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OPTIMUM REPLACEMENT OF FINE AGGREGATE BY CRUMB RUBBER AND MARBLE DUST IN HIGH PERFORMANCE CONCRETE USING STEEL FIBER

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Abstract: High strength steel fiber reinforced concrete is being used increasing as a structural material. The study was conducted to evaluate to characteristics of the Admixture High Performance steel Fiber Concrete. The concrete mix design was done for M60 grade concrete. The concrete cubes, cylinders and prisms were casted and evaluate the strength properties such as compressive strength, splitting tensile strength and modulus of rupture for M60 concrete with optimum dosage of super-plasticizer, steel content 0.5, 1, 1.5 and 2% has been tested, analysis and it has been compared in the corol mix.

Keywords: Fine Aggregate, Crumb Rubber, Marble Dust, Steel Fiber, HPC

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INTRODUCTION

Increasing amount of waste materials in landfills has become a huge problem in the last decades. Fortunately a considerable amount of waste is recycled in developed countries .This includes for example glass, plastic, electronic device, worn tires and marble dust Constantly growing number of manufactured tires and permanently increasing number of worn tires in landfills created a problem of reuse of the worn tires (Roman Chylík, TomášTrtík, Josef Fládr,Petr Bílý,year-2017).

Marble dust has been commonly used as a building material since the ancient times. Generally in literature waste marble dust has been replaced with either of the fine aggregate(0-4mm) or passing 1 mm sieve. Marble blocksare cut into smaller blocks in order to give them thedesired smooth shape. During the cutting process about 25% the original marble mass is lost in the form of dust(BaharDemirel, 18 august,2010).

The study concerning the utilization of marble dust and crumb rubber in producing a high performance concrete.

Therefore the aim of this current study is both the avoid environmental pollution and to investigate the usability of crumb rubber and marble dust in producing a high performance concrete.

High performance concrete is a concrete mixture, which possess high durability and high strength when compared to conventional concrete. The term ‘high performance’ is somewhat pretentious because the essential feature of this concrete is that it’s ingredients and proportions are specifically chosen so as to have particularly appropriate properties for the expected use of the structure such as high strength and low permeability [3].

High Performance concrete works out to be economical, even though it’s initial cost is higher than that of conventional concrete because the use of High Performance concrete in construction enhances the service life of the structure and the structure suffers less damage which would reduce overall costs [3].

In this case we use steel fibre in producing a high performance concrete. This are the fibres typically added in the concrete which are short and closely spaced with low dosage and are used in reducing plastic shrinkage cracking and improving strength. The concrete with steel fibre has a higher tensile strength then ordinary concrete. The right amount of steel fibre can also reduce the shrinkage of concrete and improve the fatigue resistant ability of concrete and the durability of concrete (Jinsong Lei, Zhiping Zhou, Zhangteng Sun, April 2015).

PROBLEM STATEMENT

High Performance Concrete (HPC) is a concrete meeting special combinations of performance and uniformity requirements that cannot be always achieved routinely by using conventional constituent sand normal mixing. Use of steel fiber in HPC is mainly for superior resistance to cracking and formation of cracks. The concrete with supplementary cementitious materials have life span more than the ordinary concrete
The annual rice husk produce in India amounts is generally approximately 120 million tons.The aim of the present work will to use different waste material as a replacement of fine aggregate in HPC using steel fiber. A series of tests will be conducted to study the effect of optimum replacement of fine aggregate by different waste material and optimum use of steel fiber.

OBJECTIVES

Our main aim of this project is to find the optimum value of replacement of fine aggregate by the waste material (Fly-ash, brick ash & Rise husk ash) in High performance concrete by using of Steel Fiber.

- To get the high Flexural strength and Compressive strength.
- To reduces the cost of project.
- To find maximum possible use of waste material.
- To optimum use of steel fiber for increasers the flexural strength.

METHODOLOGY

Step-1: Problem Defination
Step-2: introduction of study
Step-3: scope of the study
Step-4: Collection of Materials
Step-5: Testing
Step-6: Result analysis
Step-7: Thesis

MATERIALS

The materials used for making fly ash-based High-performance concrete specimens are fly ash as the source material, aggregates, alkaline solution, and water.

1. Cement:
53 Grade OPC provides high strength and durability to structures because of its optimum particle size distribution and superior crystallized structure. Being a high strength cement, it provides numerous advantages wherever concrete for special high strength application is

required, such as in the construction of skyscrapers, bridges, flyovers, chimneys, runways, concrete roads and other heavy load bearing structures. Not only is this grade of cement stronger than other grades / types, it is also more durable. Further, by substituting lower grade cement with OPC 53, overall savings can be obtained through reduced quantity of cement that would be required to be used. A savings of 8-10% can be achieved with the use of 53 Grade OPC in place of any other grade [5].

2.Fly ash:
Fly ash used in this study was unprocessed fly ash from torrent power plant (locally available). The whole quantity of fly ash was obtained from one batch.

3. Aggregates:
Locally available crushed stones of 10 mm and 20 mm aggregates were used as coarse aggregates. Local river sand was used as fine aggregate in the concrete mixtures.

4. Steel Fibers:
Steel fibers are fiber used in concrete which are short and closely spaced and are typically added to concrete in low volume dosage and are used in reducing plastic shrinkage cracking and improved strength.

5. Super Plasticizers:
In the fresh state, the concrete has a stiff consistency. Although adequate compaction was achievable, an improvement in the workability was considered as desirable. Super plasticizer result in substantial enhancement in workability at a given water cement ratio. For a constant workability reduction in water content up to 30% may be achieved by the use of super plasticizer. Superplasticizer can be used at a higher dosage than conventional plasticizer in the range of 0.5% to 3% by weight of cement [6].

Tests

1. Fresh concrete test

1.1. Slump test

The slump tesyconcrete is carried out to check the consistency of fresh concrete before it sets. It is performed to check the workability of freshly made concrete [7].

1.2. L Box test

This test is used for self compacting concrete based on the Japanese design for underwater concrete.The test measures the flow of the concrete and also the extent to which it is subjected to blocking by reinforcement [8].

1.3. V Funnel test

The equipment for V-funnel test consist of V-shaped funnel.The funnel is filled with about 12 liter of concrete and the time taken for it to flow through the apparatus measured. After this the funnel can be refilled concrete and left for 5 minutes to settle. If the concrete shows segregation then the flow time will increases significantly [9].

1.4. U Box test

U Box test is used to measure the filing ability of self compacting concrete. The apparatus consists of a vessel that is divided by a middle wall into two compartments; an opening with a sliding gate is fitted between the two sections[10].

1.5. J Ring test

The J-ring test can be used to determine the passing ability of self-consolidating concrete. It is applicable for laboratory use in testing different concrete mixtures for passing ability or can be used in the field as a quality control test[11].

2. Harden concrete test

2.1. Compression test

This test is carried out to check the compressive force or crush resistance of a material and ability of the material to recover after a specified compressive force is applied. compression tests are used to determine the material behaviour under a load [12].

RESULT AND DISCUSSION

On the basis of various literature and research study we came to the following conclusion

- The compressive and flexural values were gradually decrease with increase in the amount of crumb rubber in concrete. The rubberized concrete exhibited better resistance to abrasion than the ordinary concrete. It is possible to design high strength concrete in which waste tyre rubber may be utilized as a partial substitute for the fine aggregate up to 12.5% by weight. It can be applicable in structure where there are chance of brittle failure.
- With the inclusion of marble powder, the compressive strength of concrete gradually increase up to certain limit but then gradually decrease.
- On the basis of literature it is observed that the increase in percentage of steel fiber can increase the split tensile strength, compressive strength and the flexural strength of concrete.
- According to many researchers the addition of steel fibers into concrete create low workable concrete, therefore to solve this problem superplasticizer without affecting other properties of concrete may introduce.

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