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An Experimental Study on Behaviour of Concrete by Partial Replacement of Aggregate with Bamboo Pieces and Cement with Alccofine

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Abstract: ***In this paper, we are going to partially replace a coarse aggregate with bamboo pieces and a cement with Alccofine respectively. Alccofine is advanced micro fine material of new generation which is important in terms of workability as well as strength. The main aim of this work is to highlight the importance of bamboo and Alccofine 1203 as a coarse aggregate and cement replacement respectively in construction or concrete industries.***
ALCCOFINE 1203 of ultrafine particle size is added as a replacement of cement which wills not only help to improve the strength of the concrete but also provide resistance against chloride attack on concrete, sea water attack, and accelerated corrosion attack on concrete.
An experimental investigation has been conducted to replace the natural coarse aggregate with different percentages of bamboo aggregate (by weight).
The percentage of bamboo added by 0%, 4%, 8%, 12% , 16% , 20% and 24% as partial replacement of coarse aggregate used in concrete. Similarly, the percentage of alccofine added by 0%, 3% , 6%, 9%, 12%, 15% and 18% as partial replacement of cement (by weight) used in concrete.
Keywords: Bamboo aggregate, Alccofine, Compressive strength, workability, Flexural strength, Split tensile strength

I. INTRODUCTION

Concrete is most extensively used man made construction material in the world. The manufacturing of cement for concrete produces large amount of carbon dioxide(CO2) emissions into the atmosphere, a major contributor for Global Warming & Greenhouse effect. Therefore it becomes necessary to invent a alternate material for cement to use in construction industry. A lot of Supplementary Cementitious Materials (S.C.M) like silica fumes, fly ash , Alccofine , slag powder etc. have been identified in the past and also have been effectively used as a partial replacement to cement in the production of concrete. Boom in the infrastructure development is further demanding the production of H.P.C (High Performance Concrete) which is eco- friendly and sustainable concrete and cost effective.

The Natural aggregates used in construction are gradually / slowly being depleted due to urbanization and industrialization. Therefore, the development of feasible construction materials (e.g., bamboo chips etc.) and recyclable construction materials are necessary. Bamboo grows rapidly, and is inexpensive and is widely distributed around the world. In addition, over the last few decades, this material has been progressively used in some developing countries, because of its resistance to seismic loading and flexibility.

In this study we are going to analyse the concrete by partially replacing cement with Alccofine and by partially replacing coarse aggregate with bamboo chips. Bamboo fibres can also be used as a filler material in concrete in road construction or other ground works such as paver block construction, waist slab and other water retaining structures.

Bamboo pieces may also be used with some effectiveness as a partial replacement of inorganic aggregates in concrete applications to decrease the dead weight of structures.

In this investigation we will study the effect of partial replacement of coarse aggregate by bamboo with 0%, 4%, 8%, 12% , 16% , 20% and 24% and cement by alccofine with 0%, 3% ,6%, 9%, 12%, 15% and 18% . The effect of replacement of bamboo and alccofine was studied using basic properties, fresh and hardened concrete behaviour based mechanical strength test results

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II. LITERATURE REVIEW

A. Alccofine used as a Replacement of Cement

S.P. Upadhyaya and M.A. Jamnu

investigated effect on Compressive strength of High Performance Concrete (HPC) incorporating Alccofine and Fly Ash and concluded that the addition of Alccofine shows an early strength gaining property and that of Fly ash shows long term strength. The combination of Ordinary Portland cement-fly ash-Alccofine concrete was found to increase the compressive strength of concrete on all ages when compared to concrete made with fly ash and Alccofine alone.

Abhishek kulkarni, Dr.Anila kumar (07 | July 2019)

In this study test has been done on the partial replacement of cement by Alccofine in fibre reinforced concrete .Tests conducted are compressive strength , flexural strength, workability. From the test results it can be concluded that addition of Alccofine as a replacement material to cement improves the workability and strength properties. It is also concluded that addition of GI fibers will yield better strength characteristics compared to that of polypropylene fibers.

B. Bamboo Chips used as a Replacement of Coarse Aggregate

Bibhab Kumar Das, Girija. T. Rand Koushik Sarkar

use Bamboo as an Alternative to Coarse Aggregate. They worked on M-25 concrete for partial and full replacement of coarse aggregate with bamboo chips. They conclude that Though bamboo can take considerable amount of stress, though their strength rivals steel, yet their mechanical property and strength is not fully utilized when they were used with composite concrete.

Bhautik Dudhatra , Disha Parmar , Payal Patel (05, May – 2017)

They studied on Bamboo as a Replacement of Aggregates in Self Compacting Concrete. They conduct their test on M-25 concrete with partial replacement of coarse aggregate by bamboo in different percentages

III.MATERIALS

The concrete test specimens were casted using ordinary Portland cement of 53 grade, sand, coarse aggregate, bamboo chips, Alccofine , super plasticizer and water. The materials for experiment are confirmed to the specification as relevant Indian Standard Codes.

A. Alccofine

Alccofine or ultrafine slag is more advanced form of GGBS in which slag is further grind to less than 20 micron. As a result of it, the specific surface area is increased dramatically to 3000-5000 m2/kg. Particle shape of this ultrafine slag or alccofine is spherical which is due to ball bearing effect which gives increased workability at much reduced water content. The Pozzolanic reaction increases due to its increase in specific surface area. It increases the durability of design mix conctrete & lowers the permeability of concrete mix.

B. Bamboo

Bamboo pieces with size of varying length from 2 to 4 cm, breadth from 1 to 2 cm, and thickness of 1 cm is can be used as a partial replacement of coarse aggregate at the replacement levels of 0%, 4%, 8%, 12% , 16% , 20% and 24%. The physical properties of all these materials were tested as per IS 383-1970. The failures of bamboos are very less in seismic zones as of the energy is maximum about the joints. The Cellulose appear in the bamboo is the main source of mechanical properties of bamboo, which is very good in buckling but due to its low strength and not being straight it may not be as good as steel.

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C. Mix Design

Mix design is done as per IS:12269 methods

QUANTITIES OF MATERIAL REQUIRED FOR CEMENT CONCRETE MIX OF M-35

Particulars	Cement	Fine sand	Coarse Aggregate	Water	Super plasticizer
Per Cum in Kg	420 kg/cum	615.32 kg/cum	1247.66 kg/cum	168 kg/cum	4.2Kg/cum
Ratio	1	1.465	2.97	0.40	0.01

IV. RESULTS AND DISCUSSION

In this experimental program to study the compressive strength, flexural strength, split tensile strength, as well as workability of concrete with partial replacement of cement by Alccofine and with partial replacement of coarse aggregate by bamboo chips for M35 grade of concrete. The compressive, flexural and split tensile strength tests are conducted after replacing the 0%, 3%, 6%, 9%, 12%, 15% & 18% cement with alccofine and replacing coarse aggregate by 0% 4% 8% 12% 16% 20% & 24% by bamboo chips from the concrete mix is studied at 7days and 28 days of curing period. The compaction factor test and slump test is also performed to find the workability of the fresh concrete mix.

Replacement Percentage Of Cement & Coarse Aggregate Are As Given Below

AB-0 (0%alccofine, 0% bamboo) (By weight)
AB-1 (3%alccofine, 4% bamboo)
AB-2 (6%alccofine, 8% bamboo)
SAB-3 (9%alccofine. 12% bamboo)
AB-4 (12%alccofine, 16%bamboo)
AB-5 (15%alccofine, 20% bamboo)
AB-6 (18%alccofine, 24% bamboo)

Mix AB-0 is for conventional concrete

A. Workability

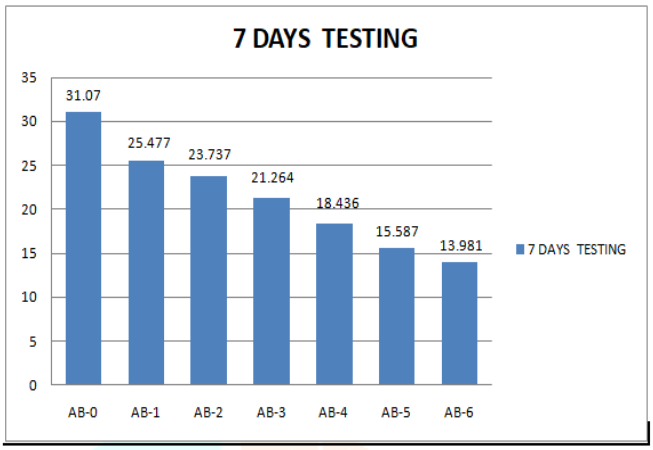
SLUMP VALUE FOR PREPARED CONCRETE MIX FOR DIFFERENT PERCENTAGE OF REPLACEMENT	
Concrete mix	Slump value(mm)
AB-0 (0%alccofine, 0% bamboo)	81
AB-1 (3%alccofine, 4% bamboo)	76
AB-2 (6%alccofine, 8% bamboo)	70
AB-3 (9%alccofine. 12% bamboo)	63
AB-4 (12%alccofine, 16%bamboo)	55
AB-5 (15%alccofine, 20% bamboo)	49
AB-6 (18%alccofine, 24% bamboo)	41

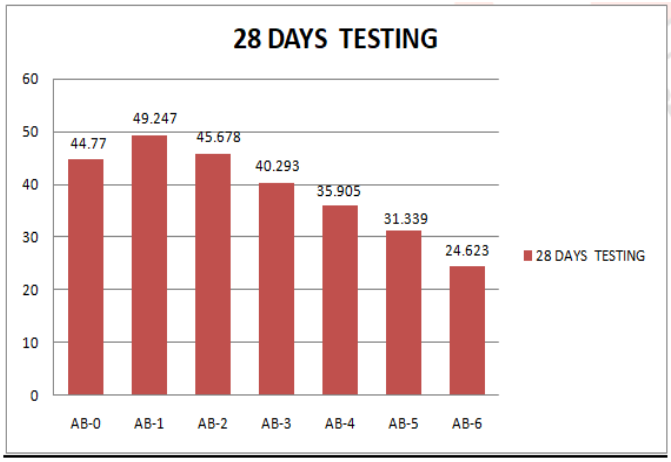
B. Compaction factor test

TABLE 5.1 COMPACTION FACTOR FOR PREPARED CONCRETE MIX FOR DIFFERENT PERCENTAGE OF REPLACEMENT	
Concrete mix	Compaction factor
AB-0 (0%alccofine, 0% bamboo)	0.917
AB-1 (3%alccofine, 4% bamboo)	0.858
AB-2 (6%alccofine, 8% bamboo)	0.823
AB-3 (9%alccofine. 12% bamboo)	0.747
AB-4 (12%alccofine, 16%bamboo)	0.645
AB-5 (15%alccofine, 20% bamboo)	0.588
AB-6 (18%alccofine, 24% bamboo)	0.535

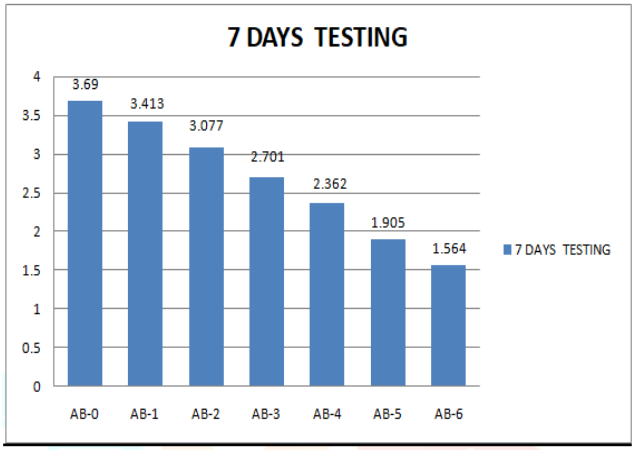
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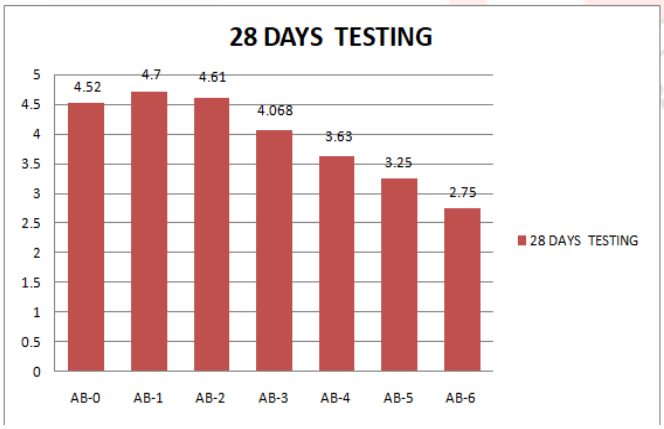
C. Compressive strength (N/mm2)



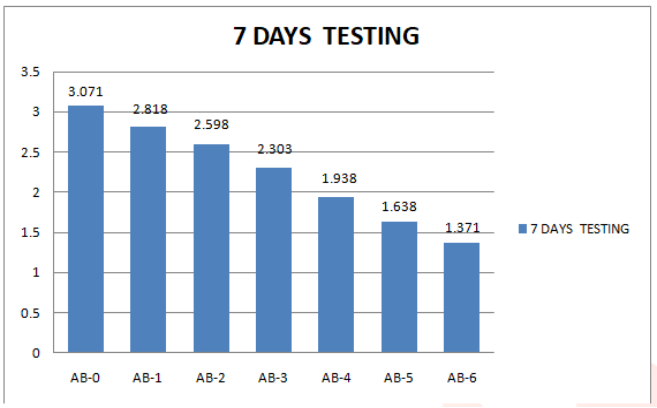


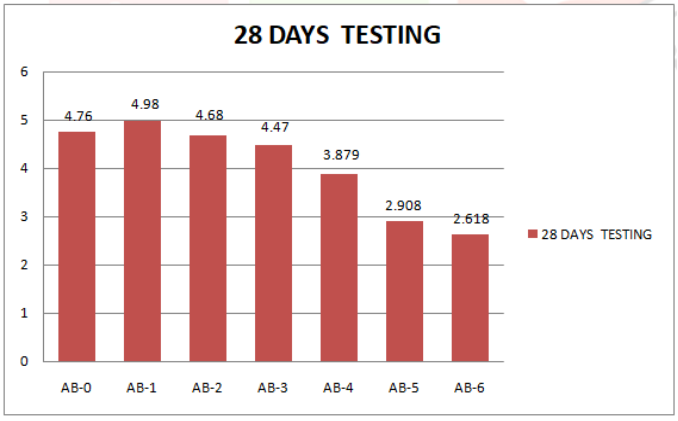
D. Flexural strength test (N/mm2)





E. FlexuE. Split tensile strength test (N/mm2)





V. CONCLUSION

A. The workability of our concrete samples are decrease as we increase in percentage of replacement with Alccofine and bamboo pieces. The slump value of alccofine -bamboo concrete is decreased with increase in percentage of alccofine and bamboo chips as a replacement of cement and coarse aggregate respectively. The conventional concrete mix AB-0 shows slump 81mm and other mixes AB-1, AB-2, AB-3, AB-4 , AB-5, AB-6 shows decrease in slump with 6.17%, 13.58%, 22.22%, 32.09%, 39.50%, 49.38% respectively with respect to conventional mix.

B. The compressive strength of the concrete will slightly increases with increase the percentage of alccofine and bamboo pieces at some extent. But after more replacement percentages strength starts decreasing. The compressive strength of conventional mix AB-0 is 44.77 N/mm^2 and there is increase in compressive strength with 10% and 2.03% on replacement of alccofine and bamboo by 3%, 6% and for bamboo 4%, 8% respectively (AB-1, AB-2) mix with respect to conventional concrete. After that all mixes AB-3, AB-4, AB-5, AB-6 shows some decrease in compressive strength with percentage of 10.0%, 19.80%, and 30% and 45.01% respectively with respect to conventional concrete.

C. The flexure strength of alccofine-bamboo concrete has been increased by 4% for mix AB-1 and by 2% for mix AB-2 with respect to conventional concrete. After that there is continuously decrease in strength of for mixes AB-3, AB-4, AB-5, AB-6 with 10%, 19.60%, 28%, 39% respectively with respect to conventional mix.

D. The split tensile strength shows behaviour as compression strength, the tensile value of AB-0 mix is 4.76 N/mm^2. The tensile strength goes on increase for first replacement i:e for mixture AB-1 with respect to conventional concrete. The tensile strength for AB-1 mix increase with 4.8%, but after that all the mixes AB-2, AB-3, AB-4, AB-5, AB-6 shows decrement in tensile strength with 1.5%, 6%, 18.50%, 38.9%, 45.0% respectively.

E. The emission of greenhouse gases decreases at greater extent with the use of alccofine as a partial replacement of cement, i:eby reducing the carbon emission of cement manufacturing industry and we can make eco-friendly concrete by using bamboo pieces as a replacement of coarse aggregate.

F. Replacement of coarse aggregate with bamboo pieces helps to decrease the degradation of natural aggregate and also gives us light weight concrete which is also the initiative of making green concrete

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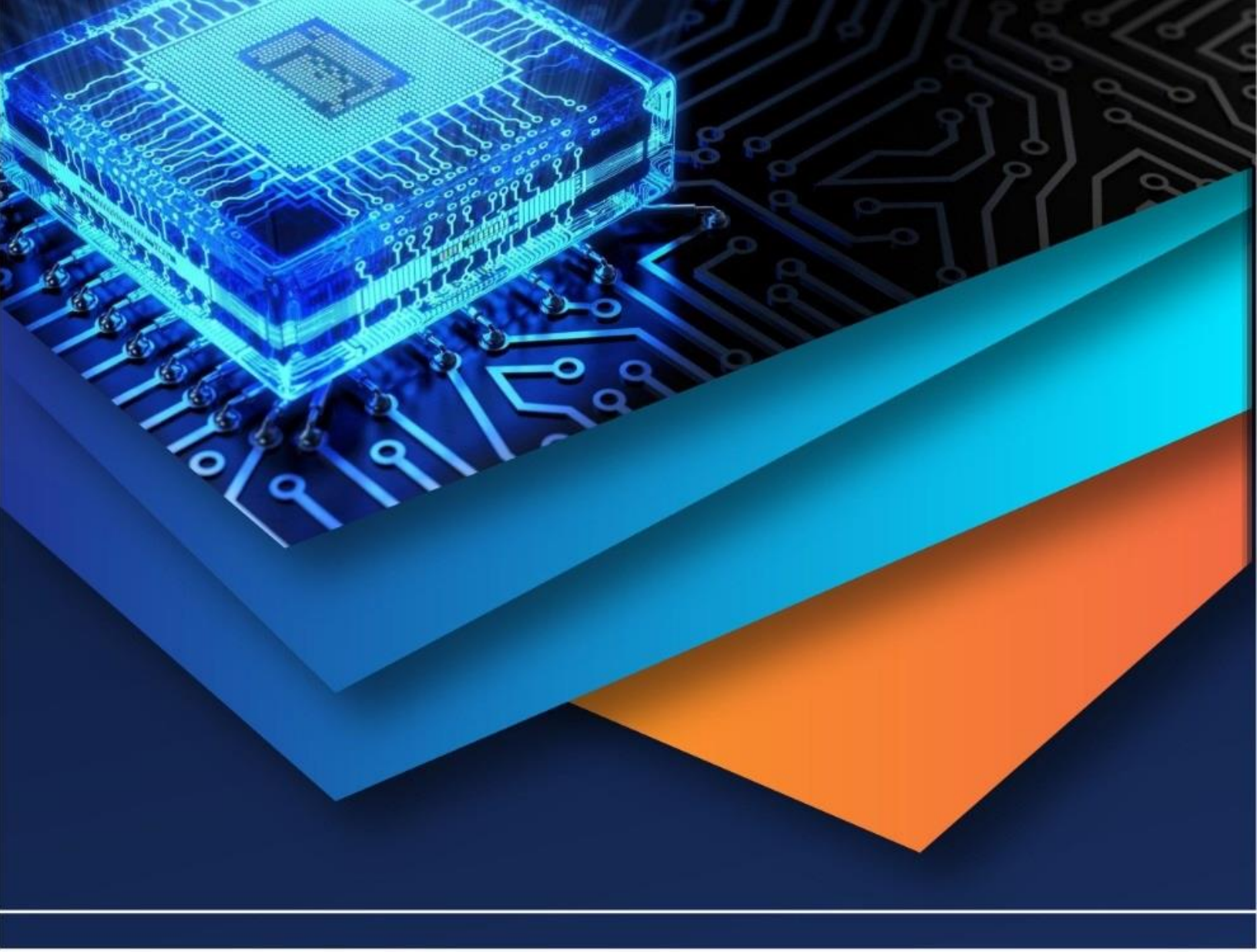
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