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STRENGTH CHARACTERISTICS BY PARTIAL REPLACEMENT OF GLASS POWDER AND RED SOIL AND DEMOLISHED CONCRETE

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ABSTRACT

Generally cement industryis producing 0.87 tons of $CO_2$for production of one ton of cement, 7% of the world`s CO_2 emission is attributable to Portland cement only, because of this there is a significant impact to the environment.The global warming is caused by the emission of green house gases, such as CO_2, to the atmosphere. Among the greenhouse gases, CO_2 contributes about 65% of global warming. The global cement industry contributes about 7% of greenhouse gas emission to the earth's atmosphere. Because of this industry a high consumption of natural resources like limestone, fly ash etc, Hence it is important to reduce cement consumption in the construction industry. In order to address environmental effects associated with cement manufacturing, there is a need to develop alternative binders to make concrete. Apart from this red soil can be made alternative to the fine aggregate and glass powder can be made alternative to the cement and demolished concrete blocks can be made alternative to the coarse aggregate.

The current work is carried out to compare the strength characteristics of conventional concrete replaced with waste glass powder as partial replacement of cement and also red soil as partial replacement of fine aggregate and recycled concrete block pieces as partial replacement of coarse aggregate. The work is carried out with M25 grade concrete with w/c ratio 0. 45 as a control specimen and the glass powder, red soil, recycled concrete block pieces is placed by cement, fine aggregate, coarse aggregate in the range from 0% to 40% with 10% increment by weight of cement, fine aggregate, coarse aggregate.

The compressive, split tensile strengths are determined at different days of curing. A total of 45 cubes, 30 cylinders were casted for M25 grade concrete respectively. Test was conducted to study the properties of concrete in hardened state like compressive, split tensile. The slump And compaction factor test values from 0% to 40% partial replacements in cement, fine aggregate, coarse aggregate with glass powder, red soil, demolished concrete blocks are detailed according to IS-1199-1959.

Keywords: *Glass powder, Red soil, Demolished Concrete blocks.*

I. INTRODUCTION

This work examines the possibility of using Glass powder as a partial replacement of cement for new concrete. Glass powder was partially replaced as 10%, 20%, 30% and 40% and tested for its Compressive, Split Tensile strength up to 28 days of age and were compared with those of conventional concrete; from the results obtained, it is found that glass powder can be used as cement replacement material up to particle size less than 75µm to prevent alkali silica reaction. In India, 0.7% of total urban waste generated comprises of glass.

In this present investigation, red soil is taken as an admixture to enhance the performance of concrete. An experimental investigation is carried out to study the behavior of concrete by replacing the fine aggregate with locally available red soil. The partial replacement of sand with red soil has been done according to the specific mix proportion to gain good strength in concrete. Red soil is rich in iron oxide, but deficient in nitrogen and lime. Its colour is mainly due to ferric oxides occurring as thin coatings on the soil particles while the iron oxide occurs as hematite or as hydrous ferric oxide, the colour is red and when it occurs in the hydrate form as limonite the soil gets a yellow colour. Red soil is a porous and friable structure. Red soil is a fine soil which holds large amount of water than the coarse soil. In red soil mixed concrete, porosity is higher than plain concrete but the permeability is low in red soil compared to the plain concrete. Due to tiny pores in fine soil it can hold water tighter in small pores, so that it is low in permeability it resists the fluid passage, hence it is impervious. Red soils denote the second largest soil

group of India covering the area of about 6.1 Lakes sq.km. The local available natural red soil is the most alternatives material of the construction industry.

Concrete is made up of materials such as cement, fine aggregates, coarse aggregates and water. Generally, aggregates are collected by cutting mountains or breaking river gravels or boulders, or by breaking clay bricks. A significant amount of natural resources can be saved if the demolished concrete is recycled for new constructions In addition to the saving of natural resources, recycling of demolished concrete will also provide other benefits, such as creation of additional business opportunities, saving cost of disposal. At present, the amount of global demolished concrete is estimated at 2–3 billion tons. Sixty to 70 percent of demolished concrete is used as sub base aggregate for road construction. By recycling of demolished concrete, 20% of normal aggregates can be saved. Recycling of concrete is needed from the viewpoint of environmental Preservation and effective utilization of resources. In the present construction world, the solid waste is increasing day by day from the demolitions of constructions. There are some researchers are also going on solid waste from construction to reuse them again in the construction to reduce the solid waste and to preserve the natural basic aggregates. These researches promotes to use the recycled aggregates in the concrete mix and they got good result when adding some extent percentages of recycled aggregates in place of natural coarse aggregate. This waste is not recycled in any form at present, however the ceramic waste is durable, hard and highly resistant to biological, chemical and physical degradation forces so, we selected these waste demolished concrete as a replacement material to the basic natural aggregate to reuse them and to decrease the solid waste produced from demolitions of construction.

Hendricks and Pieterson prepared concrete in which up to 20% natural aggregate was replaced with recycled aggregate and noticed a little effect on the properties of resulting concrete and that the concrete strength decreases when recycled aggregate was used. Their recycling ratio is close to 100%, and it is also used in concrete without adverse effects in concrete durability. Therefore, it is considered ideal for recycling Recently, Glasses and its powder has been used as a construction material to decrease environmental problems. Waste and by-products have been introduced into Indian concrete industry to conserve natural resources and environment as well as to reduce the cost of concrete. As an example, glass powder, a byproduct from thermal power plants, has been widely used in Indian concrete industries as a pozzolanic material for replacing a part of cement due to its main benefits on workability and durability.

This study could be a part of comprehensive program whereby experimental investigations are administered to gauge the result of partial replacement of coarse combination by dismantled waste on compressive strength and workability of DAC (Demolished combination Concrete) because the dismantled combination is lighter than the natural combination, therefore, the concrete made of such combination possesses rarity, however, the water absorption of the dismantled combination is the natural combination and also the strength of the dismantled aggregates is somehow lesser than the natural aggregates. This study also aimed to find the effect of age of demolished concrete powder in partial replacement of cement. The grading of aggregate conformed to the requirement as per IS: 383-1970.

II. METHODOLOGY

Slump test:
It was observed from the Slump test which is a test conducted to measure the workability of the concrete, the workability of concrete was decreased by the increase in the percentage replacement of cement with glass powder, fine aggregate with red soil, coarse aggregate with demolished concrete blocks by weight.

Cube Compression test:
At the end of 7^{th} ,14^{th} and 28^{th} day of curing the cubes specimens were removed from curing tank and kept exposed to laboratory environment till the surface becomes dry. Cube specimens were tested for compressive strength under compression testing machine as per IS 9013(1978) Indian standard. Specimens were placed under compression testing machine in a direction perpendicular to the direction in which they were cast. Rate of loading is maintained at 140kg/sq.cm/min. the average of 3 cubes is taken as compressive strength.

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Figure 1: Cube compression Test

Cylinders Split tensile test:
At the end of 7th, 14th and 28th day the cylinders were removed from curing tank and they were kept exposed to laboratory environment, till the surface becomes dry. And the cylinders were compression testing machine as per IS 9013 (1978) Indian standard. Specimens were placed under compression testing machine in a direction perpendicular to the direction in which they were cast. Rate of loading is maintained at 140kg/sq cm/min. the load at which the cylinder specimen ultimately fail is noted. The average of two cylinders is taken as splitting tensile strength the test.

Figure 2: Split Tensile test

III. MATERIALS

Cement (53Grade OPC), Fine aggregate (F.A),Coarse aggregate (C.A) , Glass powder (G.P) , Red soil (R.D) , Recycled concrete block pieces (R.C.B.P).

***Cement* :** Ultra –tech OPC 53 grade was used in this study.

Fine aggregate (F.A):Good quality zone-II fine aggregates were used, The sieve analysis **Coarse aggregate (C.A):** In the present investigation aggregate available from local crusher was used. Two size fractions i.e. 20mm and 25mm down size basalt coarse aggregate were used. Different tests such as specific gravity, bulk density etc were carried out in laboratory for basalt coarse aggregate. Results and physical properties of fine aggregate used.

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Glass powder (G.P):The waste glass pieces were brought from the local glass cutting and polishing unit. The glass pieces were powdered to required size before adding. In this experimental study glass powder passing 90 micron sieve is used and having the specific gravity 2.91.

Red soil (R.S): The Red soil was brought from local area. The Red soil required size before adding. In this experimental red soil passing 90 micron sieve is used and having the specific gravity 2.6.

Water: In the present study potable water was used for both casting and curing of specimens.

Concrete Mix Design by IS Method:
An Indian standard institute has brought out mix design procedure mainly work done in national laboratories i.e. covered in IS 10262-2009. This method can be applied to both medium strength and high strength. Grade of concrete mix i.e. M25 were designed using IS method of mix design.

IV. RESULT & DISCUSSION

Compressive strength: Compressive strength is calculated by using compression testing machine 150X150X150mm concrete cubes. The cubes are cured for 7, 14,28 days. It seen that the maximum compression test for 7 days is 28.2 N/mm^2 for 20% replacement of Glass powder, Red Soil and Demolished concrete blocks for 14 days curing the maximum value is 30.8 N/mm^2 for 20% replacement for 28days of curing 34 N/mm^2 for the same dosage.

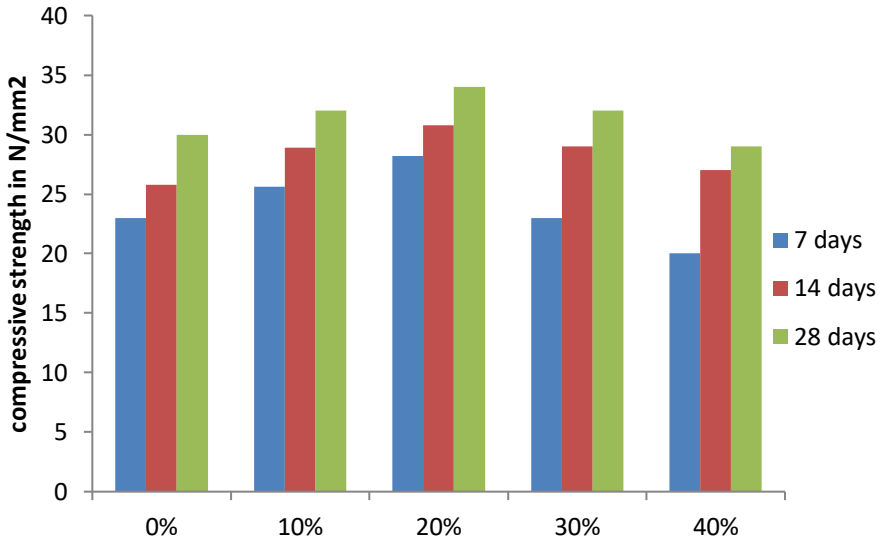

Figure 3: Replacement of glass powder, Red soil, demolished concrete blocks

Split tensile strength: The cylinders are cured for 7, 14,28 days. It seen that the maximum compression test for 7 days is 1.8 N/mm^2 for 20% replacement of Glass powder, Red Soil and Demolished concrete blocks for 14 days curing the maximum value is 2.6 N/mm^2 for 20% replacement for 28days of curing 3.7 N/mm^2 for the same dosage.

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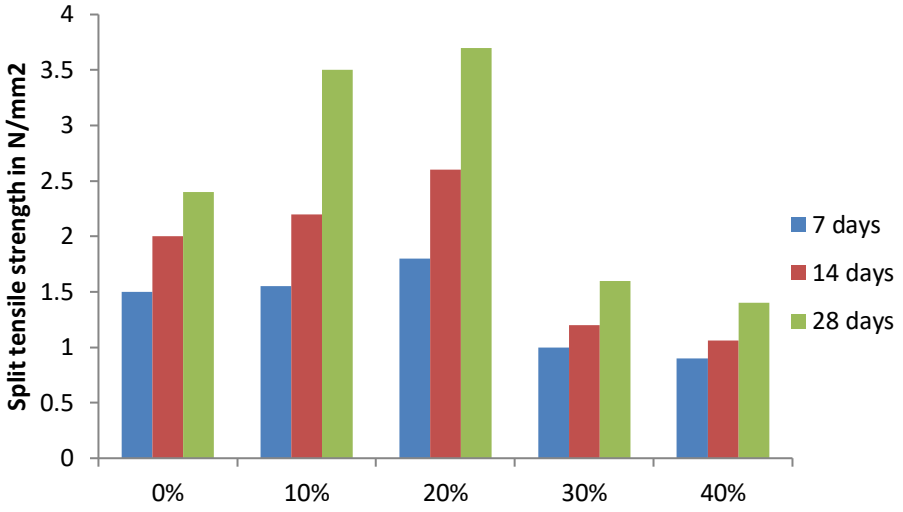

Figure 4 : Replacement of Glass powder, Red soil, Demolished concrete blocks

V. CONCLUSION

- For replacing cement by glass powder, fine aggregate with red soil, coarse aggregate with demolished concrete blocks the optimum value is 20%.
- The workability of concrete reduced with increase in replacement of cement by glass powder, fine aggregate with red soil, coarse aggregate with demolished concrete blocks.
- Glass powder concrete increases From the above mentioned work of various researchers and our present experimental work, it is clear that glass can be used as a partial replacement of cement in concrete because of its increased workability, strength parameters like compressive strength, flexural strength and split tensile strength and also because of its increased durability measured by water absorption test.
- As disposal of waste by-products problem is a major problem in today's world due to limited landfill space as well as its escalating prices for disposal, utilization of waste glass in concrete will not only provide economy, it will also help in reducing disposal problems. the compressive, tensile and flexural strength effectively, when compared with conventional concrete.
- The compressive strength for 28 days of testing after curing is 34 N/mm2 which is maximum at 20% of dosages.
- The split tensile strength for 28 days of testing after curing is 3.7 N/mm2 which is maximum at 20% of dosages. The dosage of 20% which got maximum strength is used for road construction.

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