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BEHAVIOUR OF CONCRETE USING GGBS AND VERMICULITE AS PARTIAL REPLACEMENT FOR CEMENT AND FINE AGGREGATE

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Abstract— Concrete is the most widely used construction material in Civil Engineering industry because of its high structural strength and stability. The main ingredient in the conventional concrete is Portland cement. The amount of cement production emits approximately equal amount of carbon dioxide into the atmosphere. GROUND GRANULATED BLAST SLAG (GGBS) is a new mineral admixture, whose potential is not fully utilized. Blast Furnace slag has been used extensively as a successful replacement material for Portland cement in concrete materials. M30 grade concrete are used. Vermiculite extremely has low density and thermal conductivity continue to use in concrete over other filler materials. Various mix combinations with a partial replacement of 25% and 30%, 40% by GGBS and Vermiculite. This replacement had proved to have some economic benefits as well as time effective in concreting for the future. Vermiculite in concrete that can be used for improving shrinkage, crack resistance, fire resistance and reduces environmental impact and also reduce the cost. The concrete cubes are cast and test for compressive strength after curing period of 7 &28 days.The integrated approach of working on safe disposal and utilization can lead to advantageous effects on the ecology and environmental also.

Keywords: Coarse,aggregate,cement-GGBS,fine aggregate,vermiculite.

I. INTRODUCTION

In the recent years, there is great development in the area of admixtures and now a day, the pozzolanic admixtures like fly ash, micro silica are commonly used to enhance performance characteristics of concrete. When concrete may be used for some special properties are more important than those commonly considered. Ordinary Portland cement (OPC) is one of the main materials used in casting reinforced concrete (RC) structures. The replacement of Portland cement with GGBS will lead to a significant reduction of carbon dioxide gas emission. Economics, energy and environmental considerations have had the role in the mineral admixture usage as well as better engineering and performance properties. Some of the recent studies in various parts of the world have revealed that Ground granulated blast furnace slag concrete can protect 1.2 the steel reinforcement more efficiency.GGBS is therefore an environmentally friendly construction material.

Aggregates generally occupy 60 to 80 percent of volume of concrete. River sand is most commonly used fine aggregate in the production of concrete poses the problem of acute shortage in many areas. In recent development the lightweight concrete is a versatile materials, which

offers a range of technical, economic and environmental advantages and is designed to a become vermiculite.

1.1 GROUND GRANULATED FURNACE SLAG

Ground Granulated Blast Furnace Slag is obtained from making of iron. This is one type of blast furnace slag.GGBS and finely ground pelletized slag are marketed separately to the concrete producer and used as a partial replacement for Portland cement. It is a granular product with very limited crystal formation, is highly cementations in nature and, ground to cement fines, and hydrates like Portland cement. It has been supplies by Astra Chemicals in Chennai.

1.2 APPLICATION OF GGBS

Ground Granulated Blast Furnace slag is used in mix concretes and it is utilized in the concrete mixes also. Usually used for building construction.

1.3 ADVANTAGES OF GGBS

GGBS is used to made durable concrete structures in combination with Ordinary Portland cement and other Pozzolanic materials.GGBS has been widely used in Europe, and increasingly in the United States in Asia for its superiority in concrete durability, extending the lifespan of buildings from fifty years to a hundred years.

Two major uses of GGBS are in the production of quality improved slag cement. Blast Furnace cement and high slag blast –furnace cement, with GGBS content ranging typically from 30 to 70% and in the production of ready mixed or site –batched durable concrete.

Concrete made with GGBS cement sets more slowly than concrete made with Ordinary Portland cement, depending on the amount of GGBS in the cementations material, but also continues to gain strength over a longer period in production conditions. This results in lower heat of hydration and lower temperature rises, and makes avoiding cold joints easier, but may also affect construction schedules where quick setting is required.

1.4 VERMICULITE

Vermiculite is used as a replacement of fine aggregate. Vermiculite is a phyllosilicate mineral group. It was incorporated into home insulation products branded zonolite attic insulation in Canada. It belongs to the family of light weight aggregates. A decreased density for the same strength level reduces the self weight. It has high silica content and this lets out a strong constrain for replacing sand and good in bonding, covering of voids. It is typically platelets and its diameter is ranging from 0.04μ to 4mm. The particle shape and size mainly depended on the mineralogical phases and collection system. Characteristics of vermiculite is mainly based on its color may be brown to golden brown, can also be white or yellow.

Used as an aggregate with Portland cement it forms an ultra lightweight concrete with an open structure idea for void filling suitable for use in most light industrial and domestic applications where thermal insulating and fire proof properties are required use around flue linings, behind fire backs and around pipes when fitting room heaters. Various types of vermiculite are available such as crude vermiculite, parabola vermiculite, and expanded vermiculite.

A surface texture with tiny and uniformly distributed pores is preferred. Particle size and shape as well as surface condition of aggregate influence properties of fresh concrete. The strength of the lightweight aggregates particle decreases with decreasing density. On being suddenly heated to a high temperature of about 700-1000 C, the flakes expand due to steam forcing the lamination apart. The material produced consists of accordion granules containing many minute air layers.

1.5 APPLICATION OF VERMICULITE

Vermiculite is a hydrous phyllosilicate mineral. It undergoes significant expansion when heated. Exfoliation occurs when the mineral is heated sufficienty, and the effect is routinely produced in commercial furnaces. Vermiculite is always used in the horizontal sector in its exfoliated form and it has the benefits of improving soil aeration while added aeration while retaining moisture and nutrients to feed roots, cuttings and seeds for faster, maximum growth. It soil for conditioning and lightening either alone or in conjunction with compost. This will accelerate the growth and promote anchorage for tender young root systems.It is approved for both internal and external use, as well as acoustic and heat applications.

II. MATERIAL USED

Material that go for making concrete for this study were tested before casting the specimens. The properties obtained from the tests were used in mix design.
The preliminary tests were conducted for the following materials.

2.1 GROUND GRANULATED BLAST FURNACE SLAG (GGBS)

The Ground Granulated Blast furnace used in research obtained from Bhilai steel plant. Ground granulated blast-furnace slag is the granular material formed when molten iron blast furnace slag is rapidly chilled by immersion in water. It is a granular product with very limited crystal formation, is highly cementations in nature and, ground to cement fineness, and hydrates like port land cement. The specific gravity of GGBS is 2.85.

Fig.1.GGBS

2.2 VERMICULITE

Vermiculite is a hydrous phyllosilicate mineral. It undergoes significant expansion when heated. Vermiculite is chosen to replace fine aggregate in concrete because of its specific properties such as it is lighter in weight, improved fire resistance, improved resistance to cracking and shrinkage and mainly inert chemical nature. Vermiculites taken for concrete preparation which pass through 2.36mm sieve size. Vermiculite is used filler material and it is obtainable in golden brown, can also be white, colorless or yellow. Modern civil and industrial construction makes ever greater demands for building material for a variety of parameters such as less weight, efficiency, durability, environmental, fire safety, etc. To a large extent all the above qualities has modern building material expanded vermiculite. Due to its porous structure, expanded vermiculite is an excellent heat and sound insulator.

Fig.2. vermiculite

III. Mix Design for M30 grade

Cement	=366kg/m3
Water	=140 kg/m3
Fine aggregate	=873 kg/m3
Coarse aggregate	=1166kg/m3
Water cement ratio	= 0.40

IV. CASTING AND TESTING OF CUBES

The quantities as per mix design are mixed with care and concrete cubes of size (150mmx150mmx150mm).The concrete specimens are cured for 7, 14 and 28 days in laboratory. Then concrete cubes are tested in laboratory to get their compressive strength values for various proportions.

Fig.3. Casting of cube.

Testing of cube specimen:

After curing harden concrete is tested in compression testing machine. The testing of cube is done for 7, 14, and 28 days.

Compression strength test is the most test conducted on hardened concrete, because it is easy to test and desirablecharacteristic properties of concrete are measured.

The cube specimen is of the size (150mmx150mmx150mm) isused for testing. The compressive strength test of concrete is done by using compressive testing machine. The specimen is placed in compression testing machine in such a way that loadapplied gradually in cast surface. The load at failure has been noted.

Compressive strength=(Failure load/Cross sectional area (N/mm2)

Compressive testing machine:

Fig.4. Compressive testing machine

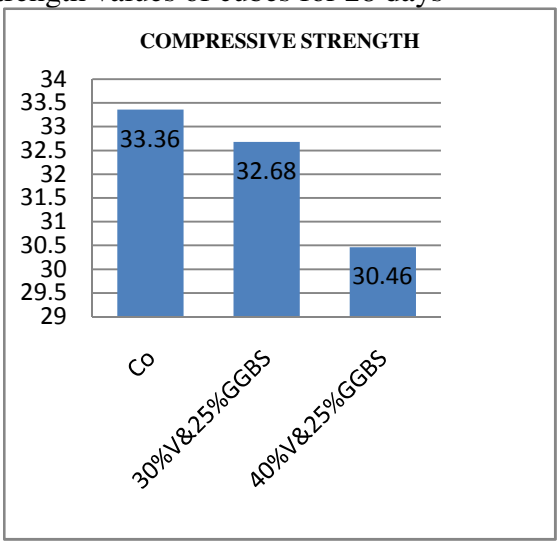
V. RESULT AND DISCUSSION:

TEST RESULTS OF COMPRESSIVE STRENGTH:

Compressive strength of concrete with various mix combination is determined at 7, 14 and 28 days for M30 grade of concrete.

The result of compressive strength are given below in table:

Compressive strength values of cubes for 28 days



CONCLUSION

- Based on the experimental investigation , it is found that GGBS and Vermiculite can be used as an alternative material to the cement and fine aggregate.
- Use of Vermiculite in concrete to gives a light weight concrete.
- It is observed the GGBS based concrete have achieved an increase in strength for 25% replacement of cement at the age of 7 and 28days.
- The GGBS has positive effects on the Workability, as the Water cement ratio decreases with the increase in GGBS content increases, for the same workability.
- Vermiculite indicates that the more suitable for more suitable for lime as a binder as compare to that cement.
- From the above results, it can be concluded that GGBS and vermiculite can be effectively used in concrete.

- It also reduces the cost of construction.
- Therefore, the partial replacement of OPC in concrete by GGBS, is not only economical but also facilitates environmental friendly disposal of the waste slag into a useful product, Which is generated in huge quantities from the iron and steel industries.

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