A STUDY ON THE PARTIAL REPLACEMENT OF COARSE AND FINE AGGREGATE BY COCONUT SHELL AND QUARY DUST MIX

A Project Submitted
in Partial Fulfillment of the Requirements
for the Degree of

BACHELOR OF TECHNOLOGY

in

CIVIL ENGINEERING

by

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2020-21

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CERTIFICATE

This is to certify that **ANKIT KUMAR YADAV, AKASH GAUTAM, PARAM SINGH, AALOK KUMAR YADAV, ZIYA ALAM** student of B. Tech Final year (Civil Engineering) has completed the project report entitled "A Study on the Partial Replacement of Coarse and Fine Aggregate by Coconut Shell and Quarry Dust Mix" during the academic session 2020-2021. I approve the project report for submission as required for partial fulfillment for completion of engineering degree in Civil Engineering.

(Signature) (Signature)

Mr. Mohammad Afaque Khan **Prof .(Dr) Omprakash Netula**

(Project Guide) (Head of Civil Department)

DECLARATION

We declare that this written submission represents our ideas in our own words and wher others' ideas or words have been included, we declare that we have adhered to all principles of the college with honesty and integrity and have not misrepresented or fabricated or falsified any idea data/fact/source in our submission. We understand that any violation of the above will cause for disciplinary action by the institute and can also evoke penal action from the sources which have not been properly cited or from whom proper permission has not been taken when needed.

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ACKNOWLEDGEMENT

Firstly, we would like to thank Dr. Omprakash Netula , Head of department, civil engineering BBD University, Lucknow for this continuous encouragement and support.

We also place on record, a sense of gratitude to one and all who directly or indirectly have lent their helping hand in this venture.

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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 CS 10 % + QD 30% and CS 20% + QD 30% was 24.35 N/mm2 and 24.98 N/mm2, Split tensile strength is 3.454N/mm2 and 3.499N/mm^2**.**

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OBJECTIVES

- To study the properties of coconut shells, compatibility of coconut shells with cement and to produce coconut shell aggregate concrete with 28 day compressive strength more than 20 N/mm2.
- To study the strength properties of concrete in replacement of coarse aggregate.
- To study the strength properties of concrete in replacement of coarse aggregate and replacement of flash with cement.
- To study the behavior of compressive and split tensile strengths.

CHAPTER -1

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.

CHAPTER-2

MATERIALS USED

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

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

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

Table 2: Results of Tests on coconut shell Aggregate

Physical properties of coconut shell aggregate Quarry Dust

Quarry dust is a product obtained from aggregate crushing plant, where the rocks are made Processed to form fine particles of less 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.

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

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

Table 3: Properties of quarry dust

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.

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

Table 4: Properties of water sample

CHAPTER-3

LITERATURE REVIEW

I. Vishwas P. Kulkarni and Sanjay Kumar B. Gaikwad (June 2013)

Concrete is the widely used number one structural material in the world today. The demand to make this material lighter has been the subject of study that has challenged scientists and engineers alike. The challenge in making a lightweight concrete is decreasing the density while maintaining strength and without adversely affecting cost. Introducing new aggregates into the mix design is a common way to lower a concrete density.

II. Gopal Charan Behera and Ranjan Kumar Behera (2013)

Abundant availability of natural resources has become a dream for present day engineering society due to large scale consumptions. The unaccountable population growth rate makes problem of availability of coarse aggregate for construction more severe. Due to rapid Urbanization and industrialization, consumption of aggregates increased to manifold. So, the researchers must find the alternatives for the coarse aggregate

III. Dr. B. Rajeevan (2011)

Natural resources such as river sand and coarse aggregate are depleting at an alarming level in developing countries like India. The possibility of utilizing recycled coconut shell aggregates in concrete as coarse aggregate is examined in the present study. An optimum percentage replacement of coarse aggregate with coconut shell aggregate is determined from the study. Coarse aggregate made from coconut shells were used in proportions of 5%, 10%, 15%, 20%, 25%, 30% and 35% to replace coarse aggregate in conventional concrete.

A constant water to cement ratio of 0.5 was used throughout the study. Tests were carried out to determine the compressive strength, split tensile strength and flexural strength using cube, cylinder and beam specimens respectively. Together, 24 cubes, 21 cylinders and 21 beam samples were tested. It was observed that when coconut shells aggregates in proportions of 15% was used in conventional concrete, compressive strengths comparable to that of conventional concrete can be obtained.

IV. Olanipekun, Olusola and Atia (2012)

Investigated the strength characteristics of concrete produced using crushed, granular coconut and palm kernel shells as substitutes for conventional coarse aggregate in gradation of 0%, 25%, 50%, 75% and 100%. It was observed that the compressive strength of the concrete decreased as the percentage of the shells increased in the mixes. However concrete obtained from coconut shell aggregate exhibited a higher compressive strength than palm kernel shell concrete in the two mix proportions.

V. Abdulfatah and Saleh(2013)

Conducted experiments to determine the suitability of coconut shell as full replacement for coarse aggregate in concrete works. A total of 72 concrete cubes of size 150×150×150 mm with different mix ratios of 1:2:4, 1:1.5:3 and 1:3:6 were casted, tested and their physical and mechanical properties were determined. Compressive strengths comparable to that of plain concrete were observed. The study concluded that cost of producing concrete can be reduced up to 48%.

VI. Gunasekaran (2012)

Used coconut shell as lightweight aggregate in concrete. It was observed that coconut shell exhibits more resistance against crushing, impact and abrasion compared to conventional aggregate. The density of coconut shell was in the range of 550 - 650 kg /m3 and was within the specified limit for qualifying as lightweight aggregate.

VII. And Ramachandrudu (2010)

Studied the effect of fly ash on concrete with coarse aggregate partially replaced with coconut shell aggregate. It was observed that coarse aggregate replaced with equivalent weight of fly ash had no influence when compared to the properties of corresponding coconut shell replaced concrete.

VIII. Delsye, Mannan and John (2013)

Used a concrete mix of 1:2:4 as control concrete, while coconut shells were used to replace crushed granite by volume. The density and compressive strength of concrete were found to reduce as the percentage replacement increased. Concrete produced with 20%, 30%, 40%, 50% and 100% replacement attained 28-day compressive strengths of 19.7 N/mm2, 18.68 N/mm2, 17.57 N/mm2, 16.65 N/mm2 and 9.29 N/mm2 corresponding to 94%, 89%, 85%,79.6% and 44.4% of the compressive strength of the control concrete.

The study recommended that concrete produced by replacing 18.5% of the crushed granite with coconut shell aggregate can be economically used in concrete.

CHAPTER-4

METHODOLOGY

Fineness modulus of fine 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

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

Table 5: Fineness modulus of fine aggregate

(1) Its value lies between 2.6-2.8. (2) 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.

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

Table 6: Fineness Modulus of coarse aggregat

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

% 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

Table No: 6.1 Mix Proportion

CHAPTER-5

RESULTS

SLUMP TEST

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

Table 7: Slump Test

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

Compressive Strength

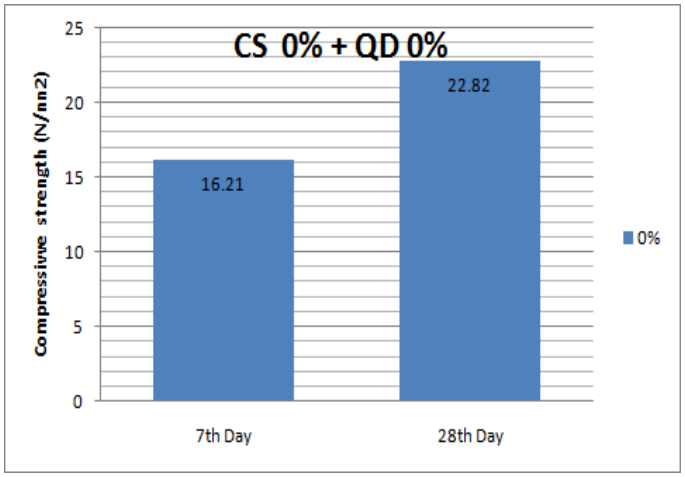
This test is done to determine the cube strength of concrete mix prepared. The test is conducted on the 7th day and the 28th day and its observation are listed below in the form of a graph. Compressive strength values with replacement for coarse aggregates by coconut shell with 10%, 20%, 30% and 40%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

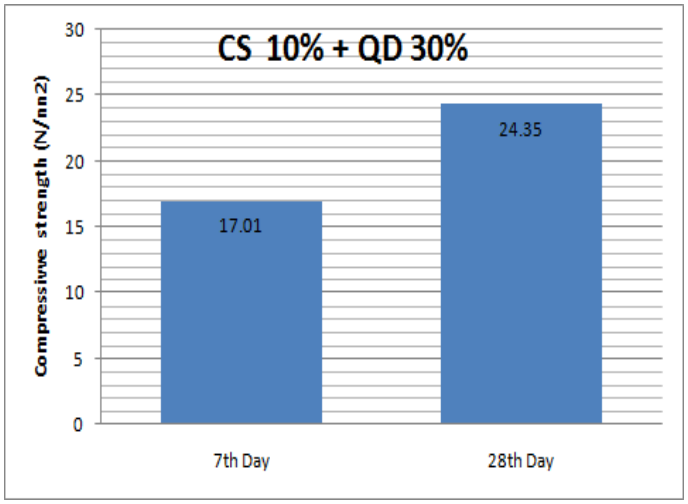
S.No	% Of Replacement OF CS + QD	Compressive Strength (N/mm2)	
		7th Day	28th Day
1	0%	16.21	22.82
2	CS 10% + QD 30%	17.01	24.35
3	CS 20% + QD 30%	17.2	24.98
4	CS 30% + QD 30%	16.89	23.31
5	CS 40% + QD 30%	13.9	21.12

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

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





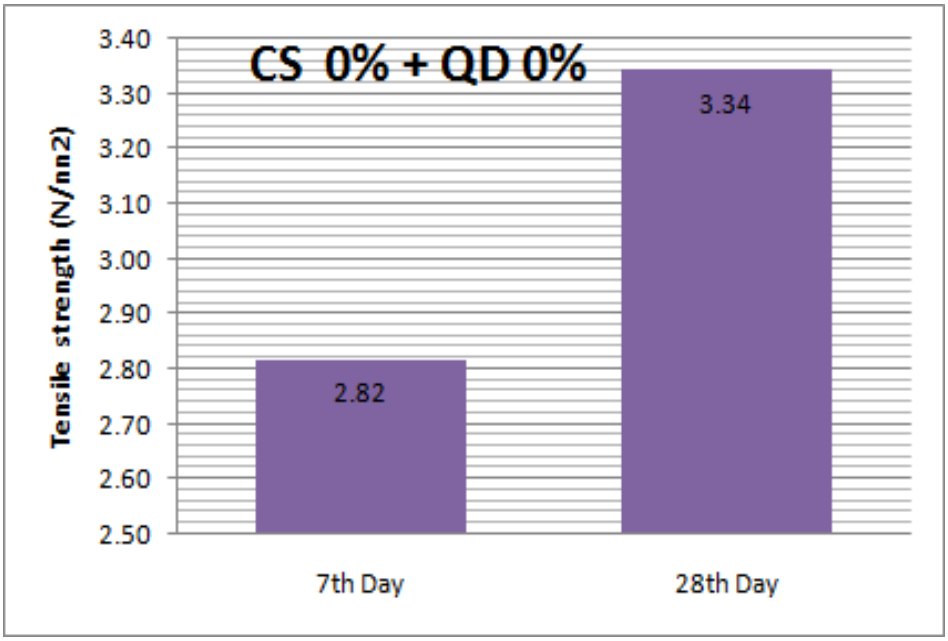
Split Tensile Strength

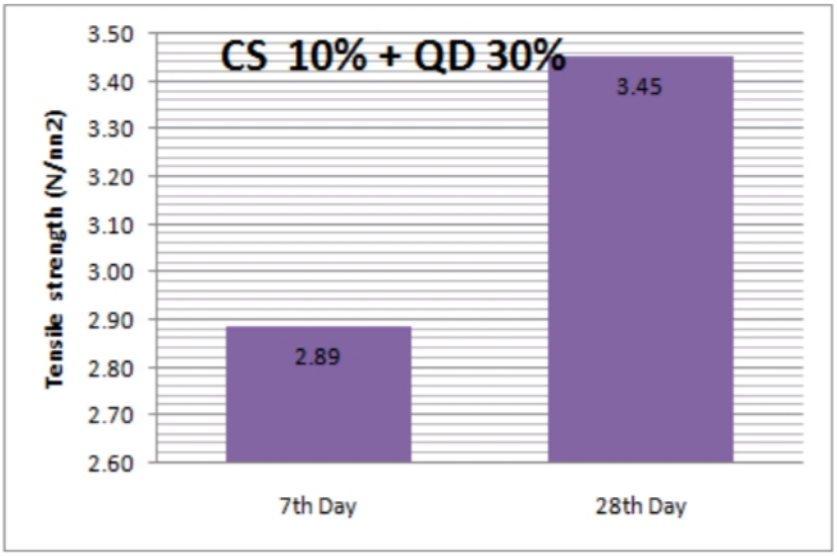
This test is done to determine the tensile strength of the cylinders. The test is conducted on the 7th day and the 28th day and its observation are listed below in the form of a graph. The cylinder is placed in a horizontal position and the load is applied gradually and value is recorded if the cylinder 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%.

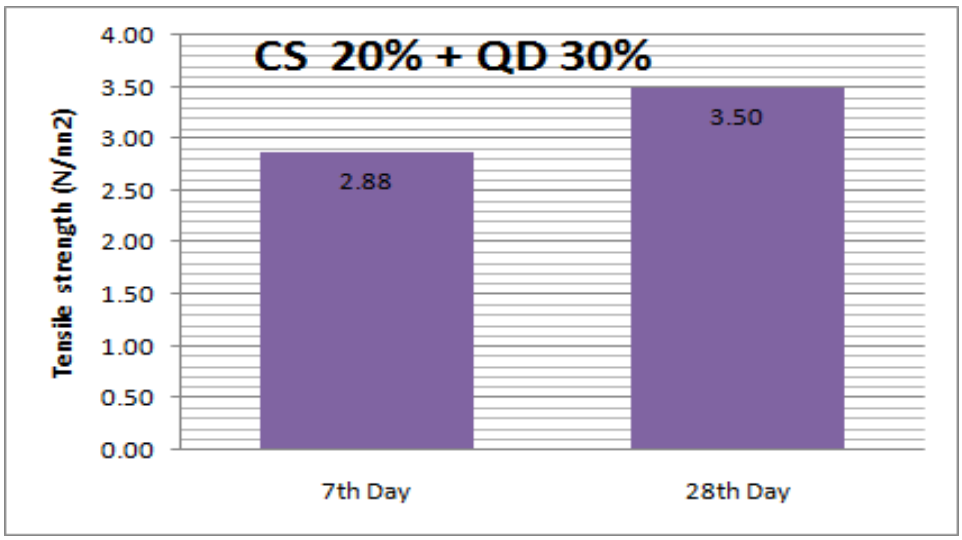
S.No	% OF Replacement of CS + QD	Tensile Strength (N/mm^2)	
		7th Day	28th Day
1	0%	2.82	3.34
2	CS 10% + QD 30%	2.89	3.45
3	CS 20% + QD 30%	2.90	3.50
4	CS 30% + QD 30%	2.82	3.38
5	CS 40% + QD 30%	2.61	3.22

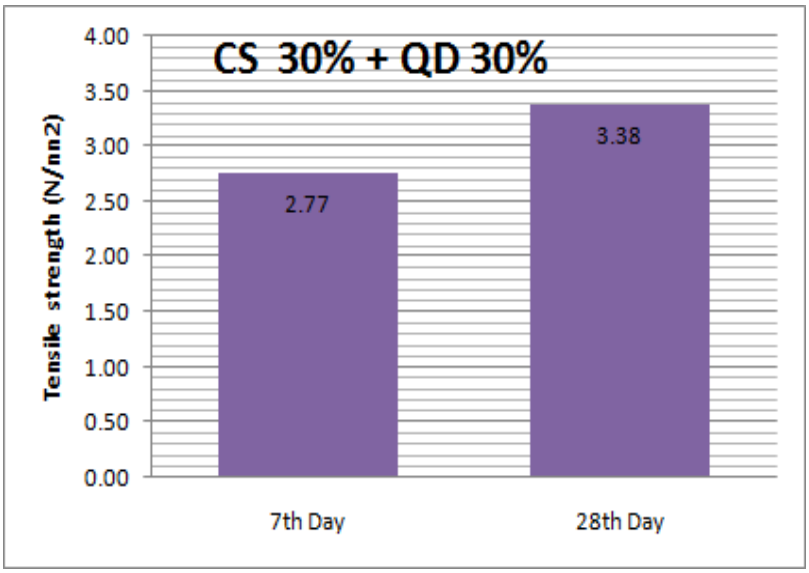
Here also the values of tensile strength at CS20%+QD30% both for 7 days and 28days the values are higher but when the percentage at CS increasing and QD maintained same 30 we see the decline over there both at 7 and 28days gradually like in the case of compressive strength test.

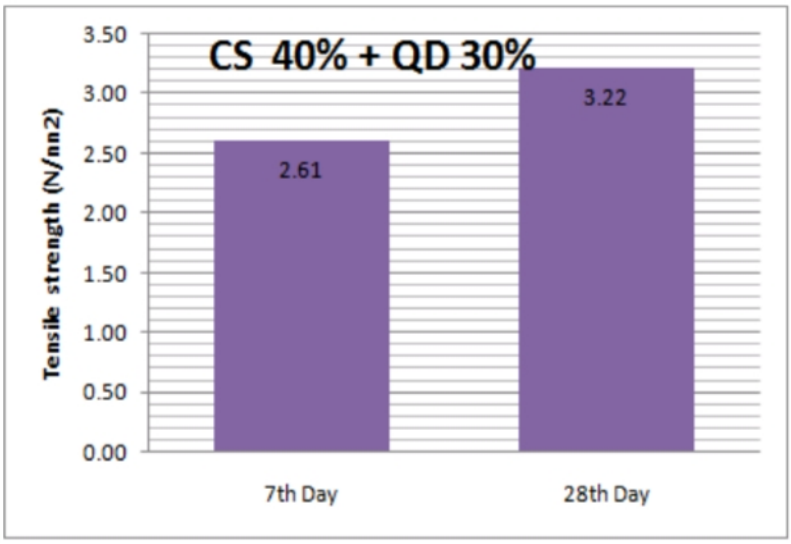
Results of Split Tensile Strength


CS 0% + QD 0%
Tensile strength (N/nn2)
3.40
3.30
3.20
3.10
3.00
2.90
2.80
2.70
2.60
2.50
2.82
3.34
7th Day
28th Day


CS 10% + QD 30%
Tensile strength (N/nn2)
3.50
3.40
3.30
3.20
3.10
3.00
2.90
2.80
2.70
2.60
2.89
3.45
7th Day
28th Day


CS 20% + QD 30%
Tensile strength (N/nn2)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
2.88
3.50
7th Day
28th Day


CS 30% + QD 30%
Tensile strength (N/nn2)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
2.77
3.38
7th Day
28th Day


CS 40% + QD 30%
Tensile strength (N/nn2)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
2.61
3.22
7th Day
28th Day

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.

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

SCOPE

The use of **lightweight concrete** has been widely spread across countries such as USA, United Kingdom and Sweden.

The main specialties of lightweight concrete are its low density and thermal conductivity. Its advantages are that there is a reduction of dead load, faster building rates in construction and lower haulage and handling costs.

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