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Studies on Flexural Behavior of OPC Concrete with Recycled Coarse Aggregates and Partial Replacement of Cement with Coconut Shell Ash Powder

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***Abstract:** The study the behaviour of OPC concrete with recycled coarse aggregate and partial replacement of cement of cement withcoconut shell ash powder M25 grade for which the coarse aggregate is replaced by recycled aggregates up to 30% and cement is replaced by an experimental study was carried out and the effect on flexural strength, compressive strengthand split tensile strength Characteristics (0%,10%,15%) was studied.Test results showed showed that the compressive strength of recycled aggregate up to 30% by demolished waste and 15% of cement replacement with coconut shell ash powder meeting the requirement for use in OPC concrete.At the end of 28 d has been found to be comparable to the conventional concrete and it also minimize the costs of construction .*

I. INTRODUCTION

Concrete a composite man-made material , is the most widely used building material in the construction field .It consists of a rationally chosen mixture of binding materials such as lime or cement ,well graded fine and coarse aggregates ,water and admixtures (to produce concrete with special properties).The aggregate is generally coarse gravel or crushed rocks such as sand. The cement, commonly Ordinary Portland cement, and other cementitious materials such as flyash and slag cement, serveas a binder for the aggregate.Utilization of industrial waste or secondary materials has been encouraged in construction field for the production of cement and concrete because it contributes to reducing the consumption of natural resources and its cost. Research on waste material such as fly ash, rice husk, slag and sludge from treatment of industrial and domestic waste water demolished building material is being done. Use of coconut shell in concrete is not only useful economical but also useful for human being. Coconut shell isone of the main contributors of pollution problem as a solid waste. Coconut shell can be used in the form of powder with epoxy resins or epoxy matrixes in concrete also

Figure 1:Recycled coarse aggregates

II. RECYCLED COARSE AGGREGATES

Recycling is the act of processing the used material for use in creating new product. The usage of natural aggregates is getting more and more intense with the advanced development in the infrastructure area. In order to reduce the usage of natural aggregates, recycled aggregates can be used as replacement materials. Disposal ofconstruction and demolished waste is a very serious problem

because on one side it requires huge space for its disposal while on other side it pollutes the environment. Continuous use of natural resources, like river and sand is another major problem and thisincreases the depth of river bed resulting in drafts and also changing the climatic conditions. So, the sustainable concept was introduced in construction industry due to growing concern about the future of our planet, because it is a huge consumer of natural resources as well as waste producer.

Since recycled material do not necessarily mean greater sustainability, since they in turn require energy to produce, it is perhaps better to not use this term and instead consider the appropriate use of materials for both performance and function. Construction industry in India generatesabout 10-12 million tons of waste annually. A shortage of aggregate to the extent of about 6600 million m^3 for housing sector.An additional of 760 million m^3 aggregate for road sector. Recycling of aggregate material from construction and demolition wastes may reduce the demand supply gap in both these sector.

Smaller piece of concrete are used as gravel for new construction project.In this project, recycled aggregate from demolished concrete 20 mm size was used as coarse aggregate. The recycled aggregates which is collected from the demolished concrete water tank of 20 mm size used in this study. It was found to be confirming the various specifications as per IS: 383-1970.Usage of these recycled aggregates as gravel reduces the mining of new gravels. And also it overcomes the problems indisposal of demolition wastes. The usage of recycled aggregates reduces the cost as well assave the environment.

III. COCONUT SHELL ASH POWDER

The cost of cement used in the concrete works is on increase and unaffordable, thus the need to find alternative binding materials that can be used fully or in partial replacement of cement. One of the agricultural waste materials, coconut shells is cheap and readily available in high quantity. Coconut shells are collected and cut into the pieces of dimensions of 1 sq.cm using hammer and then burnt in the open air (uncontrolled combustion) for three hours to produce coconut shell ash (CSA), which in turn was used as pozzolana in partial replacementof cement on concrete production. The collected powder was then sieved using different sieves.

Coconut shell ash meets the requirement for a pozzolana. The setting time increases with increase in the amount of coconut shell ash. The chemical composition of coconut shell powder having Lignin (29.4%), Cellulose (26.6%), Pentosans (27.7%), Solvent Extractives (4.2%), Moisture (8%), Uronic Anhydrides (3.5%) and Ash (0.6%). The coconut shell ash powder used in this study is of Grayish colour. The size of particle is finer than that of cement. OPC emits large amount of CO_2 during its production. This material was taken for this study in order to reduce the cost of construction and also save the environment. In this project the OPC is partially replaced with coconut shell ash up to 15% without affecting its strength.

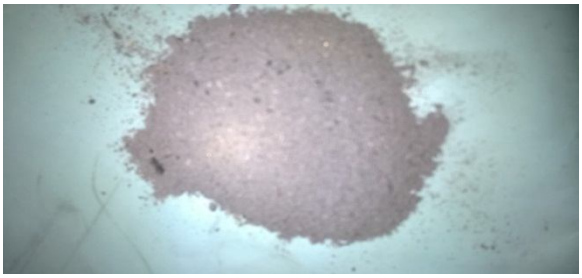


Figure 2:Coconut shell ash powder

IV. LITERATURE SURVEY

Mr.Utsev,J.T., Mr.Taku,J.K, has published a journal on "Coconut Shell Ash As Partial Replacement Of Ordinary Portland Cement In Concrete Production" in "International Journal Of Scientific & Technology Research" of ISSN 2277-8616,Vol 1,Issue 8,September 2012.This study reveals that 10-15% partial replacement of OPC with coconut shell ash using water cement ratio of 0.5 are suitable for production of both heavy weight and light concrete.

Mr.NeeteshKumar,Mr.Dilip Kumar, has published a journal on "Utilization Of Coconut Shell In Different Forms In Concrete" in "International Journal For Scientific Research &Development" of vol.2,Issue07,2014\ISSN(online):2321-0613.This studies shows that the optimal 28 days strength for OPC- coconut shell ash mix is recorded upto 10% replacement is suitable for the production of concrete.

Mr. Vignesh Kumar Nagarajan.S, Mrs.S.Aruna Devi, et al, has published a journal on "Experimental Study On Partial Replacement Of Cement With Coconut Shell Ash in Concrete" in "International Journal Of Science and Research" Of ISSN(online):2319-

7064.The results obtained upto 10% replacement for OPC-Coconut Shell Ash mix is recorded for production of concrete.

Mr.T.Subramani ,Mr.A.Anbuvel, has published a journal on "Experimental Behaviour Of reinforced concrete beams with coconut shell ash as coarse aggregate" in " International Journal Of Application or Innovation in Engineering & Management" of ISSN 2319-4847, Vol 5,Issue 5,May 2016.By using different coconut shell content of 5 to 20% in M25 grade concrete is suitable for the production of sustainable light weight concrete.

Mr. Mohd Monish, Mr.VikasSrivastava , et al, has published a journal on "Demolished Waste as Coarse aggregate in concrete''in J.Acad.Indus, of ISSN:2278-5213,Res.Vol.1(9) Feb 2013.Test results showed that the compressive strength of recycled concrete up to 30% coarse aggregate replacement by demolished waste at the end of 28 d has been found to be comparable to the conventional concrete

Mr. S.R.Yadav , Mr.S.R.Pathak, has published a journal on "Use Of Recycled Concrete Aggregate In Making Concrete -An Overview" in 34th Conference on "Our World In Concrete & Structures:16-18 August 2009,Singapore,conducted by Singapore concrete institute& CI-Premier PTE Ltd .The research work has concluded that a 20 -25% recycled aggregates may not have significant effect on concrete properties. These properties depend upon the adhered mortar would be essential to calculate the adhered mortar.

V. PERIMENTAL INVESTIGATIONS

A. Tests On Hardened Concrete

1) Compressive strength on cube specimens (150x150x150mm), were determined for 7, 28 days.

2) Split tensile strength on cylinders of dia 150mm and depth 300mm was found for 28 days. Modulus of elasticity is obtained from split tensile strength values.

3) Flexural strength on (150x200x1000mm) beam specimens was found at 28 days. Modulus of rupture is obtained from the values.

B. Compression Strength Test (Astm C109/C109m)

The compression test shows the compressive strength of hardened concrete. The testing is done in a laboratory off-site. The only work done on-site is to make a concrete cubes for the compression test. Thestrength is measured in N/mm^{2}and is commonly specified as a characteristic strength of concrete measured at 28 days after mixing. The compressive strength is a measure of the concrete's ability to resist loads which tend to crush it.

The compressive strength (f_{cu}) was computed from the fundamental principle as,

f_{cu} = load at failure / cross sectional area(N/mm^2)

Where,

P = load at failure (N)

A = Area of the specimen (mm^2)

The total number of mixes taken are listed below.

Table 1 Mix Proportions

INDICATION	COARSE AGGREGATE	CEMENT	RECYCLED COARSE AGGREGATES	COCONUT SHELL ASH
C1	100%	100%	-	-
C2	70%	90%	30%	10%
C3	70%	85%	30%	15%

The various compressive strengths recorded are tabulated as follows.

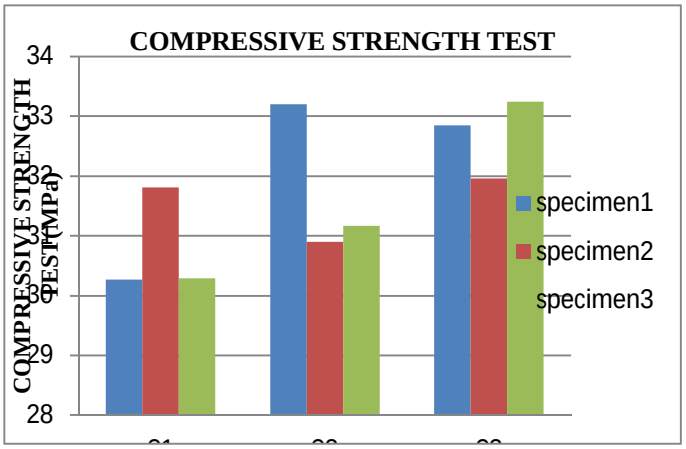
Table2 Compressive Strength Test

INDICAT ION	COMPRESSIVE STRENGTH(N/mm^2)		AVER AGE (N/mm^2)
	7 DAYS	28 DAYS	
C1	18.5	30.26	30.78
	18.43	31.81	
	17.91	30.29	
C2	17.48	33.20	31.75
	18.76	30.89	
	18.16	31.16	
C3	18.21	32.84	32.68
	18.86	31.96	
	19.28	33.24	

Table3: Split Tensile Strength Test

INDICATION	SPECI MEN NO.	SPLIT TENSILE STRENGTH 28 DAYS(MPa)	AVERAGE
C1	1	2.72	2.60
	2	2.66	
	3	2.68	
C2	4	2.42	2.54
	5	2.58	
	6	2.61	
C3	7	2.63	2.69
	8	2.69	
	9	2.77	

Chart1 Compressive Strength Test



Splitting Tensile Strength Test (Astmc 496-90)

For the determination of splitting tensile strength of concrete, cylinder specimens of diameter to length ratio1:2 was selected **,** with diameter as 150 mm and the length as 300 mm. specimens were dried in open air after 28 days of curing and subjected to splitting tensile test under universal testing machine.

The splitting tensile strength (f_{sp}) was obtained using the formula,

$\mathbf{f_{sp} = 2P/\pi dl}(N/mm^2)$

Where,

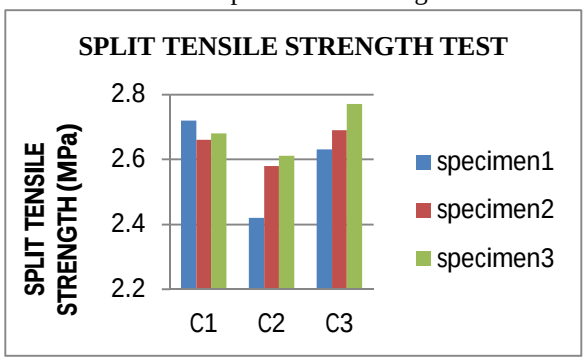
P = load at failure (N)

d = diameter of specimen (mm)

l = length of specimen (mm)

Split tensile strength for the cast cylinder specimens are carried out for all the three mixes and they are tabulated .

Chart 2 Split Tensile Strength Test



VI. TEST RESULTS

Table 2, Table 3 is the result of 28 day compressive and split tensile strength results.As far as the compressive strength,split tensile strength are concerned, the mixes C1,C2 gives the target strength. The C3 mix gives the maximum strength.

VII. CONCLUSION AND RECOMMENDATION

The flexural strength of the above mixes has to be studied. From the results obtained up to 30% of coarse aggregate was replaced by demolished waste gave the strength closer to the plain concrete for recycled concrete mix. Three specimens each having 0%,10%,15%coconut shell ash as replacement of cement ,the optimal 28 days strength for OPC-coconut shell mix is recorded at 15% replacement.In conclusion,the study reveals that 15% partial replacement of OPC with coconut shell ash is suitable for both heavy weight and light weight concrete.

REFERENCES

[1] Mr.Utsev,J.T., Mr.Taku,J.K, has published a journal on "Coconut Shell Ash As Partial Replacement Of Ordinary Portland Cement In Concrete Production" in "International Journal Of Scientific & Technology Research" of ISSN 2277-8616,Vol 1,Issue 8,September 2012.

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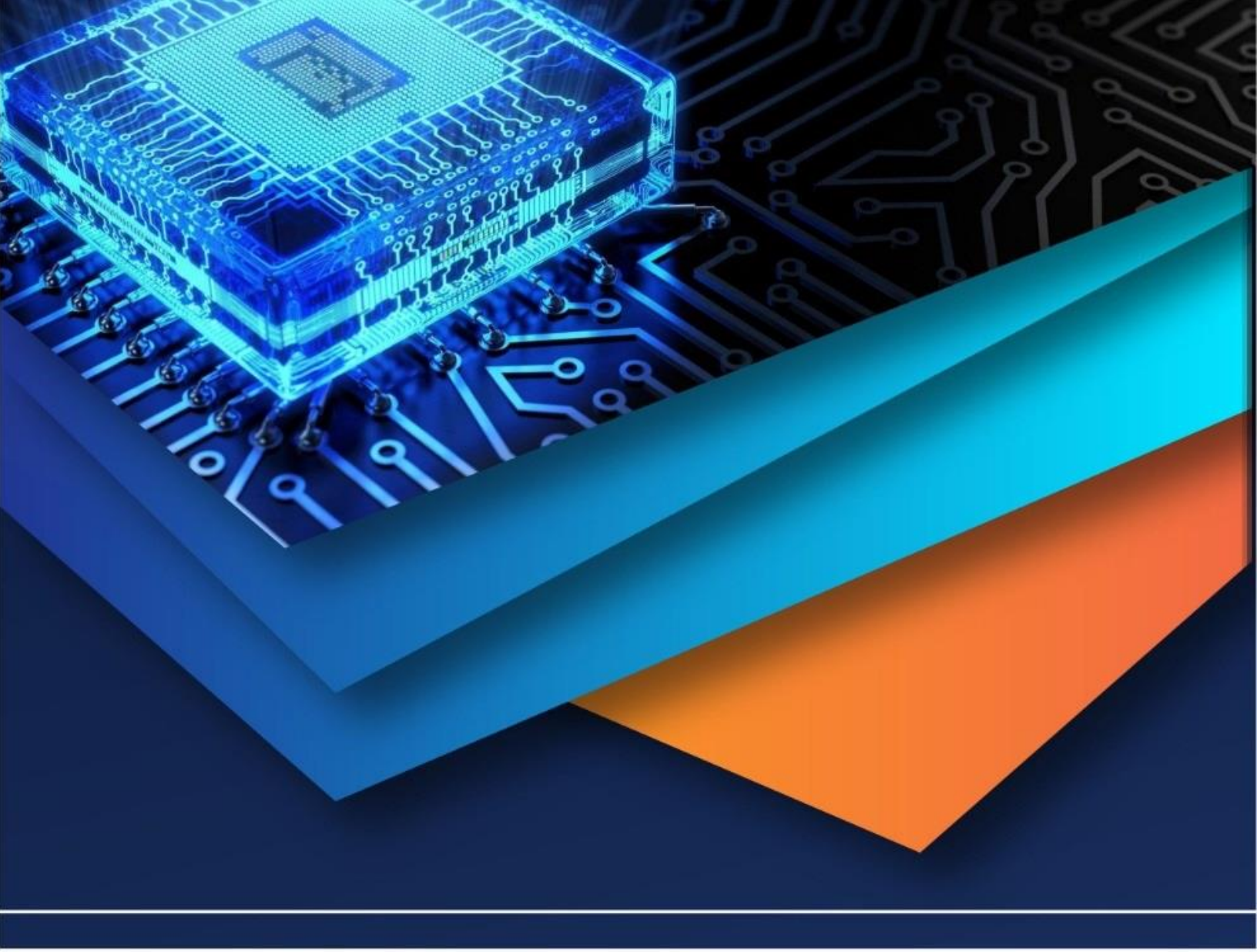

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