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Study of Green Concrete: Case Study

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ABSTRACT: *Green Concrete is a resource-saving structure that reduces environmental impact, carbon dioxide emissions, and waste water. Here comparative evaluation of strength and durability properties of conventional concrete and green concrete incorporating recycled coarse aggregates and fly ash. In the laboratory total of three series of concrete mixtures were prepared. Series I, II and III were prepared with the water to cement (W/C) ratio of 0.3, 0.4 and 0.5 respectively. Each Series, comprises of 3 concrete types named as conventional concrete mixture with 0% RCA and 0% fly ash indicated by notation R0. Recycled concrete mixture with 50% RCA and 0% fly ash indicated by notation R50. And green concrete mixture with 50% RCA and fly ash was incorporated as 25% replacement to cement indicated by notation R50F25. As per IS 10262 1982 and IS 456 the mix design of concrete for all mix proportions is done. A marginal reduction in compressive strength and tensile strength has been noticed in the case of green concrete (10 to 12%). And this may be due to lesser angularity index of recycled aggregates. A large reduction in tensile strength of 25% was noticed in recycled aggregate concrete compared to conventional concrete. This may be attributed to less binding of aggregates in the case of recycled aggregate concrete. Results shows that water absorption, Chloride ion permeability and sorptivity of concrete [R50] increased due to the intrinsic porosity of RCA compared to conventional concrete [R0]. And water absorption, chloride ion permeability and sorptivity of green concrete [R50F25] is almost same as conventional concrete [R0]. This is due to the pozzolanic action of fly ash present in green concrete. Green concrete shows Moderate rate of chloride ion permeability for W/C of 0.3 and 0.4 slightly high rate of chloride ion permeability for W/C of 0.5.*

KEYWORD: *Green Concrete, water to cement, recycled coarse aggregates and fly ash, compressive strength, tensile strength.*

INTRODUCTION

Green concrete name easily gives an illusion of something related to the color of the substance or the product. But this logic is nowhere in picture as the product has no resemblance to the green colour. Normally in the production of cement there is emission of carbon-di-oxide. The cement industry is also in question to lower its co2 emission as to rising global concerns. The connection between the cement industry and concrete industry is very evident as the latter cannot be produced with the former. So, Green concrete can also be an answer to those concerns. As this world is developing so fast it is next to impossible to replace concrete industry, it is evident from the fact that it is one among the largest industries providing economy capital and employment.

The only way-out is to find an alternative which can bring a balance between the development and the environmental concerns. That is why green concrete is catching eyeballs of various analyst worldwide “Denmark” being the first among them. Checking the possible ways to get green

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concrete in work will certainly boost the development process without hampering the current growth rate.

Green concrete is also comparably cheap to manufacture, as, for example, waste products are used as a partial substitute for cement portion, costing for the disposal of waste are avoided, energy consumption of materials in manufacturing period is lower, while durability is greater. Green concrete is a new form to the existing (regular) types of concrete which resembles the conventional concrete but its manufacturing or usage of this concrete requires minimum amount of heat energy and causes the minimal destruction or damage to the surrounding environment.

LITERATURE REVIEW

Literature review on the works carried out by earlier researchers on strength and durability properties of green concrete is conducted. The summary and gap of literature are discussed below.

Summary of Literature:

Utilization of industrial waste like fly ash can be made to improve the various properties of recycled aggregate concrete. The results from previous studies showed that mechanical properties like compressive strength, tensile strength and modulus of elasticity of concrete at all the ages reduced as the percentage of recycled aggregates and fly ash increased. With the 40% use of recycled coarse aggregates in concrete, workable and good strength concrete can be obtained. Durability properties of recycled aggregate concrete can be improved by incorporation of fly ash in concrete. The results from previous studies also showed that one of the helpful ways to use a high percentage of recycled aggregate in structural concrete is by incorporating 25–35% of fly ash as some of the disadvantages induced by the utilization of recycled aggregates in concrete could be reduced.

Gap in Literature:

Previous studies also showed that drawbacks of recycled aggregate concrete can be improved by incorporating certain amount of fly ash. It can be used as replacement for cement or as an additional cementitious material in concrete. In the present study use of fly ash as partial cement replacement is presented. The effect of Recycled coarse aggregates and fly ash on strength and durability properties are investigated.

Experimental Study 25 M And Experiment:

STRENGTH ANALYSIS CONVENTIONAL CONCRETE M25

Cement + Aggregates (Fine + Coarse) + Water

GREEN CONCRETE MIX M25

I. Cement 50% replaced by Fly Ash

II. Aggregates

Portion of Fine Aggregates is remained in same quantity as Conventional Concrete Proportion.

Portion of Coarse Aggregates is remained in same quantity as Conventional Concrete Proportion.

WATER

Same Quantity of water to be used as per the mix of conventional concrete. (Water/Cement Ratio Taken: 0.5)

MATERIALS

Cement: cement of 53 grade confirming to grade IS 8112- 1989 is used of specific gravity 3.1.

Fly ash: fly ash of Class F grade collected and used in this study. From test Specific gravity of the fly ash was found to be 2.16.

Fine aggregates: In the present Work crushed stone aggregates were used of gradation zone II and specific gravity 2.7.

Natural Coarse aggregates: In the present work, crushed stone aggregates of size 20mm down were used of specific gravity 2.66 and water absorption 0.3%.

Recycled coarse aggregates: In the present work, crushed recycled concrete aggregates collected from demolished building of size 20mm to 4.75mm were used of specific gravity 2.2 and water absorption 3.02%.

Concrete Mixtures:

In the laboratory total of three series of concrete mixtures were prepared. Series I, II and III were prepared with the water to cement (W/C) ratio of 0.3, 0.4 and 0.5 respectively. Each Series, comprises of 3 concrete types named as conventional concrete mixture with 0% RCA and 0% fly ash indicated by notation R0. Recycled concrete mixture with 50% RCA and 0% fly ash indicated by notation R50. And green concrete mixture with 50% RCA and fly ash was incorporated as 25% replacement to cement indicated by notation R50F25.

COMPRESSIVE STRENGTH TEST

The hardened concrete sample were tested for strength determination as per IS 516-1959 “METHODS FOR TEST FOR STRENGTH OF CONCRETE”. Concrete cubes of size 150 mm × 150 mm × 150 mm were cast with and without granite dust and steel slag. After 24 hours, the specimens were demolded and subjected to curing for 7, 14, 28 days in portable water. After curing, the specimens were tested for compressive strength using universal testing machine. The maximum load at failure was taken. The average compressive strength of concrete specimens was calculated by using the following equation.

Fig. 1: Compressive Strength Testing

COMPARISION B/W CONVENTIONAL CONCRETE AND GREEN CONCRETE-50% REPLACEMENT

Table 1

	7days Strength	28days Strength
Conventional Concrete		
Sample 1	22.454	**27.923**
Sample 2	22.001	**29.767**
Sample 3	21.105	**28.963**
Avg Strength	**21.853**	**28.884**

Table 2

Green Concrete (50%flyash in place of cement)		
Sample 1	20.321	**23.814**
Sample 2	18.159	**22.835**
Sample 3	18.180	**24.504**
Avg Strength	**18.887**	**23.730**

CONVENTIONAL CONCRETE AND GREEN CONCRETE-25% REPLACEMENT

Table 3

	7days Strength	28days Strength
Conventional Concrete		
Sample 1	21.856	**26.987**
Sample 2	21.921	**29.172**
Sample 3	22.211	**29.438**
Avg Strength	**21.996**	**28.532**

Table 4

Green Concrete (25%flyash)		
Sample 1	19.567	**24.213**
Sample 2	20.005	**24.462**
Sample 3	19.792	**24.118**
Avg Strength	**19.788**	**24.264**

CONCLUSION

- For a given W/C ratio the green concrete has shown lower workability than the conventional concrete. And this may be due to moisture absorption of recycled aggregates.
- A marginal reduction in compressive strength and tensile strength has been noticed in the case of green concrete (10 to 12%). And this may be due to lesser angularity index of recycled aggregates.
- A large reduction in tensile strength of 25% was noticed in recycled aggregate concrete compared to conventional concrete. This may be attributed to less binding of aggregates in the case of recycled aggregate concrete.
- Results shows that water absorption, Chloride ion permeability and Sorptivity of concrete [R50] increased due to the intrinsic porosity of RCA compared to conventional concrete [R0]. And water absorption, chloride ion permeability and Sorptivity of Green concrete [R50F25] is almost same as conventional concrete [R0]. This is due to the pozzolanic action of flyash present in green concrete.
- Green concrete shows Moderate rate of chloride ion permeability for W/C of 0.3 and 0.4 slightly high rate of chloride ion permeability for W/C of 0.5
- Green concrete results in better performance and durability which ensures long lifetime concrete and can be used for conventional use for the structures with important factor 1 and 1.2 as per IS 1893-2016.

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