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Flexural Strength Behaviour of R C Beams using Environmental Wastes

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ABSTRACT

The concrete which is made with wastes that are freely available in present environment is named as eco-friendly concrete or Green concrete. It has been observed that 1.71 tons of CO_2 is produced per ton of cement production which is one of the causes for environmental pollution. This Green Concrete is an environmental friendly material and the overall impact on the environment per ton of concrete is limited. Some of the eco-friendly materials are fly ash, marble powder, ceramic, crushed stone dust, demolition wastes, rice husk ash etc. In the present study, cement is replaced with ceramic powder, marble powder and rice husk ash and the cement is further replaced with ceramic powder and bonding material glass fibres and tested for compression and flexural strength to find the optimum mix.

Keywords— Cement, Ceramic Powder, Compressive Strength, Flexural Strength , Tensile Strength.

I. INTRODUCTION

As the resources are limited and constructions are heavy and cost of material is high. On the other hand, wastes are large in quantity, it requires large amount of area to disposal those wastes. There are several wastes like GGBS , Fly Ash , Rice husk ash , ceramic waste , marble waste etc.,

CEMENT: Cement is a material, a substance that can bind itself and other materials together. It has adhesive and cohesive properties so as to form a good bond with other materials. It is the most important and costliest ingredient of concrete and it is obtained by burning of mixture of siliceous, argillaceous and calcareous material in definite proportions.

CEMENT REPLACEMENT MATERIAL: Cement replacement materials are naturally occurring materials or industrial by products which can be used as a replacement material of cement in concrete mix. They are called as pozzolona or fine minerals.

Some of the cement replacement materials are:

- Ceramic waste
- Rice husk ash
- Marble powder
- GGBS(Ground granulated blast furnace slag)

The following are some of the most commonly used replacement material:

MARBLE POWDER: Marble powder is the one which is the most commonly used replacement material. Utilization of marble powder will avoid the disposal problems and related to Environmental issues. Utilization of marble powder will reduce the usage of cement and conserve natural resources. Also we can say that some amount of cost of cement can be reduced. There is best possible way of disposal of waste material like marble powder by using it in concrete, which will reduce environmental burden.

RICE HUSK ASH: The substitution of Rice Husk Ash and Bone Powder can be used as used as one of the replacement materials. There is abundance of this material in developing countries and it will help in removing thousands of tons of waste from the environment annually.

CERAMIC WASTE POWDER: The ceramic industry inevitable generates wastes, irrespective of the improvements introduced in the manufacturing process. In the ceramic industry, about 15%-30% production goes as waste. These wastes pose a problem in present-day society, requiring a suitable form of management in order to achieve sustainable development. Utilization of Ceramic waste and its application are used for the development of the construction industry, Material sciences. It is the possible alternative solution of safe disposal of Ceramic waste.

II. METHODOLOGY

The methodology of the present project work is shown in the following flowchart.

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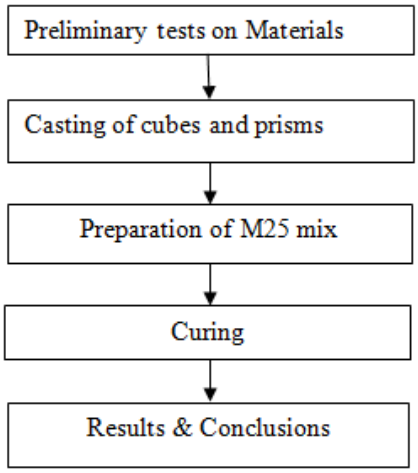

Preliminary tests were conducted on the cement material as shown in table 1.

Table1.Preliminary tests on Cement and different mixes

Type of Material	Specific Gravity	Consistency	Initial Setting Time(min)
Cement	2.6	30	30
Cement + Ceramic	2.3	30	90
Cement + Marble	1.6	27	60
RHA	1.8	45	120

Casting of Cubes and Prisms:

The total number of 20 cubes with different proportions (0%, 10%, 20%, 30%, and 40%) of ceramic waste for 7 and 28 days were casted as shown in table2. The total number of 28 prisms with different proportions (0%, 5%, 10%, 15%, 20%, 30%, and 40%) of ceramic and 1% of glass fibers were casted for 28days curing period as shown in table3.

Table2. Casting of cubes

% of replacement	0	10	20	30	40
Cubes	4	4	4	4	4

3. Casting of Prisms

Prisms	Replacement of Ceramic and glass fiber						
% of replacement	0	5	10	15	20	30	40
With reinforcement and glass fiber	2	2	2	2	2	2	2
Without reinforcement and glass fiber	1	1	1	1	1	1	1
Without reinforcement and without glass fiber	1	1	1	1	1	1	1

III. RESULTS & DISCUSSIONS

Cement is replaced with ceramic and cubes are tested for compressive strength. The obtained compressive strength values are shown in table3.

Table4.Compressive strength of Cubes

Cement %	Ceramic %	7 Days N/mm^2	28 Days N/mm^2
100	0	20.54	31.28
90	10	21.2	32.1
80	20	22.36	33.07
70	30	25.5	37.5
60	40	23.34	35.5

It is observed that the compressive strength is found to be increasing with the replacement of cement with ceramic and further replacement of cement with ceramic decreases the compressive strength of cube as shown in tabule3. The optimum content is found to be replacement of cement with 30% of ceramic powder.

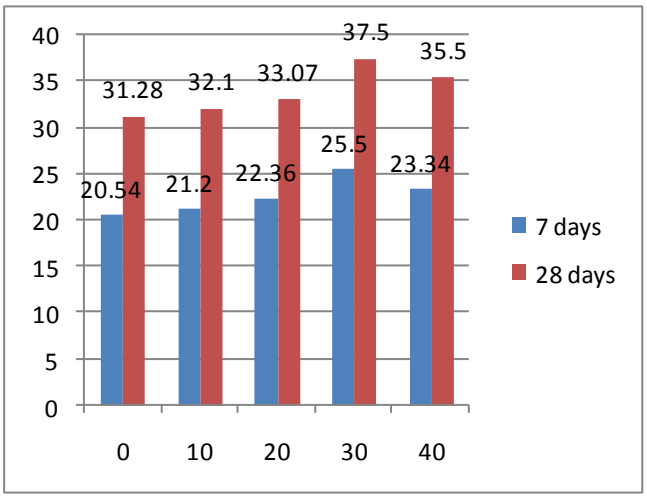

Figure1.Compressive strength of cubes

The compressive strength of cubes with various ceramic content for 7 days and 28 days is shown in figure1. It is found that 30% is the optimum replacement of cement with ceramic.

Prisms are casted and cured for 28 days and then tested for flexural strength and the values are shown in table5.

Table5. Flexural strength of Prisms

% of ceramic powder	Ultimate load N/mm^2	Deflection (mm)
0	27.34	5.8
5	32.33	4.3
10	44.63	4.2
15	45.09	4.2
20	40.76	45
30	29.18	4.7
40	24.26	5.3

It is observed that the flexural strength of prism is found to be increasing initially with the replacement of cement with ceramic powder but it is decreasing with further replacement of cement with ceramic powder. So the optimum content of ceramic powder is 15%.

V. CONCLUSION

1) From the results it is clear that, compressive strength increases to 37.5 N/mm^2 with 30% replacement of cement with ceramic waste.
2) Flexural strength increases to 45.09 N/mm^2 with 15% replacement of cement with ceramic waste and glass fibers.
3) For 15% replacement of cement with ceramic waste and 1% of glass fibers to the weight of cement, flexural strength increased up to 60% when compared to conventional concrete.
4) For 30% replacement of cement with ceramic waste, flexural strength increased up to 9% when compared to conventional concrete.
5) 15% is the optimum content and 30% is minimum for the flexural strength.

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