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EXPERIMENTAL STUDY ON MECHANICAL AND DURABILITY PROPERTIES OF CONVENTIONAL CONCRETE AS A PARTIAL REPLACEMENT OF IRON ORE WITH AND WITH OUT USE OF GLASS FIBER

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ABSTRACT

Plain concrete possess very low tensile strength, limited ductility and little resistance to cracking. Internal micro cracks are inherently present in concrete and its poor tensile strength is due to propagation of such micro cracks. To increase the tensile strength some of the materials will be added. We are using the material iron ore and admixture like glass fibres as a replacement of fine aggregate in different proportions in the concrete to improve the physical and chemical properties like density, compressive strength, tensile strength and strain properties as well as crack resistance, ductility as flexure strength and toughness.

This iron ore is locally available material that leaving in environment can cause the environment problem. So, revising the waste has be stressed. The waste product can be used as replacement of ingredients as well as admixtures by using the waste products the impact of waste on the environment is minimized.

In recent times, admixture like glass fibers have also become available, which are free from corrosion problem associated with steel fibers. Also, aiming the use of iron ore and admixture (glass fiber) as fine aggregate replacement.The present experimental investigation were carried on iron ore and glass fiber has been chemically and physically characterized, and partially replaced in the ratio of iron ore content (0%, 5%, 10%, 15%, 20% and 25%) and admixture (glass fiber) content (0%, 0.25%, 0.5%, 0.75%, 1%) exposure periods of 7, 14, 28, 56, and 90 days on the compressive, and split tensile strength tests of concrete were investigated and also obtained durability aspect of iron ore and admixture (glass fiber) concrete for sulphates attack was tested. The specimens are cured in H_2SO_4 solution for concentrations of 1%, 3%, 5% for exposure periods of 7, 14, 28, 56 & 90 days, and the strengths of concrete at these ages were
investigated. The result indicates that the iron ore and admixture like glass fiber fines used could satisfactorily replace the sand up to 10% iron ore and 0.5% admixture (glass fiber).

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I. INTRODUCTION

Concrete is most widely used construction material in the world due to its ability to get cast in any form and shape. It also replaces old construction materials such as brick and stone masonry. The strength and durability of concrete can be changed by making appropriate changes in its ingredients like cement material, aggregate and water and by adding some special ingredients.

Concrete is a composite material containing hydraulic cement, water, coarse aggregate and fine aggregate. The resulting material is a stone like structure which is formed by the chemical reaction of the cement and water. This stone like material is a brittle material which is strong in compression but very weak intension. This weakness in concrete makes it to crack under small loads, at the tensile end. These cracks gradually propagate to the compression end of the member and finally, the member breaks. The formation of cracks in the concrete may also occur due to the drying shrinkage. These cracks are basically micro cracks. These cracks increase in size and magnitude as the time elapses and the finally makes the concrete to fail. The formation of cracks is the main reason for the failure of concrete. There is a possibility of replacing the fine aggregate with iron ore is useful for the development of high density concrete and to increase the tensile strength of concrete may attempts have been made by partial replacement of admixture (glass fiber) in place of fine aggregate.

Investigations have been made by partial replacement of iron ore and admixture like glass fiber in place of fine aggregates. Also revealed that with proper proportioning of iron ore and admixture like glass fiber the required strength can be achieved at 7, 14, 28, 56 & 90days.

Using the iron ore as a replacement of fine aggregate (0%, 5%, 10%, 15%, 20%, 25%) and admixture (glass fiber) content (0%, 0.25%, 0.5%, 0.75%, 1%) in the concrete will give adverse effect on the properties of the concrete that to the increase in compressive strength, tensile strength compared to the conventional concrete.

II. LITERATURE REVIEW

The Future Concrete: High Density Concrete

Authors: Liana Iures and Corneliue bob.

Discussions:

- Fly ash can replace a significant part of the necessary filler when used into a High Density Concrete Composition.
- The elimination of vibrating equipment improves the environment protection. Near construction and precast sites where concrete is being placed, reducing the exposure of workers to noise and vibration.
- HDC is favourably suitable especially in highly reinforced concrete members like bridge decks or abutments, tunnels linings or tubing segments, where it is difficult to vibrate the concrete, or even for normal Engineering structures.

Study on Durability Characteristics of High Density Concrete with Fly Ash:

Authors: Dhiyaneswaran.S., Ramanatham.P, Bhaskar.I, Suresh.P.

Discussions:

- The Acid resistance of HDC with fly ash was higher when compared with concrete mixes without fly ash at the age of 28, 56 and 90 days.
- Compressive strength loss decreases with the increase of fly ash.
- When the specimen is satured is immersed in sodium sulphate solution for 28, 56 and 90 days.
- The average reduction in weight increases and weight is decreased when fly ash is increased in concrete.

III. EXPERIMENTAL ANALYSIS

Cement: (ANJANI cement of 43grade ordinary Portland cement was used)

Ordinary Portland cement (43 grade) available in the local market of standard brand was used in the investigation. Portland cement is most commonly used type of cement in the world today. Care has been taken that it has to be stored in airtight containers to prevent it from being affected by the atmospheric and monsoon moisture and humidity.

Fine Aggregate (Sand):

The size of the fine aggregate is below 4.75mm, natural sand used as the fine aggregate in concrete mix. Sand may be obtained from rivers, lakes but when used in concrete mix, it should be properly washed and tested to ascertain the total percentage of clay silt, slit and other organic matters does not exceed the specified limit.

Coarse Aggregate:

The material whose particles of size retained on i.s. sieve no. 4.75mm is termed as coarse aggregate. The size of coarse aggregate depends upon the nature of the work. The coarse aggregate used in the experimental investigation is 20mm size, crushed on angular in shape. The aggregates are free from dust before used in the concrete.

Iron Waste:

Iron waste is a kind of waste material that is generated from the cutting of iron strips in the welding shops it is abundantly available in the world from various aspects which has landfill disposal problems and health and environmental hazards. The present study is an attempt to experiment on use of iron waste that is from cutting of iron strips to replace in concrete.

Glass Fibers:

The glass fiber use shall be high-quality alkaline-resistant glass fiber which is designed to reinforce cementanious and other alkaline matrix glass fibers used in our project work are cem-fil anti-crack high dispersion glass fibers which are manufactured venkateswara glass wares pvt ltd.

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IV. TESTS CONDUCTED

COMPRESSIVE STRENGTH OF CONCRETE SPECIMENS:

In this study, the compression testing machine CTM having capacity of 3000kn was used for compressive strength of the concrete cubes.

COMPRESSION TESTING MACHINE

The measured compressive strength of the specimen shall be calculated by dividing the maximum load applied to the specimen during the test by the cross sectional area calculated from mean dimensions of the section and shall be expressed to the nearest kg/cm^2, average of all values shall be taken as the representation of the batch provided and individual variation is not more than that -15 percent of average.

Compressive Strength = Max. Load/Area = (W/A)

Where, W = Maximum Load on Cube

A = Effected cross sectional area

Final values are adopted using standard deviations.

SPLIT TENSILE STRENGTH:

The splitting tests used for determining the tensile strength of concrete sometimes referred to as split tensile strength of concrete

This test is Compression–testing machine by placing the cylindrical specimen horizontally, so that its axis is horizontal between the plates of the testing machine. The load is applied uniformly at a constant rate until failure by splitting along the vertical diameter takes place. Load at which the specimen failed is recorded. Test is performed as per IS: 5816-1970.

The Split Tensile strength of cylinder specimens of size 150 mm X 300 mm. The cylinders were tested by placing them uniformly. Specimens were taken out from curing tank at the age of 7, 14, 28, 56 and 90 days of moist curing and tested after surface water dipped down from specimens. This test was performed on Testing Machine as shown in figure.

Split tensile strength (f_s) = (2W)/(πLD)

Where, W = Maximum Load on Cylinder
L = Length of the Cylinder
D = Diameter of the Cylinder
d = Depth of the Prism

DURABILITY:

In present project, the durability tests are conducted by partial replacement of iron ore and admixture like glass fibre mineral such as, sulphuric acid. The response of sulphuric acid attack on concrete for various percentages was studied by observations like loss in strength .For conducting these tests; concrete cubes with different percentages were casted. These cubes were immersed in 1% 3%, 5% solutions of sulphuric acid for different periods of 7, 14, 28, 56days and 90days, and deterioration was studied by means of loss of strength.

V. CONCLUSIONS

Based on the experimental study concrete for M30 grade concrete, the following conclusions are drawn:

1. The compressive strengths of concrete (with 0%, 5%, 10%, 15%, 20%, and 25% of weight replacement of FA by iron ore and 0%, 0.25% , 0.5%, 0.75%, 1% of admixture) cured in Normal water for, 7, 14, 28, 56 and 90 days have reached the target mean strength.
2. The Split tensile strength of concrete (with 0%, 5%, 10%, 15%, 20%, and 25% of weight replacement of FA by iron ore and 0%, 0.25% , 0.5%, 0.75%, 1% of admixture) cured in Normal water for, 7, 14, 28, 56 and 90 days have reached the target mean strength.
3. Based on the test results, the optimum value is found and it indicate that at 10% of iron ore and 0.5% of admixture replacement there is an increase in compressive strengths and split tensile strengths beyond that the strength decreases.

4. The target mean strength achieved mostly at 10% replacement of sand with iron ore. At this dose, by the use of glass fiber , it indicate at 0.25% replacement there is increase in strength and it extended in 0.5% replacement.
5. Decrease in strength is noticed at 0.75% and 1% replacements. The maximum strength obtained at 0.50% and starts decreases.
6. The compressive strengths of concrete cured in different concentrations of (1%, 3%, 5%) Sulphuric acid solution for 7, 14, 28, 56 and 90 days indicate that at 1% of sulphuric acid there is increase in strength and beyond that the strengths decreases.
7. The strength decreases in acidic environment with age of concrete also with increasing of FA content in concrete.

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