Partial replacement of Fine Aggregate By using Spent Fire Brick Waste

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ABSTRACT

Due to the day to day innovations and development in construction field, the use of natural aggregates is increased tremendously and at the same time, the production of solid wastes from the demolitions of constructions is also quite high. Because of these reasons the reuse of demolished constructional wastes like ceramic tile and tile powder came into the picture to reduce the solid waste and to reduce the scarcity of natural aggregates for making concrete. The ceramic tile waste is not only occurring from the demolition of structures but also from the manufacturing unit.

Studies show that about 20-30% of material prepared in the tile manufacturing plants are transforming into waste. This waste material should have to be reused in order to deal with the limited resource of natural aggregate and to reduce the construction wastes.

I.INTRODUCTION

Concrete is a composite material consist of mainly water, aggregate, and cement. The physical properties desired for the finished material can be attained by adding additives and reinforcements to the concrete mixture. A solid mass that can be easily mould into desired shape can be formed by mixing these ingredients in certain proportions. Over the time, a hard matrix formed by cement binds the rest of the ingredients together into a single hard (rigid) durable material with many uses such as buildings, pavements etc., The technology of using concrete was adopted earlier on large-scale by the ancient Romans, and the major part of concrete technology was highly used in the Roman Empire. The colosseum in Rome was built largely of concrete and the dome of the pantheon is the World's largest unreinforced concrete structure. After the collapse of Roman Empire in the mid-18th century, the technology was re-pioneered as the usage of concrete has become rare. Today, the widely used man made material is concrete in terms of tonnage.

II. LITERATURE REVIEW

2.1 GENERAL

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 by product not only helps to utilize these waste materials but also enhances the properties of concrete in fresh and hardened states. The usage of industrial by-products especially industrial slag in making of concrete is an important study of worldwide interest. Many researchers have investigated the possible use of copper slag as a concrete aggregate. For this study, some of the important literatures were reviewed and presented briefly.

2.3 REVIEW OF LITERATURE

Aruna D (2015)[1]: For tile waste based concrete, coarse aggregates were replaced by 20mm down size, tile wastes by 0% , 5%, 10%, 15%, 20% and 25% and also the cement is partially replaced by fly-ash. The average maximum compressive strength of roof tile aggregate concrete is obtained at a replacement of 25%. A reduction of 10-15% of strength is observed compared to conventional concrete at 25% of roof tile aggregate replacement. The workability of roof tile waste concrete is in the range of medium. Overall, the replacement of tiles in concrete is satisfactory for small constructions.

Suchithra S, Manoj Kumar, Indu V.S in their paper **"Study on replacement of coarse aggregate by spent fire bricks waste in concrete**" published by International Journal of Technical Research and Applications in July-August 2015. This paper presents the partial replacement of spent fire bricks with fine aggregate. The work was conducted on M20 grade mix. The replacement of fine aggregate with spent fire brick waste in the range of 0%,5%,10%,15% and 20%. Finally the mechanical properties and durability of the concrete mix specimens obtained from the addition of these materials is comparedwith control concrete mix. The test results showed that a significant improvement in compressive strength was achieved in the SFB concrete compared to conventional concrete and can be used effectively in concrete.

PanneerSelvam. N1, Gopala Krishna GVT in their paper **"Recycle of SFB in Concrete**" published in International Journal of Science and Research (IJSR), April 2016. In this work printed circuit board is used as a SFB waste material. Benefits of recycling are extended when responsible recycling methods are used. Concrete mixes with different percentages of SFB were casted. It has been decided to make three different types of conventional specimens with partial replacement of SFB on a percentage of 10%, 20%, and 30% to coarse aggregate with water cement ratio of 0.45. For conventional specimens are also prepared for M20 Concrete without using SFB aggregates. The effect of physical and mechanical properties of the concrete were studied.

Manikandan.P, Senthamilkumar.S in their paper **"Behavior of SFB in Concrete"** published in International Journal for Research in Applied Science & EngineeringTechnology (IJRASET) inOctober 2015.An experimental study utilization of SFB materials in concrete with a percentage of 0% to 20% at the strength criteria M25 grade of concrete. Following that thechemical properties like chloride and sulphate testing also conduct for this study. Finally this study gives the environmentalaspects for the SFB and basic mechanical properties and chemical behavior of conventional and SFB concrete for M25grade.

P.KrishnaPrasanna, M.KantaRaoin their paper **"International Journal of Education and applied research Strength Variations in Concrete by Using SFB as Fine Aggregate"** published in Jan - June 2014.An experimental study is made by preparing specimens by utilizing SFB particles as fine aggregates in concrete with a percentage replacement from 0% to 20% i.e. (5%, 10%, 15%, and 20%). And Conventional specimens are also prepared for M30 grade Concrete without using SFB aggregates. By conducting tests for both the specimens the hardened properties of concrete are studied. It is found that use of SFB aggregates results in the formation of concrete which has lesser weight than that of conventional concrete. This study ensures that reusing of SFB waste as fine aggregate substitutes in concrete gives a good approach to reduce cost of materials and solve solid waste problems posed by SFB.

R. Ilangovana, N. Mahendrana and K. Nagamanib in their paper, "**Strength and durability properties of concrete containing SFB as fine aggregate**" published in ISSN 1819-6608, ARPN Journal of Engineering and Applied Sciences in October 2008.This paper presents the feasibility of the usage of SFB as hundred percent substitutes for Natural Sand in concrete. Mix design has been developed for three grades using design an approach IS, ACI, USBR, RN.No.4 and BRITISH for both conventional concrete and SFB concrete. Tests were co

III.PROPERITIES OF MATERIALS

Cement, fine aggregate, coarse aggregate, Spent fire bricks waste are the various materials used in this project. Before casting the specimens various tests of materials has been conducted and a study on them is presented in this chapter.

3.2 STUDY OF MATEIALS

CEMENT

Cement is defined chemical entity formed from predetermined ratios of reactants at a fairly precise temperature.Cement is obtained from limestone (calcium carbonate) and small quantities of other materials (such as clay) through a heating process in kilns, the process known as Calcinations. The resulting hard substance, called 'clinker', is then ground with a small amount of gypsum to form Ordinary Portland Pozzolana Cement also referred as PPC. This forms a basic ingredient of concrete, mortar, grout etc. and its most common

use is in the production of concrete. Concrete is a composite material which consist of cement, aggregates (both coarse [gravel] and fine [sand]), and water. It has a wide application in the construction industry since it can be cast and molded in any desired shape. After it hardens, it can be effectively used for load bearing structures.

b)FINE AGGREGATES

Fine aggregate consist of mainly sand which may be natural, manufactured or a combination of both. It consists of clean and durable particles generally spherical or cubical in shape. The use of flat or elongated fine aggregate particles should be restricted and also care should be taken to ensure that there are no contaminating substances - dirt, dust, mud, and construction debris - present in fine aggregates. Fine aggregates particle size varies from 0.075 to 0.425 mm. The specific gravity of sand is 2.5.

c) COARSE AGGREGATE

Coarse aggregates consist of aggregates larger than fine aggregates and their sizes vary from 20 to 4.75mm. These tend to improve quality and bond characteristics and generally results in a higher flexural strength of concrete. It also helps in reducing shrinkage. These aggregates occupy 70-80% of volume of the concrete. The specific gravity of sand is 2.7.

d) CERAMIC TILE AGGREGATE:

Broken tiles were collected from the solid waste of ceramic manufacturing unit and from demolished building. The waste tiles were crushed into small pieces by manually and by using crusher. The required size of crushed tile aggregate was separated to use them as partial replacement to the natural coarse aggregate. The tile waste which is lesser than 4.75 mm size was neglected. The crushed tile aggregate passing through 16.5mm sieve and retained on 12mm sieve are used. Crushed tiles were partially replaced in place of coarse aggregate by the percentages of 10%, 20% and 30%, 40% and 50% individually and along with replacement of fine aggregate with granite powder also.

e)WATER

Water for construction of concrete structure should be same quality as drinkable water. The strength of concrete is totally depend upon the water thus water should be free from impurities. Impurities like suspended solids, dissolved salts organic matter. Which affect properties of concrete. These impurities can be changed setting time, hardening, strength, durability and etc. Water should be tested from an approved lab and should be checked regularly and pH value of water is 7.

III Mix design of Concrete for M20

Design mix of concrete for 25 grade are made as per IS 10262: 2009. Water cement ratio and minimum cement content is taken as per IS 456: 2000 (Table 5). Size of nominal maximum ofaggregates is 20 mm used. Minimum water content as per IS 10262: 2009.

IV TESTING OF MATERIALS

SPECIFIC GRAVITY TEST:

Specific gravity of fine aggregates is found to be 2.5. And as per IS 2386 (part3):1963, the specific gravity of coarse aggregate should be 2.2 to 3.2.

SIEVE ANALYSIS TEST:

Fineness modulus of Fine Aggregate is 4.82%.The soil belongs to zone II of classification (IS383).

WATER ABSORPTION TEST

% of water absorption of fine aggregate = 1.2%.

SPECIFIC GRAVITY TEST:

Specific gravity of coarse aggregate is found to be 2.71 and as per IS 2386 (part3):1963, the specific gravity of coarse aggregate should be 2.6 to 2.9.

SIEVE ANALYSIS TEST:

Fineness modulus of Coarse Aggregate is 5.18%.The soil belongs to zone II of classification (IS383).

WATER ABSORPTION TEST:

% of water absorption of coarse aggregate = 0.72 %

v)RESULT

1 GENERAL

The values obtained for Compressive Strength of cubes are tabulated. Comparisons are made and are presented in this chapter.

8.2 COMPARISON OF RESULTS

a) COMPRESSIVE STRENGTH OF CUBES

The values obtained from the compression test on cubes (28th day) are tabulated. Graphs are plotted for compressive strength vs. % adding for waste ceramic tile and tile powder. Further satisfactory results are obtained for 0%,10%, 20%, 30%.

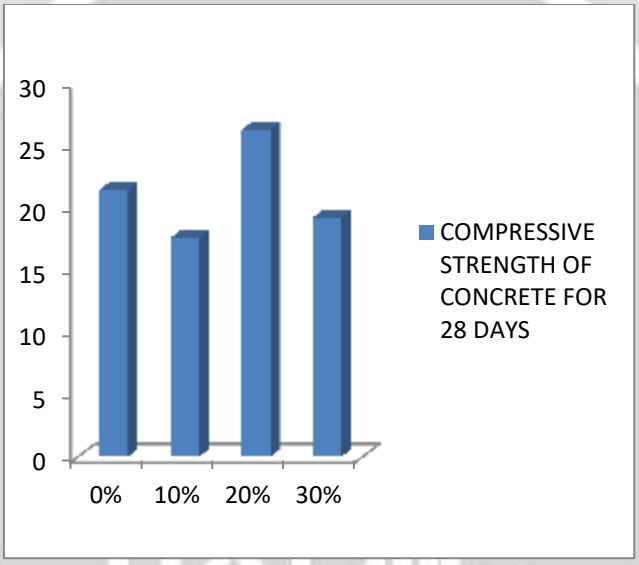

Fig Compressive strength of concrete at 28 days

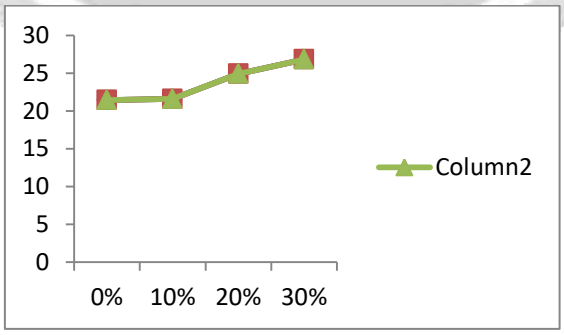

Fig Compressive strength of concrete at 28 days

V) CONCLUSION

- The workability of concrete increases with the increase in tile aggregate replacement. The workability is further increased with the addition of tile powder which acts as admixture due to its chemical properties.

- The properties of concrete increased linearly with the increase in ceramic aggregate up to 30% replacement later it is decreased linearly.

- The split tensile strength of ceramic tile aggregate is very much in a straighter path compared to the conventional grades of concrete.
- The usage of ceramic fine aggregate has some effect on the properties of concrete in decrement manner.
- Tile powder using as fine aggregate has more influence on the concrete than the ceramic fine because of chemical composition it is made of and works as admixture.
- The addition of tile powder along with the ceramic coarse aggregate improves the mechanical properties of concrete slightly since mineral and chemical properties are of tile.

VI.FUTURE SCOPE

1. It will slightly reduce the dependency on natural sand.
2. High strength gives in tension as compare to conventional concrete.
3. Accidental fire bricks or fire bricks who has deformed or recycled bricks are easily available in India when partially replaced with sand then cost will be reduced.
4. Natural aggregates are the natural resources and which are limited. Thus fire bricks aggregates concrete can be best cheap material instead of natural sand.

VII. REFERENCES

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