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Experimental Study on Partial Replacement of Cement and Coarse Aggregate with Fly Ash and Coconut Shells respectively

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Abstract: ***Due to incremental growth in the use of concrete, these days many ingredients of concrete are in scarcity. Hence supplementary cemetitious materials are being widely used.***
The current study aims at using supplementary cemetitious materials as well as partially replacing coarse aggregate in M25 grade concrete. Cement is partially replaced by 5%,10%,15% and 20% of fly-ash, coarse aggregate is partially replaced by 2%,4%,6% and 8% of coconut shells.
In this project M25 grade concrete is used as design mix. Use of waste material as construction material has several benefits such as a decrease in cost, saving in energy and protection of environment.
Keywords: Fly-ash, coarse aggregate, coconut shells, ordinary Portland cement.

I. INTRODUCTION

Due to globalization there is an increase in growth of infrastructure across the globe. Hence there is vital demand for concrete. Due to these growing demand, these days there is a shortage for various ingredient used in concrete. Hence use of supplementary cemetitious materials, partial replacement of fine aggregate and coarse aggregate are proved to advantageous. The main motive of concrete industry today to perform its level best without harming the environment balance. The excessive emission of greenhouse pollutants has caused the total imbalance in sustainable growth. Fly-ash is the byproduct from thermal power plants and is widely available.

From earlier literature it is evident the use of fly ash as partial replacement was proved to be advantageous both for environment and economy. Similarly coconut shells are available in abundance in countries like India. Hence in this study we have aimed at using fly ash as partial replacement for cement and broken coconut shells as partial replacement for coarse aggregate in M25 grade concrete.

II. LITERATURE REVIEW

On doing the literature survey, we found that incorporation of high volume of fly-ash as partial replacement for cement improved workability, durability, minimized water demand and reduced sulphate attack and minimized cracking.

It was also found that use of broken coconut shells as partial replacement for coarse aggregate has decreased the density of concrete and improved the strength properties till certain percentage replacement. As we know major portion of cost of concrete is due to cement.

On using flyash as partial replacement for cement, we can reduce the cost of concrete to certain extent and also improved fresh properties and hardened proprieties of concrete. Coconut shells are very cheap as compared to coarse aggregates.

Due to their smooth surface the workability of concrete may also be improved.

The combined use of flyash and broken coconut shells as partial replacement for cement and coarse aggregate may prove to be further more economical and may also enhance the fresh properties and hardened proprieties of concrete. In the current study we have tried to study the fresh properties and hardened proprieties of concrete in which cement was partially replaced with flyash and coarse aggregate was partially replaced with broken coconut shells.

III.METHODOLOGY

A. Tests on various ingredients to be used in concrete.

1) Cement: Ordinary Portland cement of 53 grade conforming to Indian Standard IS 12269-1987 was used throughout the experimental program. The test results for various tests conducted on cement are as follows.

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S.no	Test	Result
1.	Fineness	5.3%
2.	Normal consistency	35%
3.	Initial setting time	32 Minutes
4.	Final setting time	600 Minutes
5.	Compressive strength	
	a) 3days	28.5Mpa
	b) 7days	38Mpa
	c) 28days	54.5Mpa
6.	Specific gravity	3.1

2) *Fine Aggregate:* Fine aggregate (sand) used for this entire investigation for concrete was river sand conforming to zone-II of IS:383-1970.The test results for various tests conducted on fine aggregate are as follows

S.no	Test	Result
1.	Fineness modulus	2.75
2	Specific gravity	2.5

3) *Coarse Aggregate:* Crushed granite of 20mm passed and 10mm retained size has been used as coarse aggregate.The test results for various tests conducted on Coarse aggregate are as follows

S.no	Test	Result
1.	Fineness modulus	7.17
2	Specific gravity	2.78

4) *Fly-Ash:* Fly ash is a by product of the combustion of pulverized coal in electric power generation plants. When the pulverized coal is ignited in the combustion chamber,the carbon and volatile materials are burned of. However,some of the mineral impurities of clay,shale,felsper etc.., are fused in suspension.The test results for various tests conducted on fly-ash are as follows

S.no	Test	Result
1.	Specific gravity	2.5

5) *Coconut Shells:* They were collected from the street waste ,cleaned ,sun dried , removed dust to analyze its properties . It has high water absorption . Due to this property, they were pre-soaked in water for 24 hours . The coconut shell is broken into small pieces up to 20 mm The broken pieces are passed through IS 20 mm sieve and those retained on 10 mm sieve are utilized.The test results for various tests conducted on coconut shells are as follows

S.no	Test	Result
1.	Specific gravity	1.26
2.	Fineness modulus	5.9

B. M25 Grade Concrete Mix Design

The mix design is carried out as per Indian Standard code IS 10262:2009
Designation of concrete mix - M25
Obtained mix proportion is **1:1.04: 2.08** (cement: fine aggregate : coarse aggregate)

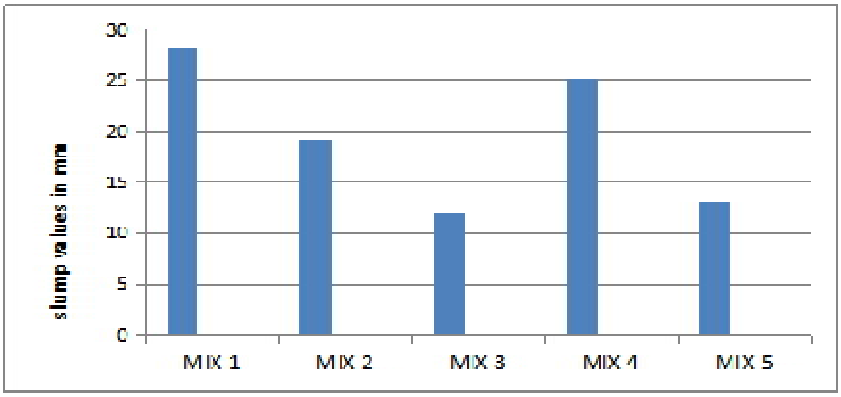
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C. Mix Designations

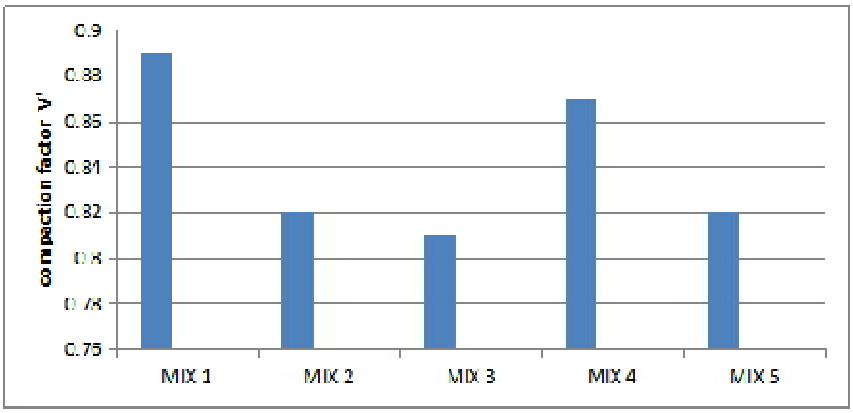
MIX ID	REPLACEMENTS
M1	Conventional concrete with 0% replacement in FA & CS
M2	concrete with5% FA,2% CS
M3	concrete with 10% FA,4% CS
M4	concrete with 15% FA,6% CS
M5	concrete with 20% FA,8% CS

D. Tests on Fresh Concrete

1) Slump cone Test: The test results are as shown in the bar chart



2) Compaction Factor Test: The test results are as shown in the bar chart



E. Compressive Strength Test on Hardened Concrete

The cube specimens are tested on compression testing machine after 7days, 28days, and 90days curing. The results are as follows:

Compressive strength (MPa)			
Mix Id	7 days	14 days	28days
MIX 1	23.42	26.12	33.35
MIX 2	31.5	34.36	39.62
MIX 3	32.7	36.22	41.53
MIX 4	33.47	38.57	43.17
MIX 5	26.64	31.22	37.71

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IV. CONCLUSIONS

The following are the conclusions which we arrived at on partially replacing flyash and coconut shells for cement and coarse aggregate in M25 grade concrete .

A. On conducting the slump cone test and compaction factor test to determine the workability of concrete,it was found that the slump value and compaction factor of MIX 4 that is M25 grade concrete with partial replacement of 15% of cement by fly-ash and 6% of coarse aggregate with coconut shells has shown slump value and compaction factor nearer to that of conventional M25 grade concrete.

B. The test results showed a gradual increase in Compressive strength of concrete specimen till 15% replacement with flyash for cement and 6% replacement with coconut shell for coarse aggregate in M25 grade concrete.

C. Hence the optimum percentage replacement is found to be 15% replacement with flyash for cement and 6% replacement with coconut shell for coarse aggregate in M25 grade concrete.

D. It was found that the compressive strength has increased by about 9.82% for MIX 4 than that of M25 grade conventional concrete .

E. On using fly-ash as partial replacement for cement and coconut shells as partial replacement for coarse aggregate,the overall cost of production of concrete drastically comes down as the cost of fly ash and coconut shells is far much less as compared to that of cement and coarse aggregate respectively.

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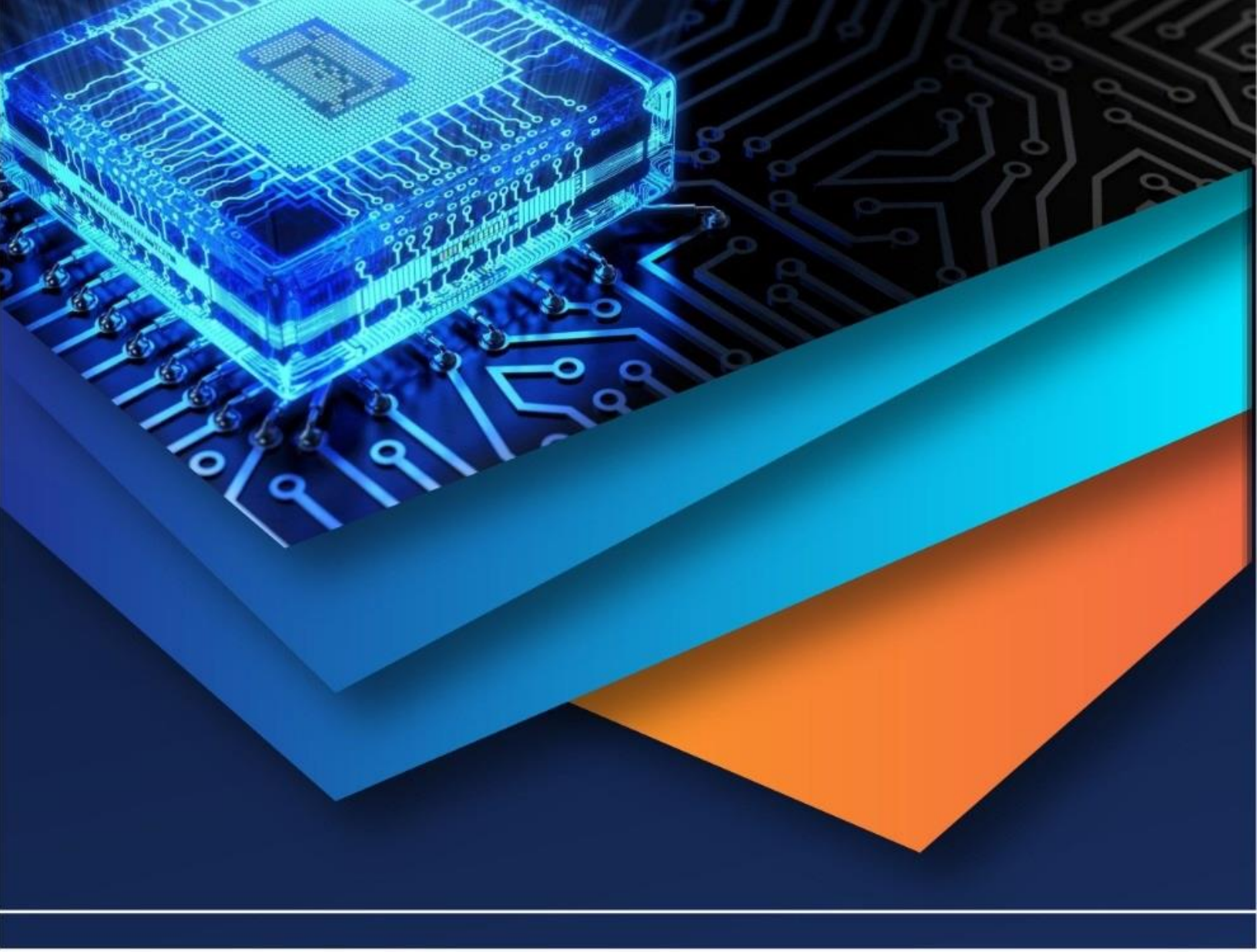
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