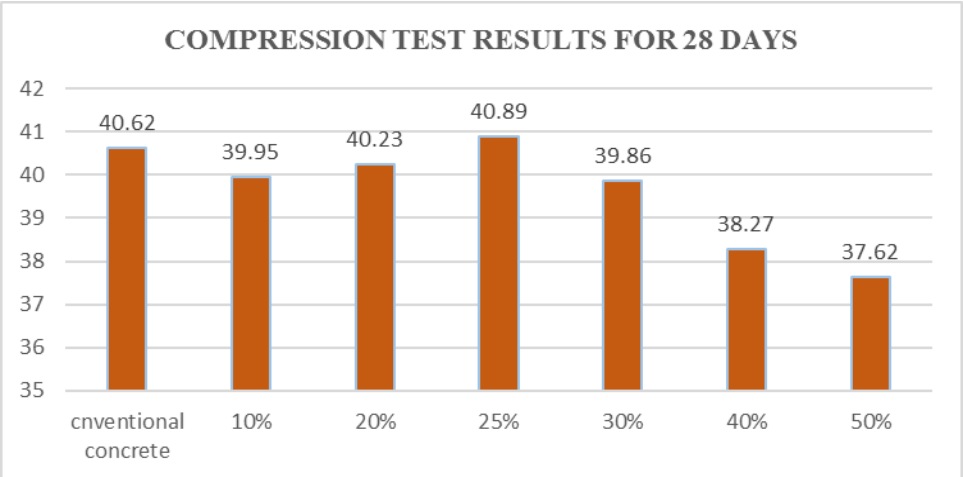
Graph 3: For 7 days



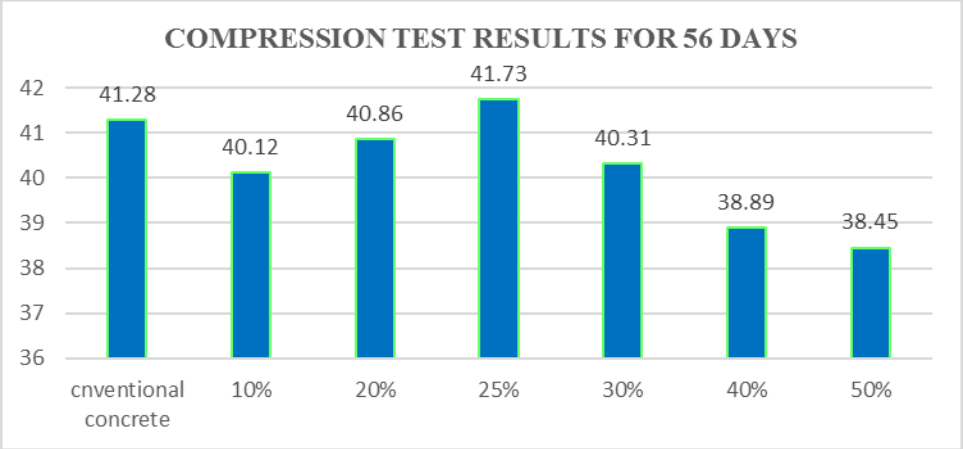
Graph 4: For 14 Days:



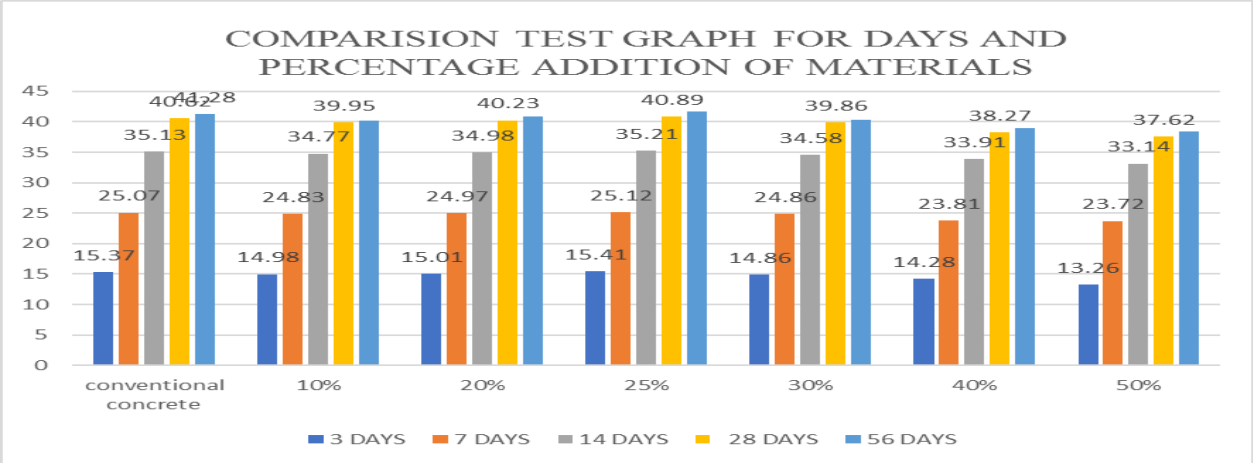
Graph 5: For 28 Days:



Graph 6: For 56 Days:



GRAPH 7: STRENGTH COMPARISION CHART:



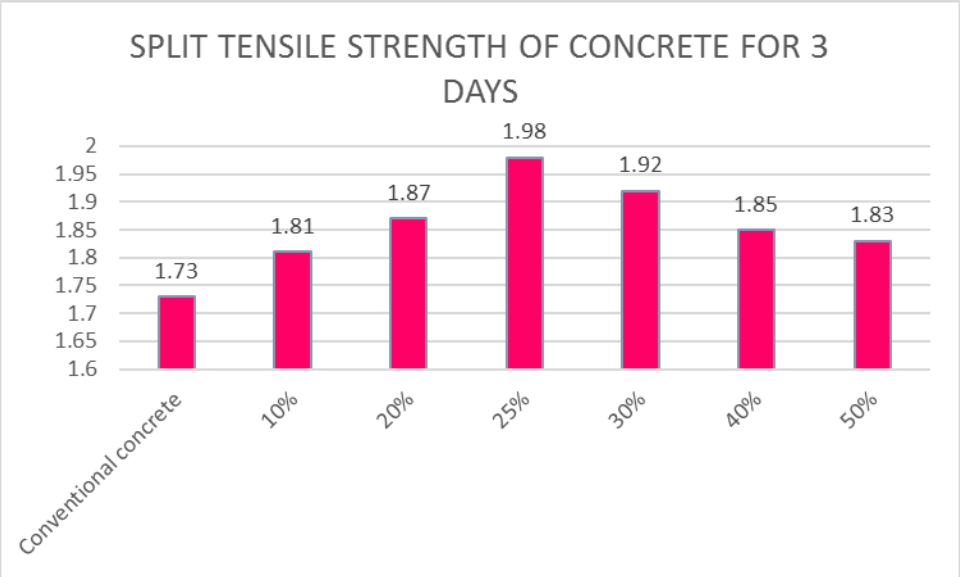
5.3 SPLIT TENSILE STRENGTH OF CONCRETE:

5.3.1 Table: 4 SPLIT TENSILE STRENGTH OF CONVENTIONAL AND REPLACEMAENT CONCRETE

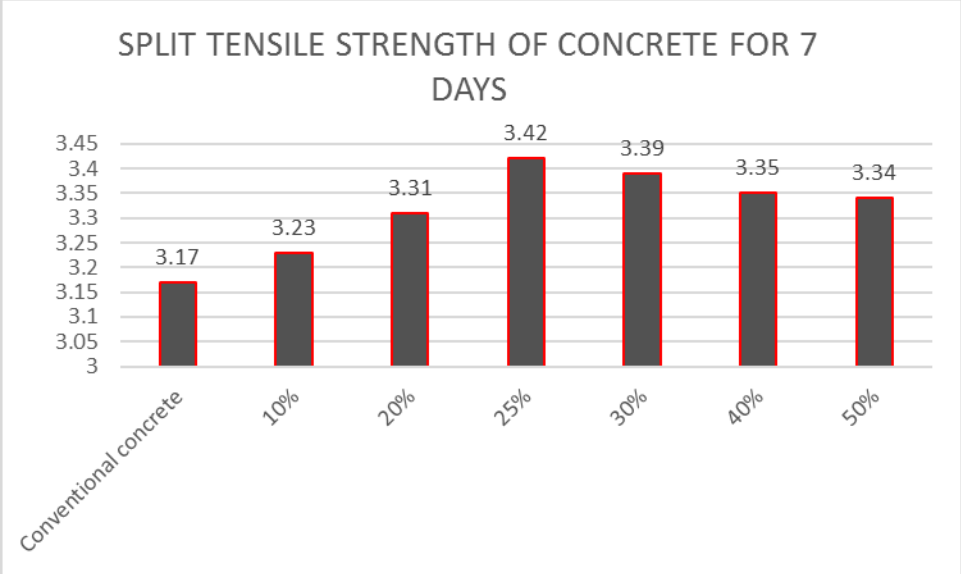
S. No	Concrete mix type (or) Percentage	3 days (N/mm^2)	7 days (N/mm^2)	14 days (N/mm^2)	28 days (N/mm^2)	56 days (N/mm^2)
1	Convention al concrete	1.73	3.17	4.21	4.67	4.73
2	10%	1.81	3.23	4.29	4.72	4.76
3	20%	1.87	3.31	4.36	4.79	4.83

4	25%	1.98	3.42	4.52	4.93	5.01
5	30%	1.92	3.39	4.44	4.86	4.92
6	40%	1.85	3.35	4.35	4.75	4.87
7	50%	1.83	3.34	4.32	4.71	4.79

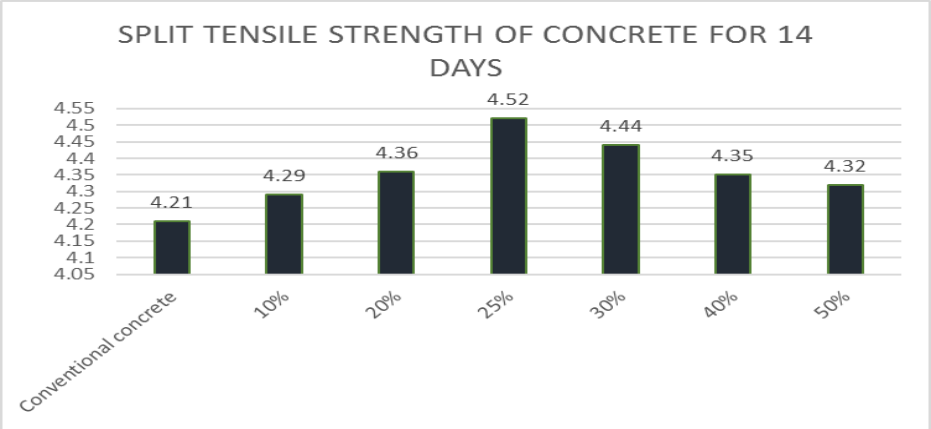
Graph 8: For 3 Days:



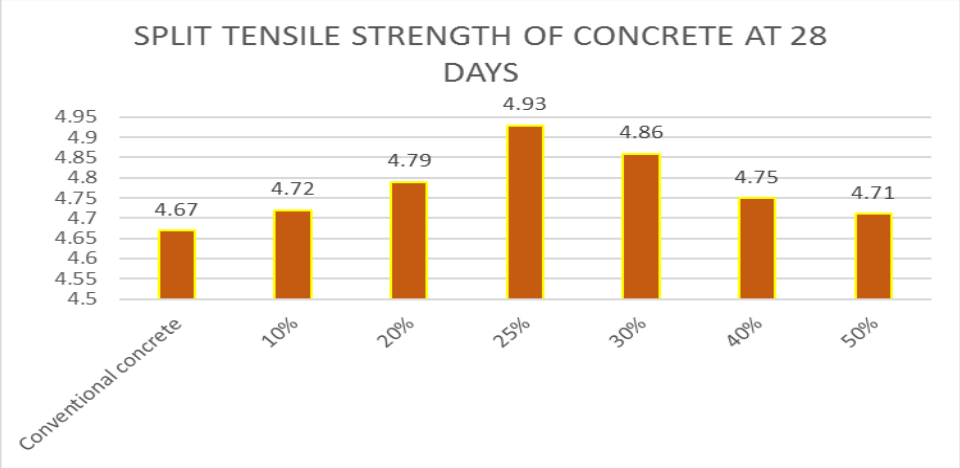
Graph 9: For 7 Days:



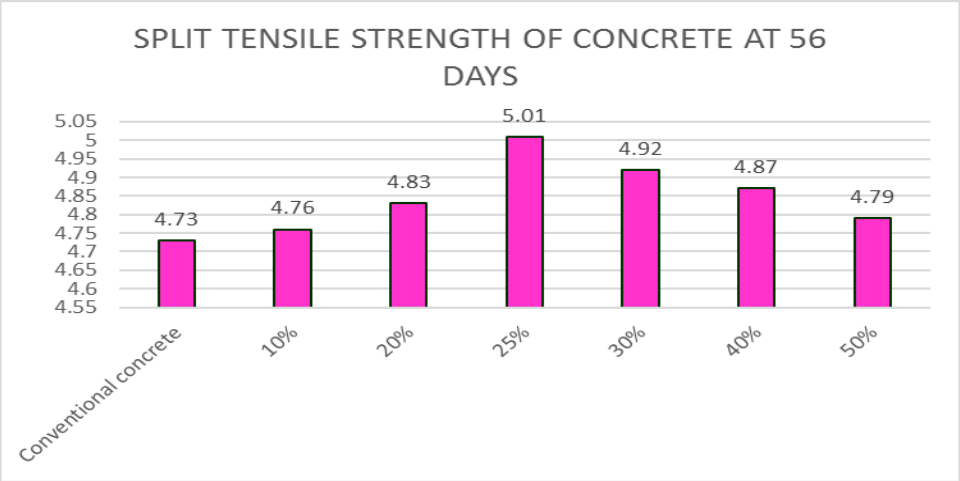
Graph 10: For 14 Days:



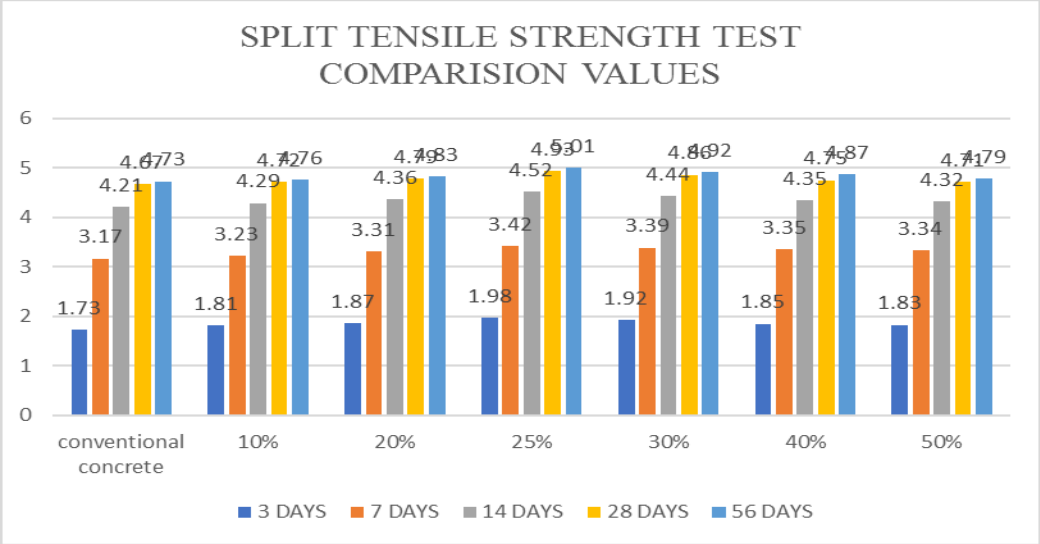
Graph 11: For 28 Days:



Graph 12: For 56 Days:



Graph: 13 Comparison of Split Tensile Strength of Conventional and Replacement Concrete For 3,7, 14 28 And 56 Days:

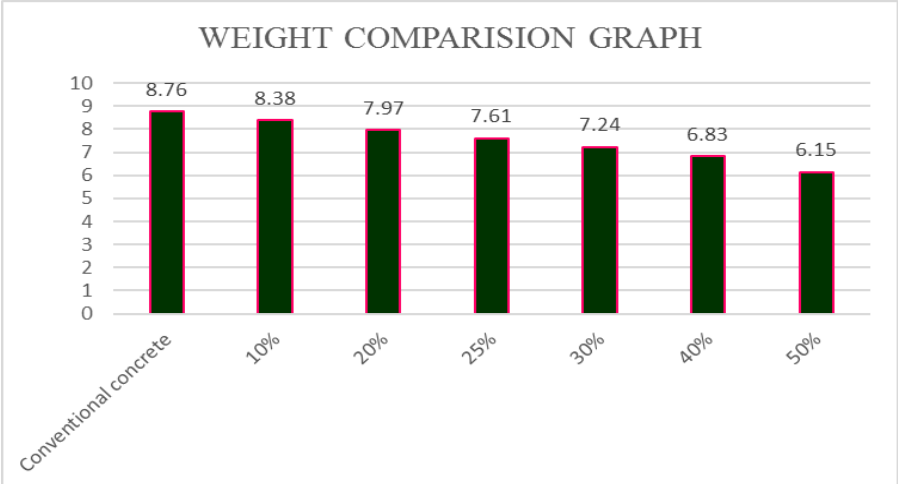


5.4 WEIGHT COMPARISION:

Table: 5 WEIGHTS OF CUBES OF CONVENTIONAL CONCRETE AND REPLACEMENT CONCRETE FOR 3,7, 14, 28 AND 56 DAYS:

S.No	Concrete mix type (or) Percentage	Weight(Kg)
1	Conventional concrete	8.76
2	10%	8.38
3	20%	7.97
4	25%	7.61
5	30%	7.24
6	40%	6.83
7	50%	6.15

Graph:14



6. CONCLUSIONS:

1. in this study, it is shown that the compressive strength of concrete increased at 25% replacement of materials to conventional concrete.
2. There is a considerable growth in split tensile strength also at that 25% because the coconut coir which is added to concrete induces tensile strength in concrete.
3. There is a decrease in weight of concrete made with coconut shells and it can be used for soils where there is less bearing capacities.
4. The cost of the concrete produced is also less because the materials used are of low cost and are locally available in all places.
5. The total process is eco-friendly.
6. It gives good strength when compared to normal mix.
7. Exhibited satisfactory result for compressive strength.
8. It also reduces the overall cost of construction.
9. It is advantageous of using 50% replacement concrete of M30 grade for residential buildings because it reduces the construction cost and gives more strength when compared with M20 grade concrete and workable for temporary constructions.

- **Future Scope of Study**:

The following areas are identified as those having scope in further research. Similar work can be done using any other eco-friendly materials to arrive maximum strength and minimal overall cost of the project for temporary constructions.

7. REFERENCES:

1. *R.Nagalakshmi, "Experimental Study on Strength characteristics on M 25 Concrete with Partial replacement of cement with fly ash and coarse aggregate with coconut shell", International Journal of Science & Engineering Research, 2013, Vol. 4, Issue 1.*
2. *K. Gunasekaran, "Utilization of Coconut Shell as coarse aggregate in the development of light concrete", Thesis- SRM University, 2011.*
3. *Seeni ., C. Selvamony., S. U. Kannan and M.S.Ravikumar. (2012), "Experimental Study of Partial Replacement of Fine Aggregate with Waste Material from China Clay Industries", International Journal of Computational Engineering Research (IJCER).*
4. *Tomas.U.Ganisson "Sustainable management of waste coconut shells as aggregates in concrete mixture", journal of engineering science and technology, volume 6(5), issue date 7.2014.*
5. *Anju Paul, Life John, "Improvement of strength of concrete with partial replacement of coarse aggregate with coconut shell and coir fibers", IOSR Journal of Mechanical and Civil Engineering, ISSN:2278-1684, Issue 3 volume 11 May, June 2014, pp 16-24.*
6. *Apeksha Kanojia, S.K.Jain, "Performance of coconut shell as coarse aggregate in concrete", International Research Journal of Engineering and Technology, ISSN2395-0056, Issue 4, volume 02, July-2015.*
7. *Zamir Irfan, Syed Zeeshan Shafi, Altaf Ahmad Bhat, "Utilization of Surkhi as a Partial Replacement of Sand in Concrete", International Journal for Research in*

Applied Science & Engineering Technology (IJRASET), Volume 5 Issue XI November 2017.

8. Junaid Showkat Hamdani, Ravi Kumar, "Replacement of Fine Aggregate by Mixture of Ceramic and Surkhi Powder in Concrete", International Journal of Engineering Research & Technology (IJERT) Vol. 6 Issue 04, April-2017.

9. D.M. Parbhane, S.B. Shinde, "Strength properties of coir fiber concrete", International Journal of Civil Engineering and Technology (IJCIET), Volume 5, Issue 2, February (2014).