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FRESH CONCRETE TEST ON REPLACEMENT OF FINE AGGREGATE BY WASTE MATERIAL (CRUMB RUBBER) IN HIGH PERFORMANCE CONCRETE USING STEEL FIBER

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Abstract: - High strength Steel-fiber reinforced concrete is being used increasing day by day as a structural material. From many years High Performance Concrete has been used in column of high rise building [1]. 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 [2]. In High performance concrete we are using crumb rubber as a waste material with 10%, 20%, 30%, and 40% replacement of fine aggregate. The aim of the present work will to use waste material as a replacement of fine aggregate in HPC using steel fiber [3]. A series of workability tests will be conducted to study the effect of optimum replacement of fine aggregate by waste material (crumb rubber) and optimum use of steel fiber. [4]

Keywords: High performance concrete, steel *fiber*, replacement, waste material, crumb-rubber

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INTRODUCTION

ACI (American Concrete Institute) defines HPC as a specially engineered concrete, one or more specific characteristics of which have been enhanced through the selection of component materials and mix proportions.[5] Note that this definition does not cover a single product but a family of high-tech concrete products whose properties have been tailored to meet specific engineering needs, such as high workability, very-high early strength (e.g. 30-40 MPa compressive strength in 24 hours), high toughness, and high durability to exposure conditions.[6].There is some special Characteristics of HPC like Ease of placement, Compaction without segregation, Early age strength, Long-term strength and mechanical properties Permeability, Density, Heat of hydration, Toughness, Volume stability. There are major application of HPC is Pavements, Long-span bridges, High-rise buildings and other miscellaneous application are Floor slabs, Pavements, Refractories, Hydraulic structures, Thin shells, Rock slope stabilization, Mine tunnel linings, Many precast products etc.

MATERIALS USED

A. *Cement:*

The Ordinary Portland Cement of 53 grade conforming to IS: 8112 is being used.

PROPERTY	IS CODE IS : 8112 - 1989
Specific Gravity	3.12
Consistency	33
Initial setting time	30 minimum
Final setting time	600 maximum

B. *Fine aggregates:*

Those fractions from 4.75 mm to 150 microns are termed as fine aggregate. Fine aggregate are basically sands won from the land or the marine environment. Fine aggregates generally consist of natural sand or crushed stone with most particles passing through a 9.5mm sieve.

C. *Coarse aggregates:*

Coarse aggregates are particles greater than 4.75mm, but generally range between 9.5mm to 37.5mm in diameter. They can either be from Primary, Secondary or Recycled sources.

D. *Steel fibers:*

Steel fibers of 50 mm length and 0.8 mm thickness with corrugated shape which gave an aspect ratio of 62.5 were used. The steel fiber was added by 2% of weight fraction. Double hooked end steel fibers were used, since it helps in improper bonding.

E. *Superplasticizer:*

Glenium SKY 8784 helps to produce high performance concrete with longer workability retention, and high early strength. Mostly compatible with all OPC, PPC, PSC and can be used with high pozzolonic material.

F. *Crumb Rubber:*

40 mesh Crumb Rubber Powder used as a replacement of fine aggregate.

PROCEDURE

The mix design was carried out for M55 grade concrete as per ACI: 363 which yielded a proportion of **1: 2.28: 1.55** with a w/c ratio of 0.33. The dosage of super plasticizer used was 0.79% (by weight of cement). The steel fibers were added at the rate of 2.0% by weight fraction. The cement, sand and coarse aggregates were weighed according to the proportion of 1: 2.28: 1.55 and dry mixed. The required amount of water was added to this dry mix and intimately mixed. The calculated quantity of superplasticizer was now added and mixed thoroughly. After this, steel 2% by weight of concrete material was added to the mix and the entire concrete was agitated thoroughly to get a homogeneous mix and workability test were carried.

METHODOLOGY

1) *Slump Test:*

As per IS: 1199(1959) Slump test is the most commonly used method of measuring consistency of concrete. It is not a suitable method for very wet or very dry concrete. The apparatus for conducting the slump test essentially consist of a metallic mould in the form of a frustum of a cone having the internal dimensions as under:

Fig – 1 (a) Slump Test (b) Compaction Factor Test

Slump Apparatus

Bottom diameter: - 20 cm

Top diameter: - 10 cm

Height: - 30 cm

The internal surface of the mould shall be thoroughly cleaned and freed from superfluous moisture and any set concrete before commencing the test. The mould shall be placed on a smooth, horizontal, rigid and non-absorbent surface, such as a carefully levelled metal plate, the mould being firmly held in place while it is being filled. The mould shall be filled in four layers, each approximately one-q6arter of the height of the mould. Each layer shall be tamped with twenty-five strokes of the rounded end of the tamping rod. The strokes shall be distributed in a uniform manner over the cross-section of the mould and for the second and subsequent layers shall penetrate in the underlying layer. The bottom layer shall be tamped throughout its depth. After the top layer has been rodded, the concrete shall be struck off level with a trowel or the tamping rod, so that the mould is exact19 filled. Any mortar which may have leaked out between the mould and the base plate shall be cleaned away. The mould shall be removed from the concrete immediately by raising it slowly and carefully in a vertical direction. This allows the concrete to subside and the slump shall be measured immediately by determining the difference between the height of the mould and that of the highest point of the specimen being tested. The above operations shall be carried out at a place free from vibration or shock, and within a period of two minutes after sampling**.**

2) ***Compacting* Factor *Test:***

As per IS: 1199(1959), the sample of concrete to be tested shall be placed gently in the upper hopper, using the hand scoop. The hopper shall be' filled level with its brim and the trap-door shall be opened so that the concrete falls into the lower hopper. Certain mixes have a tendency to stick in one or both of the hoppers. If this occurs, the concrete may be helped through by pushing the rod gently into the concrete from the top & ring this process, the cylinder shall be covered by the trowels. Immediately after the concrete has come to rest, the cylinder shall be uncovered, the trap-door of the lower hopper opened, and the concrete allowed to fall into the cylinder. The excess of concrete remaining above the level of the top of the cylinder shall then be cut off by holding a trowel in each hand, with the plane of the blades horizontal, and receiving them simultaneously one from each side across the top of the cylinder, at the same time keeping them pressed on the top edge of the cylinder. The outside of the cylinder shall then be wiped clean. The above operation shall be carried out at a place free from vibration *or* shock. The 'weight of the concrete in the cylinder shall then be determined to the nearest 10 g. This weight shall be known as c the weight of partially compacted concrete '. The cylinder shall be refilled with concrete .from the same sample in layers approximately 5 cm deep, the layers being heavily rammed or preferably vibrated so as to obtain full compaction. The top surface of the fully compacted concrete shall be carefully struck off level with the top of the cylinder. The outside of the cylinder shall then be wiped clean.

The compacting factor $= \frac{\textbf{Weight of partially compacted concrete}}{\textbf{Weight of fully compacted concrete}}$

TEST RESULTS

Different test results such as workability are tabulated as shown. Following Table 2 gives the workability test results as measured from slump, compaction factor.

Table 1: Workability test results

Mix Design	Slump (mm)	Compaction factor
M0	Collapsed	0.96
M1	201	0.96
M2	198	0.96
M3	184	0.95
M4	178	0.95
M5	165	0.94

CONCLUSION

In this study of replacement of fine aggregates with Crumb rubber, we got maximum workability when replacement percentage is zero and minimum workability when replacement percentage is 50. Replacement of Fine aggregates with Crumb Rubber will reduce the workability of Concrete. Increase in the percentage of replacement of aggregate will decrease the workability of high performance concrete with steel fibers.

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