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Replacement of Coarse and Fine Aggregate by Coconut Shell and Quarry Dust Mix

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ABSTRACT: *In developing countries where concrete is widely used, the high and steadily increasing cost of concrete has made construction very expensive. The production of concrete requires various materials like Cement, Fine aggregate and Coarse Aggregate .Due to extensively use of concrete which lead to an increase in cost of materials. Therefore an alternate material is used for partial replacement of Fine aggregate and coarse aggregate in concrete. This project is experimented to reduce the cost of concrete. In this research work experiments have been conducted with collection of materials required and the data required for mix design are obtained by sieve analysis and specific gravity test. Sieve analysis is carried out from various fine aggregates (FA) and coarse aggregates (CA) samples and the sample which suits the requirement is selected. Specific gravity tests are carried out for fine and coarse aggregate. In this project Fine aggregate is replaced by Quarry dust of 30 % along with the partial replacement of coarse aggregate with coconut shell. The coarse aggregate is replaced with 10 %, 20%, 30% and 40 % by coconut shell. The design Mix used for the project is M20 grade (1:1.5:3) with W/C Ratio 0.5.The Conventional concrete and Coconut shell with quarry dust concrete specimens were casted and tested for compressive strength and split tensile strength for 7 and 28 days The compressive strength of the CS10%+QD30% and CS20%+QD30% was 24.35N/mm2 and 24.98 N/mm2, Split tensile strength is 3.454N/mm2 and 3.499N/mm^2*.

KEYWORD*: Coconut shell, Quarry dust, coarse aggregate, Fine aggregate***.**

I. INTRODUCTION

Concrete is the civil engineering construction material. Its manufacturing involves the utilization of ingredients like cement, sand, aggregates, water and admixtures. The Demand for the construction material is increasing day by day due to the infrastructural development across the world. During coarse aggregate production greenhouse gases emission are produced which are major concern for global warming and climate change .Excavating of Fine aggregate causing environmental problems such as water retentions in lakes and rivers. Therefore, there is a need to find some alternate or sustainable materials to use concrete mix.

Day to day different types of waste materials production is increasing and creating many environmental issues. Making use of these waste materials in manufacturing of concrete will decrease environmental pollution and the cost of concrete. The concrete mixture consists of coarse and fine aggregate. Coarse aggregate is naturally available and factory crushed. Fine aggregate is often obtained from river beds. The quality of the river sand normally depends on its source and most of the time it varies quite a lot. As the use of fine aggregate in concrete is more than 30% of the composite, its mechanical properties affect the quality of concrete. The alternative material should be waste materials in the aspects of reduction in environmental load and waste management cost, reduction of production cost of concrete. Hence crushed sand has been identified as a substitute for river sand and coarse aggregate occupy more than 30% in concrete there for coarse aggregate is partially replaced by coconut shell in concrete by this agriculture waste material get reduced and minimize environment problems.

Cement

II. MATERIALS

Cement is a binder, a substance that sets and hardens independently, and can bind other materials together. The word "cement" traces to the Romans, who used the term opus caementicium to describe masonry resembling modern concrete that was made from crushed rock with burnt lime as binder. The volcanic ash and pulverized brick additives that were added to the burnt lime to obtain a hydraulic binder were later referred to as cimentum, cement, and cement.

Cement used in construction is characterized as hydraulic or non-hydraulic. Hydraulic cements (e.g., Portland) harden because of hydration, chemical reactions that occur independently of the mixture's water content; they can harden even underwater or when constantly exposed to wet weather. The chemical reaction

that results when the anhydrous cement powder is mixed with water produces hydrates that are not water-soluble. Non-hydraulic cements (e.g., gypsum plaster) must be kept dry in order to retain their strength.
The most important use of cement is the production of mortar and concrete, which is a combination of cement and an aggregate to form a strong building material that is durable in the face of normal environmental effects

Properties of OPC Cement:

Table 1: Properties of O.P.C cement

Properties a)Physical	**Requirements as per IS12269-1987**	**Cement values**
SPECIFIC GRAVITY		3.15
Fineness (m^2/kg)	225 (min)	325
Soundness (mm)		
Lechatlier method	10mm (max)	1
Autoclave (%)	0.8 (max)	0.03
Setting time		
Initial (min)	30 minutes	150
Final (max)	600 minutes	260
Compressive Strength (MPa)		
1 day		20
3 day	27	39
7 day	37	49
28 day	**53**	70
b) Chemical		
1)Lime saturation factor	0.8-1.0-2	0.9
2)Alumina Modulus	0.66(min)	1.23
3) Insoluble residue (%)	4(max)	0.25
4) Magnesia (%)	6(max)	1.1
5) Sulphuric anhydride S03 (%)	3(max)	1.5
6) Loss on ignition (%)	4(max)	0.8
7)Alkalis		
8) Chloride (%)	0.1 (max)	0.002
9)C34 Content		7
10)Temperature during Testing	27 ± 2	27 ± 2
11) Humidity (%)	65 ± 5	65 ± 5

Fine Aggregate

Sand is naturally occurring granular material composed of finely divided rock and mineral particles. The most common constituent of sand is silicon dioxide, usually in the form of Quartz. Normally fine aggregate is used as fine aggregate for preparing concrete. An individual particle in this range is termed as sand grain. These sand grains are between coarse aggregate (2mm to 64mm) and silt (0.004mm to 0.0625mm).Aggregate most of which passes 4.75mm IS sieve is used.

Coarse Aggregate

Aggregates are the most mined material in the world. Aggregates are a component of composite materials such as concrete and asphalt concrete; the aggregate serves as reinforcement to add strength to the overall composite material. Coarse aggregate of size 20mm is sieved and used.

Coconut shell

Coconuts are referred to as "man's most useful trees", "king of the tropical flora" and "tree of life". Coconuts or its scientific name cocos nucifera are the most important of cultivated palms and the most widely distributed of all palms. Coconut shells are cheap and readily available in high quantity. The coconuts were broken manually to drain out the water. The coconut half shells were sun-dried for three days.

Fig 1: Crushed coconut shell

Physical properties of coconut shell aggregate

Table 2: Results of Tests on coconut shell Aggregate

S. No	Physical Property	Test Results
1	Specific Gravity	1.33
2	Water Absorption (%)	24
3	Bulk Density(kg/m)	800
4	Shell Thickness	(2-7)mm

2.4 Quarry Dust

Quarry dust is a product obtained from aggregate crushing plant, where the rocks are made Processed to form fine particles of le ss than 4.75 mm. The production of quarry dust Plants. Quarry dust is obtained from crushing plants located in Gowripatnam near Rajamahendravaram. By replacement of quarry dust, the requirement of land fill area can be reduced and can also solve the problem of natural sand scarcity. The availability of sand at low cost as a fine aggregate in concrete is not suitable and that is the reason to search for an alternative material. Quarry dust satisfies the reason behind the alternative material as a substitute for sand at very low cost. It even causes burden to dump the crusher dust at one place which causes environmental pollution.

Fig 2: Quarry dust

Table 3: properties of quarry dust

Properties of Quarry dust		
1	Quarry dust Specific gravity	2.57
2	Fineness modulus	2.41
3	Density	1.85gm/cc

Water

Water used in concrete is free from sewage, oil, acid, strong alkalies or vegetable matter, clay and loam and is satisfactory to use in concrete.

Table 4: Properties of water sample

S.NO	Parameter	Results	Limits as per IS 456-2000
1	Ph	6.3	6.5-8.5
2	Chlorides (mg/l)	45	2000 (PCC) 500 (RCC)
3	Alkalinity (ml)	6	< 25
4	Sulphates (mg/l)	105	400
5	Fluorides (mg/l)	0.04	1.5
6	Organic Solids (mg/l)	43	200
7	Inorganic solids (mg/l)	115	3000

Fineness modulus of fine aggregate

III. METHODOLOGY

Fineness modulus is only a numerical index of fineness, giving some idea of the mean size of particular in the entire body of aggregate. Determination of fineness modulus may be considered as a method of standardization of the grading of the aggregates.

Table 5: Fineness modulus of fine aggregate

Sieve No.	% of passing F = 100-f
10mm	100
4.75mm	99.1
2.36mm	94.9
1.18mm	83
600µ	48.5
300µ	19.6
150µ	2.7
PAN	0

Its value lies between 2.6-2.8. Percentage of water absorption is 0.19.

Fineness Modulus of Coarse Aggregate

Fineness modulus is only a numerical index of fineness, giving some idea of the mean size of particular in the entire body of aggregate. Determination of fineness modulus may be considered as a method of standardization of the grading of the aggregates

Table 6: Fineness Modulus of coarse aggregate

Sieve No.	**Weight retained (Wi)**	**% Retained. (Wi/W) X100**	**Percentage Retained. (C)**	**Cumulate% Passing. (F)**
20mm	267	13.35	13.35	86.65
10mm	1698	84.90	98.25	1.75
4.5mm	35	1.75	100	0
2.36mm	0	0	0	0

Weight of aggregate taken = W = 2000g
Fineness Modulus of Coarse Aggregate = ∑C /100 = 211.6/100= 2.12
Result: Fineness Modulus of Coarse Aggregate = 2.74
Mix Proportion

The concrete mixture proportions for M20 Grade concrete are 1:1.5:3 and water cement ratio 0.5, the specimen were casted using varying CS + QD Ratio. The Coarse aggregate replaced by CS and QT (30%) constant in different Percentage

Table No: 6.1 Mix Proportion

% CS+QD	**Coarse Aggregate**		**Fine aggregate**	
	% Coarse aggregate	**% coconut Shell**	**% Fine aggregate**	**% Quarry Dust**
0%+0%	0	0	0	0
10%+30%	90	10	70	30
20%+30%	80	20	70	30
30%+30%	70	30	70	30
40%+30%	60	40	70	30

SLUMP TEST

IV. REULTS AND DISCUSSIONS

Table 7: Slump Test

% coconut Shell	% Quarry Dust	Slump (mm)
0	0	60
10	30	66
20	30	70
30	30	69
40	30	75

Ingredients of mixes are properly mixed so as to produce homogeneous and uniform fresh concrete in macro-scale in order to know its workability using slump test. The results of same test for the conventional concrete and various CS and QD 30% concrete

Fig 3: Slump cone test

Compressive strength

This test is done to determine the cube strength of concrete mix prepared. The test is conducted on the 7th day and the 28th day and its observation are listed below in the form of a graph. Compressive strength values with replacement for coarse aggregates by coconut shell with 10%, 20%, 30% and 40% and Fine aggregate by quarry dust with 30%.

Fig 4: compressive testing machine

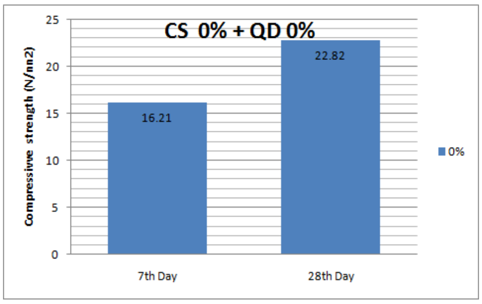
Table no. 8 Compressive strength of concrete for 7 & 28 Days

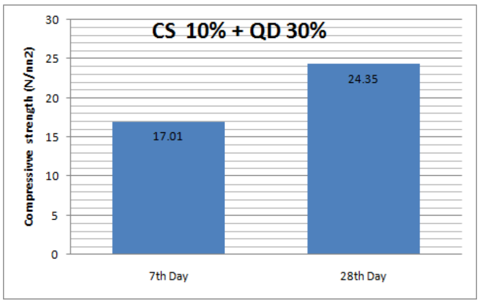
S.No	% OF REPLACEMENT OF CS + QD	Compressive Strength (N/mm2)	
		7th Day	28th Day
1	0%	16.21	22.82
2	CS 10% + QD 30%	17.01	24.35

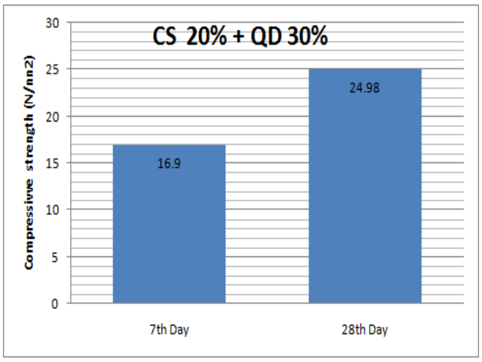
3	CS 20% + QD 30%	17.2	24.98
4	CS 30% + QD 30%	16.89	23.31
5	CS 40% + QD 30%	13.9	21.12

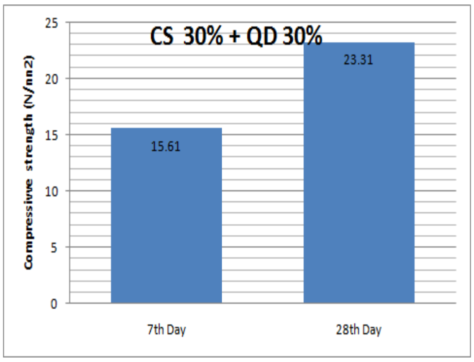
When we consider the values of compressive strength at CS20%+QD30% both for 7 days and 28days the values are higher but when the percentage at CS increasing and QD maintained same 30 we see the decline over there both at 7 and 28days gradually.

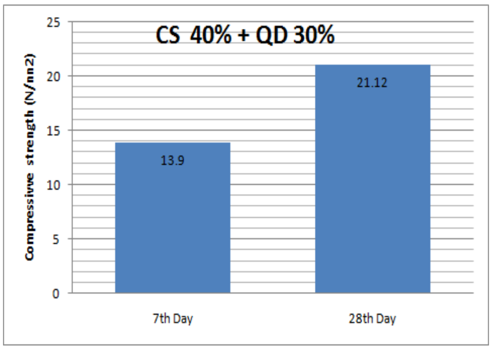
Results of Compressive strength











SPLIT Tensile Strength

This test is done to determine the tensile strength of the cylinders. The test is conducted on the 7th day and the 28th day and its observation are listed below in the form of a graph. The cylinder is placed in a horizontal position and the load is applied gradually and value is recorded if the cylinder splits into two half or if the cylinder fails while applying the load on it. Tensile strength values with replacement for coarse aggregates by coconut shell with 10%, 20%, 30% and 40% and Fine aggregate by quarry dust with 30%.

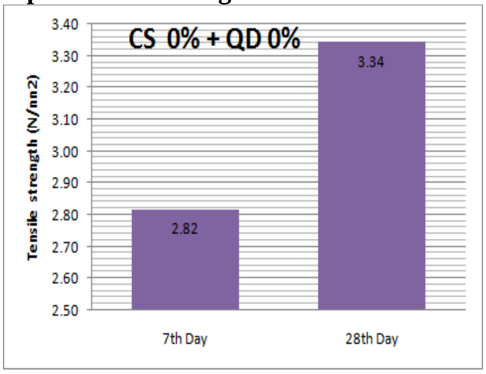
Table no. 9 Compressive strength of concrete for 7 & 28 Days

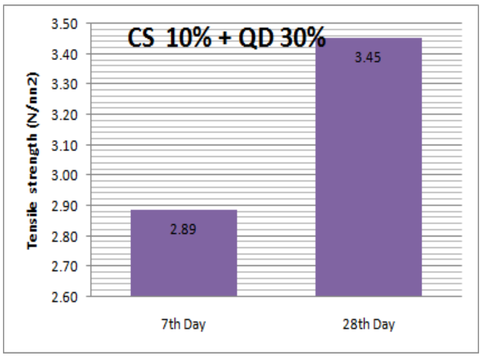
S.No	**% OF REPLACEMENT OF CS + QD**	**Tensile Strength (N/mm^2)**	
		7th Day	**28th Day**
1	0%	2.82	3.34
2	CS 10% + QD 30%	2.89	3.45
3	CS 20% + QD 30%	2.90	3.50
4	CS 30% + QD 30%	2.82	3.38

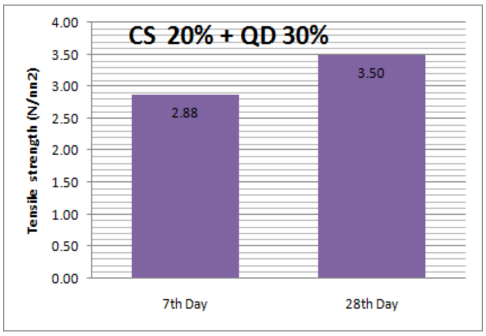
5	CS 40% + QD 30%	2.61	3.22

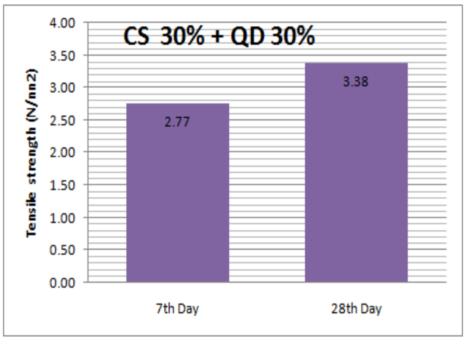
Here also the values of tensile strength at CS20%+QD30% both for 7 days and 28days the values are higher but when the percentage at CS increasing and QD maintained same 30 we see the decline over there both at 7 and 28days gradually like in the case of compressive strength test.

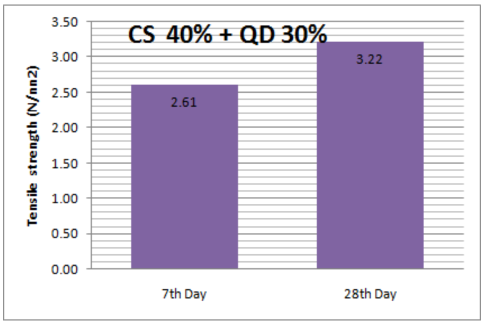
Results of Split Tensile strength











Production cost of concrete

Table no.10 Production cost of concrete

Normal concrete (M20 Grade) Rate/m^3	**CS 20%+ QD 30% concrete Rate/m^3**
Rs:3000/-	Rs:2500/-

As shown in table No.10 The cost of CS 20% +QD 30% was decreased by 16.6% due to replacement of coconut shell 20% and Quarry dust 30% in concrete

V. CONCLUSION

- The compressive strength of the CS10%+QD30% and CS20%+QD30% was 24.35N/mm2 and 24.98 N/mm2, Split tensile strength is 3.454N/mm2 and 3.499N/mm^2.
- The strength of the concrete increases with increase in percentage of coconut shell up to 20% .and there is gradual decrease at 30% replacement
- The strength of the Coconut shell and Quarry dust CS10%+QD 30% and CS20%+QD30% concrete is increasing comparatively with normal concrete

- So we conclude that the coarse aggregate and fine aggregate replaced with coconut shell aggregate
- Moreover it reduces 16.6% cost construction by reducing the cost of coarse and fine aggregate and it also reduces the environmental pollution due to fly ash and coconut shell

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