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Study on Properties and Strength of Concrete by Partial Replacement of Fine Aggregate with Copper Slag And Cement With Egg Shell Powder

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Abstract*: - At the same time scarcity of aggregates are also greatly increased nowadays fine aggregate occupy a major volume in concrete,the volume can be various from 40% to 60%, so we use partial amount of copper slag, in concrete by replacement of fine aggregate, because the properties of copper slag is same as the coarse aggregate, the properties of the copper slag were researched, and were compared to those of natural fine aggregate concrete, the copper slag aggregate produced by copper plant is also utilized in asphalt concrete, Generally, the copper slag is formed by a direct reduction of iron in an electric arc furnace, Due to slow cooling in atmosphere, the copper slag has large size fractions, only we used the copper slag is partial in concrete, because the copper lag increased the dead load in concrete ,Concrete is a widely used construction materials for various types of structures due to its durability. For a long time, it was considered to be a very durable materials requiring little or no maintenance. Concrete is a composite construction material composed of cement (normal Portland cement), coarse aggregate (generally crushed stones or rock), fine aggregate (river sand), and water. Concrete hardness solidifies after mixing with water and placement due to a chemical process known as hydration. The water reacts with the cement which bonds the other components together, eventually creating a robust stone like materials. The industrial waste has been encouraged in construction industries because it contributes to reduce the usage ofnatural resources. For many years, by product such as fly – ash, silica fumes and copper slag were considered as waste materials.*
KEYWORDS: - *aggregates, copper slag, crushed stones, egg shell, fly – ash, silica fumes*

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I. INTRODUCTION

Concrete is used more than any other man – made materials in the world. So the use of concrete is unavoidable. At the same time scarcity of aggregates are also greatly increased nowadays fine aggregate occupy a major volume in concrete,the volume can be various from 40% to 60%, so we use partial amount of copper slag, in concrete by replacement of fine aggregate, because the properties of copper slag is same as the coarse aggregate, the properties of the copper slag were researched, and were compared to those of natural fine aggregate concrete, the copper slag aggregate produced by copper plant is also utilized in asphalt concrete, Generally, the copper slag is formed by a direct reduction of iron in an electric arc furnace, Due to slow cooling in atmosphere, the copper slag has large size fractions, only we used the copper slag is partial in concrete, because the copper lag increased the dead load in concrete ,Concrete is a widely used construction materials for various types of structures due to its durability. For a long time, it was considered to be a very durable materials requiring little or no maintenance. Concrete is a composite construction material composed of cement (normal Portland cement), coarse aggregate (generally crushed stones or rock), fine aggregate (river sand), and water. Concrete hardness solidifies after mixing with water and placement due to a chemical process known as hydration. The water reacts with the cement which bonds the other components together, eventually creating a robust stone like materials. The industrial waste has been encouraged in construction industries because it contributes to reduce the usage ofnatural resources. For many years, by product such as fly – ash, silica fumes and copper slag were considered as waste materials. They have been successfully usedin the construction industries, for the partial or full replacement of both fine and coarse aggregates.

1.1 SCOPE & OBJECTIVE:

In this present investigation, copper slag, an industrial by-product obtained duringthe manufacturing of copper has been used to partially replacement to fine aggregate. As the copper slag power considered to be a waste product and theland for its dumping increasing day by day showing a serious impact on environment, hence to reduce it we are making use of copper slag in construction field. Although copper slag has many uses but to a little

percent when it comparedto its use in construction. The main objective is to study the feasibility of use of copper slag as fine aggregate in concrete. The scope of the work includesknowing the strength parameters of concrete such as compressive strength, split tensile strength, flexural strength in which copper slag powder replaced with fine aggregates and cement with egg shell powder by 0%, (5%+5%),(10%+10%), (15%+15%), (20%+20%), (25%+25%), and (30%+30%) using M30
and M40 grades of concrete.

1.2 OBJECTIVE OF THE STUDY

The objectives of the present study are as follows:
This work attempts to evaluate effect of change of seismic zones on the design, detailing and performance of the building. The work includes comparison of base shear, percentage steel in columns and beams, and detailing of selected members. Moreover, it includes a performance comparison of the designed buildings on the basis of over-strength factors obtained from
pushover analysis of the buildings.

II. LITERATURE REVIEW

GENERAL

Due to exponential growth in the usage of concrete world over, there is a huge demand for natural river sand as construction materia Copper slag is a byproduct of the copper industry and can potentially be used as aggregate in the asphalt mixture Concrete is a most versatile construction material because it is designed to withstand the harsh environments. Engineers are continually pushing the limits to improve its performance with the help of innovative chemical admixtures and supplementary materials. These materials are majority by products from other processes. The use of these byproducts not only helps to utilize these waste materials but also enhances the properties of concrete in fresh and hydrated states.
Many researchers have investigated the possible use of copper slag as a concreteaggregate. For this investigation, some of the important literatures were reviewed and presented briefly.

2.1 PAPERS REVIEWED

Utilization of slag: The copper slag is used as aggregates. Natural aggregate resources are becoming more difficult to develop or remove aggregate from the ground when slag can be used as a substitutewhich reduce waste and conserve resources

Abhijit B Kachare et al; (2020): studied An experimental investigation are going to be conducted to review the properties of concrete containing copper slag as a partial replacement of fine aggregates and eggshell powder by cement within the concretemix design. Various durability tests are going to be conducted on such concrete of M25 gradeto understand the compressive strength, flexural strength by varying proportions ofcopper slag (CS) with fine aggregates by 0%, 10%, 20%, 30%, 40% and Egg shell
powder (ESP) as cement by 0%, 7%, 14%, 21%, 28% by weight. The obtained results aregoing to be comparedwith the traditional concrete, there by knowing the changes within the properties of concrete containing copper slag as a partial replacement of fine aggregates and eggshell powder by cement

R. Elamaran et al (2019) : studied the Copper slag is an excellent by-product or waste material which retains its original properties. Due to its chemical composition which includes high iron, silica and aluminum oxide content, it can be used as a partial replacement for sand in concrete mixes. Mix design of concrete is done on weight basis, by adding various percentages of copper slag (10%, 15%, 20%, 25%, 30% and 35%) instead of sand and concrete mixtures were prepared based on it. The cube, beam and cylindrical specimens were then prepared, demoulded after 24 hours and properly cured. The specimens were subjected to compression testing, split tensile strength testing and flexural testing at 7 and 28 days. It was observed from the test results that the compressive strength of the specimens was higher than the control specimen on adding 10 to 30% of copper slag and on further increasing it, the compressive strength was observed to be reducing. In particular, 10% addition gave more strength than 30%addition. Delay in hardening of concrete specimens was observed. Replacement of copper slag increased the self-weight of the specimens of about 15%.

K. Mahesh babu: (2019): Studied the Utilization of high volume Copper Slag (CS) in concrete is the aim of present work. This study leads towards cleaner production; by utilizing industrial waste i.e. CS. The objective of the present paper is to make High Strength Concrete (HSC) by utilizing CS as Fine Aggregate (F.A.). The work was carriedin two phases. In first phase, sand was replaced with CS in various percentages of 0, 20%, 40%, 60%, 80% & 100%. In second phase, cement was replaced with Nano silica (1%, 2% & 3%) to get maximum strength & impermeable concrete. Performance of concrete mixtures containing CS and Nano silica (NS) in terms of

compression, split tensile & flexural strength and durability characteristic like water absorption were also identified. From all these studies it could be determined that replacing F.A. with 100%CS in HSC was technically viable.

C.K.Madhawan et al; (2014): studied the This work focuses on the use of copper slag, as a partial replacement of sand for use in cement concrete and building construction. Cement mortar mixtures prepared with fine aggregate made up of different proportions of copper slag and sand were tested for use as masonry mortars and plastering. Three masonry wall panels of dimensions 1 × 1 m were plastered. The studies showed that although copper slag based mortar is suitable for plastering, with the increase in copper slag content, the wastage due to material rebounding from the plastered surfaces increases. It is therefore suggested that the copper slag can be used for plastering of floorings and horizontal up to 50 % by mass of the fine aggregate, and for vertical surfaces, such as, brick/block walls it can be used up to 25 %. In this study on concrete mixtures were prepared with two water cement ratios and different proportions of copper slag ranging from 0 % (for the control mix) to 100 % of fine aggregate. The Concrete mixes were evaluated for workability, density, and compressive strength.

MATERIALS USED

The different materials utilized in the investigation are explained briefly below

• Cement
• Fine aggregates
• Coarse aggregates

Copper slag

Cement

OPC grade of 53 tested according to IS: 4031-1988 and confirmed to IS: 12269- 2004 was used in the investigations. Table 3.1 indicates Physical characteristics of cement.

Fine Aggregates The materials smaller than 4.75 mm size is called fine aggregates.

The code to be referred to understand the specification for fine aggregates is: IS 383:1970.

The criteria to classify fine aggregates are:

 If they are Natural/ Man-made.
 According to their size.
 According to the IS specification

Fine aggregate may be described more clearly according to their availability as:

• Natural Sand– it is the aggregate resulting from the natural disintegration of rock and which has been deposited by streams or glacial agencies
• Crushed Stone Sand– it is the fine aggregate produced by crushing hard stone. Crushed Gravel Sand– it is the fine aggregate produced by crushing natural gravel.

According to size the fine aggregate may be described as coarse sand, medium sand and fine sand.IS specifications classify the fine aggregate into four types according to its grading as fine aggregate of grading Zone-1 to grading Zone-4. The four grading zones become progressively finer from grading Zone-1 to grading Zone-4. 90% to 100% of the fine aggregate passes 4.75 mm

IS sieve and 0 to 15% passes 150 micron IS sieve depending

rise buildings are designed by staad which makes a compulsion for a civil engineer to know about this software. This software can be used to carry rcc, steel, bridge, truss etc according to various country codes. Coarse Aggregates: Locally available well graded granite aggregates of normal size greater than 4.75 mm and less than 16mm. The code to be referred to understand the specification of the coarse aggregates from natural sources is: IS 383:1970.

Coarse aggregate may be further classified as:

• Uncrushed Stone– it results from natural disintegration of rock.
• Crushed Stone– it results from crushing of gravel or hard stone.
• Partially Crushed Stone– it is a product of the blending of the above two aggregate. In this project Crushed stone used as coarse aggregate of following properties

Copper slag: Copper slag is an industrial waste product produced in the smelting process during the production of copper from its ore.

It has a promising future in making of concrete as full or partial replacement material for fine aggregate. Copper slag is generally used as grit for blast cleaning of rough surfaces or for removal of rust, paint etc. It is a black, glassy granular material.

Copper slag has a bulk density of 1.70 to 1.90 g/cc, hardness between 6 to 7 MoH Scale. In this work, copper slag obtained from, the copper slag which we used had collected from a dealer of 'Hindustan copper limited' at Moubhandar, Ghatshila, Jharkhand. The wholesale price of the

copper slag is about 620/ton and is also economical to use copper slag at the places where it is available. Egg shell powder:

The egg shell wastelands in the poultry manufacturing have been highlighted because of its recovery potential. Egg shell waste is available in huge amounts from the food processing, egg breaking, and shading industries.

The food indulgence industry is in need of investigation to find another method for processing and using egg shells waste in an ecological friendly way. There is a need to find a low cost solution.

Removal of egg shell waste are usually not income centers but cost centers. Therefore, the least cost of removal is most necessary. Some of the options left
should be watched at very critically and the most cost effective method of recycling are considered. Egg shells procured from local nearby schools regularly and packed in bags. Then the collected egg shells were washed in normal water and then dried in hot sun light for a day to make it dry to make grinding easy and also to avoid the paste formation while grinding.
Blackened egg shells were removed separately and the unwanted dust mixed in the sample collections were removed before bringing it to grinding. After collecting, drying and clearing, the
samples were placed in a box for manual crushing up to some extent. Then samples were crushed by using some electronic equipment like mixer, grinder, etc. The grinded egg shells were sieved through the 90-micron sieve size and then packed to use it in the cement replacement. Given below in figure 2 shows the eggshell powder.

III. EXPERIMENTAL INVESTIGATIONS

• Tensile test

The tension assessment is perhaps the most essential kind of mechanical test that can conduct on materials. These are simple, inexpensive and fully standardized. As the material is pulled in its length direction we can find the strength based on how much it. To perform the test, bamboo samples should prepare. Firstly, the suitable size and shape of the samples were cut.

The distance
between the nodes gives the length of the specimen. Usually the 9 and 12 inches (229 and 305 mm) long samples were tested. So, we have taken 9 inches (230mm) sized specimen bamboo strips as shown in the figure 3.9. Some of the samples were too strong to brake, widths of the samples were reduced.

The thickness along with the widths are differed between the samples. Since it is a natural material whose physical characteristics are varied and careful sample dimensioning to be done before testing.

• Compressive strength

indicates compressive strength of bamboo fiber reinforced concrete cubes of size 150mmx150mmx150mm using fibers of diameters (D1) 700 μ and (D2) 1.156 mm for M30 grade of concrete for 28 days for the aspect ratio of 30, 40 and 50. it is shown that the diameters 700μ and 1.156 mm fibers at 1% aspect ratio (l/d) of 40 gave the maximum compressive strength. The diameter 1.156 mm fibers at 1% gave the maximum compressive strength of 41N/mm2with an aspect ratio (l/d) of 40 when mixed with concrete. Both the diameters of fibers showing the decrement in the strength at the 1.25% addition of fibers.

• Splitting tensile strength

indicates splitting tensile strength of BFRC cylinders of size 150mmx300mm using two different diameters (D1) 700 μ and (D2) 1.156 mm for M30 grade of concrete for 28 days for the aspect ratio of 30, 40 and 50. It is shown that the diameter of 1.156 mm fibers at 1% gave the maximum split tensile strength of 4.8N/mm2with an aspect ratio (l/d) of 40 when mixed with concrete. Both the diameters of fibers showing the lesser decrement in the strength at the 1.25% addition of fibers.

• Flexural strength

indicates the flexural strength of BFRC beam of size 150mmx150mmx1200mm using two different diameters (D1) 700 μ and (D2) 1.156 mm for M30 grade of concrete for 28 days for the aspect ratio of 30, 40 and 50. It is shown that the diameter of 1.156 mm fibers at 1% gave the maximum split tensile strength of 8.5N/mm2with an aspect ratio (l/d) of 40 when mixed with concrete.

Both the diameters of fibers showing the very less decrement in the strength, at the 1.25% addition of fibers. Method of curing Curing is a procedure that maintains proper moisture and temperature to ensure continuous hydration.

After 24 hours of casting the specimens were demoulded and then the specimens were immersed in water of curing tank continuously for a period of 7 days and 28 days separately.

The fresh water tanks used for the curing of the specimens were emptied and cleaned once in every fifteen days and were filled once again.

All the specimens immersed were always kept well under water with at least about 15 cm of water above the top of the specimens. All the specimens were removed from water tank and stacked after the curing period. The whole curing process is done in the civil engineering structure

IV. RESULT

The egg shell wastelands in the poultry manufacturing have been highlighted because of its recovery potential. Egg shell waste is available in huge amounts from the food processing, egg breaking, and shading industries. The food indulgence industry is in need of investigation to find another method for processing and using egg shells waste in an ecological friendly way. There is a need to find a lowcost solution. Removal of egg shell waste are usually not income centers but cost centers. Therefore, the least cost of removal is most necessary.

Some of the options left should be watched at very critically and the most cost effective method ofrecycling are considered. Egg shells procured from local nearby schools regularly andpacked in bags.

Then the collected egg shells were washed in normal water and then dried in hot sun light for a day to make it dry to make grinding easy and also to avoid the paste formation while grinding. Blackened egg shells were removed separately and the unwanted dust mixed in the sample collections were removed before bringing it to grinding.

After collecting, drying and clearing, the samples were placed in a box for manual crushing up to some extent. Then samples were crushed by using some electronic equipment like mixer, grinder, etc. The grinded egg shells were sieved through the 90 micron sieve size and then packed to use it in the cement replacement. Given below in figure 2 shows the eggshell powder.

V. SCOPE OF FUTURE WORK

On the basis of the present work done, the scope for future study is identified on the following aspects-

- In the present study, seismic design of buildings is carried out using Equivalent Static analysis. Similar studies may be taken up with other methods such Response-spectrum Analysis, Time-History Analysis and Pushover Analysis.
- In this work, only the Indian Seismic design codes have been taken into account, the workcan be further extended by incorporation of British, American and other design codes as well.
- The present study considers only the over-strength factor obtained from the Pushover Analysis output. Several other parameters such as- Capacity spectrum, hinge-backbone results, etc., can also be augmented to it.
- Efforts may be made to take the soil-structure interaction into account as well.
- The present study is carried out on RC buildings. Similar studies may be taken up with Steel structures as well.
- Efforts may be made to study the pushover analysis using different software tools or someother procedures to validate the results.

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