JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

Experimental Study of Fiber Reinforced Concrete by using Demolition Waste as Coarse and Fine Aggregate incorporating High Volume Flyash as an admixture

M. Saravanan*, Dr. M.M. Vijayalakshmi. Dr.P.Partheeban$.**

[1]Research Scholar Sathyabama Institute of Science and Technology, Assistant Professor P. B. College of Engineering, Chennai. *msaravanan70@gmail.com,
[2]Professor in Civil Engineering, School of Building and Environment, Sathyabama Institute of Science and Technology, Chennai-119, Tamilnadu, India.
[3] Principal, Chennai Institute of Technology, Chennai.,Tamilnadu, India.
Corresponding Author : ** vnat12345@gmail.com, *msaravanan70@gmail.com

Received: 14 Feb 2020 Revised and Accepted: 25 March 2020

ABSTRACT: The usage of recycled materials has great importance in the field of Civil Construction as its application is crucial for a permanent sustainable development in all countries. The use of naturally occurring aggregates in such huge amount and rate is becoming a economic as well as ecological concern, therefore the re-utilization of the recycled aggregates (RA) into useful building products is the need of the hour. The demolished waste attracts the issue of waste disposal due to the huge volume of waste generated from demolishing of a structure. Hence, recycling the waste is the most practical and essential way of reducing those concerns. A broad range of applications are available on the reuse of demolished waste into useful building products in all sectors of Civil Engineering.This paper presents a thorough investigations on verifying the best proportion of Recycled Aggregate Concrete (RAC) by incorporating fibers and High Volume Fly Ash (HVFA) as an admixture contain partial or complete replacement for Natural Coarse Aggregate (NCA) with demolished concrete aggregate. The combination and fusion of the demolished concrete aggregates along with the fire and admixtures produces a new concrete composite which attracts a vast range of applications. The results were drawn from the physical and mechanical strength investigations done on the RAC.

KEYWORDS: Demolished concrete waste aggregate Compressive strength, Split tensile strength, Flexural strength.

I. INTRODUCTION

The concrete is accounted as one of the largest man made material. In the last 10 decades, varieties of recycling methods for recycled concrete aggregate have been explored and well developed. The rapidly increasing population is led to large number of Constructions, Repairing, Renewing and Rebuilding process produced large amount of waste construction materials and demolitions. This research focuses on the replacement of the natural aggregates with recycled aggregates as both fine and coarse aggregates using steel fibers by producing Fibre Reinforced Concrete.

II. MATERIAL PROPERTIES

A. Material

Selecting the appropriate ingredients, evaluation and interpretation of their physical and mechanical properties and also understanding the nature of the interaction between the materials play a extensive part in determining the performance of the RAC. The various materials chosen for this investigation are cement, natural sand, natural coarse aggregate (NCA), Fine and coarse form of demolished waste and super plasticizer as chemical admixture.

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

B. Demolished concrete wastes

The RAC produced using fine and coarse forms of demolished concrete waste assures the minimum need of natural aggregates and produced adequate strength needed for the structural concrete. When the demolished waste was utilized effectively in both fine and coarse form in concrete, reduces the environmental concern on disposal of the tones of solid waste generated every year. The waste-cement obtained for the demolished structure is found to be extremely compatible and does not require any pretreatment. The RAC shows better resistance to impact when it compare with the conventional concrete, whereas on other side its water absorption and retention capacity is found to be more than the conventional concrete. The demolished waste procured from the site is first washed prior to drying and then crushed manually.

Fig: 2.1 Demolished Concrete Waste

2.2.1 Natural Fine Aggregate

Table 2.1 Properties of Natural fine aggregate

S. No	Physical properties	value
1.	Specific gravity	2.657
2.	Physical form	fine
3.	Size	2.36mm

2.2.2 Natural Coarse Aggregate

Table 2.2: Natural coarse aggregates - Properties

S. No	Physical Properties	Values
1.	Specific Gravity	2.689
2.	Physical form	Coarse
3.	Size	20mm

2.2.3 Recycled coarse aggregate

Table 2.3: Recycled coarse aggregate - Properties

S. No	Physical Properties	Values
1.	Specific Gravity	2.689
2.	Physical form	Coarse
3.	Size	20mm

Fig: 2.2 Recycled coarse aggregate

2.2.4 Recycled Fine Aggregate

Table 2.4 : Recycled fine aggregate - Properties

S. No	Physical Properties	Values

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

1.	Specific gravity	2.4
2.	Physical form	Fine
3.	Size	2.36mm

Fig 2.3 Recycled Fine Aggregate

2.2.5 Super plasticizers

Super plasticizer named Conplast SP430 is used. It can reduce mixing of water requirements by 1/4th, thereby increasing the concrete compressive strength. The various physical properties of super plasticizer are shown in the below Table 2,5

Table 2.5: Super Plasticizers Properties

S. No	Physical Properties	Values
1.	Specific Gravity	1.22
2.	Solid content	42%

2.2.6 Fly Ash

The use of High volume fly ash as a mineral admixture in RAC reduces the porosity of concrete due to the presence of pozzolanic materials which reacts with the lime present in the ingredients to from cementious materials there by the mechanical property was improved in the concrete.

2.2.7 Steel Fibre

Inclusion of steel fibre into the concrete boosts the resistance of the concrete

Table 2.6: Steel Fibre - Mechanical property

S.No	Fiber Type	DRAMIX 3D 80/60BG
1	Length-L	60mm
2	Diameter-D	0.75mm
3	Aspect Ratio(L/D)	80
4	Tensile Strength	1225N/mm^2
5	Minimum Dosage	10kg/m^3
6	Fiber Network	4584er/Kg

III. MIX DESIGN

3.1 GENERAL

The design for concrete mix deals with the procedure of determining the quantity of various ingredients used in the concrete for a particular grade based on the physical properties of each material to be used in preparing concrete of desired strength. The various proportions to be chosen is based on the performance of the concrete in fresh and hardened state. If the workability of the concrete is found to be undesirable, then addition of chemical admixtures should be done to produce a workable concrete.

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

3.2 MIX PROPORTIONS

Cement	-	342.09 kg/m^3
Fine Aggregate	-	699.31 kg/m^3
Coarse Aggregate	-	1223.89 kg/m^3
Water	-	143.68liters/m^3
Super plasticizers	-	3.42 Litres/m^3
Steel Fibres	-	3.42 Kg/m^3
Flyash	-	50% of Cement

IV. EXPERIMENTAL PROGRAM

4.1. MECHANICAL PROPERTIES

4.1.1 Compression Test – Performance (Ref: IS: 516-1959)

The compressive strength test is conducted for the conventional concrete specimens, the concrete specimen made with 100% RFA and 100% RCA and the concrete specimen made with 100% RFA, 100% RCA and 50% fly ash of standard size 150mm x 150mm at 7 days, 21 days and 28days. The cured cubes were placed on the compressive strength testing machine and load was applied gradually till the failure of specimen occurs. The crushing strength of the specimens were noted.

Fig 4.1 Compressive Strength Test

4.1.2 Flexure Test (Ref: IS: 516-1959)

The flexural strength tests was carried out on the concrete prism specimens made of conventional concrete , the concrete specimen made with 100% RFA and 100% RCA and the concrete specimen made with 100% RFA, 100% RCA and 50% fly ash of standard size 100mm x 100mm x 500mm at 28 days only. The modulus value of rupture can be calculated using the formula as below

$$f_{cr} = (P_{max} \times I)/bh^2$$

Where,

f_{cr} = Flexural -strength

P_{max}= maximum load in (N) kg.

B = width of the prism(mm)

H = depth of the prism (mm)

I = span of the prism(mm)

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

Fig 4.2 Flexural Strength Test

The prism specimens were placed in the central location of the loading frame for allowing the load to be applied centrally making use of the axis of both the specimen and loading device without any surrounding stress. The load is applied to the specimens without any shock and at a continuous steady rate.

4.1.3 Split tensile- strength Test (Ref: IS: 5816-1999)

The M35 grade cylindrical specimens of size 150mm x 300mm conventional concrete , the concrete specimen made with 100% RFA and 100% RCA and the concrete specimen made with 100% RFA, 100% RCA and 50% fly ash were casted, cured and tested for determining its split tensile strength at 7, 14, 28 days. While casting the specimens manual compaction was done 25 times for each layer of concrete using tamping rod.

Before testing, the specimens were sandwiched between the 3mm thick plywood in such a way that the axis of the specimens lies perpendicular to the axis of the load applied.

Two packing strips of plywood 3mm thick were provided .

The load is applied to the specimens without any shock and at a continuous steady rate.

Fig 4.3 Split Tensile Strength Test

Tensile strength of concrete, $f_t = 2P/\pi DL$

Where, P = Maximum load in N applied to specimen

D = Measured length in cm of the specimen

L = Measured diameter in cm of the specimen

V. RESULTS AND DISCUSSION

5.1 GENERAL

This part of the paper deals with the various results obtained from the experimental investigations conducted on the specimens prepared with demolished aggregates. Various mechanical and physical properties of the RAC were calculated and presented.

5.2 MECHANICAL PROPERTIES

5.2.1 Compressive Strength

The compressive strength obtained for various mixes of concrete prepared with natural aggregates and recycled aggregates in both fine and coarse form is shown below Table 5.1.

Table 5.1: Compressive Strength

Curing	COMPRESSIVE STRENGTH

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

days	N/mm^2		
	Mix 1(0%)	Mix 2 (100% RFA & 100% RCA)	Mix 3 (100% RFA & 100% RCA & 50% Flyash)
7 days	26.2	26.70	25.40
14 days	33.9	35.10	31.90
28 days	39.9	41.60	38.01

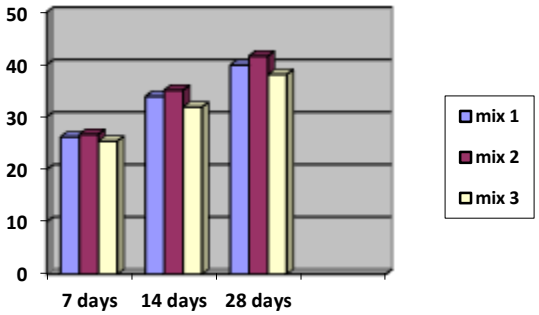

Fig:5.1

5.2.2 FLEXURAL STRENGTH

The flexural strength obtained for various mixes of concrete prepared with natural aggregates and recycled aggregates in both fine and coarse form is shown below

Table 5.2: Flexural Strength

Curing days	FLEXURAL STRENGTH N/mm^2		
	Mix 1(0%)	Mix 2(100% RFA & 100% RCA)	Mix 3(100% RFA & 100% RCA &50%fly ash)
28 days	4.87	5.01	4.55

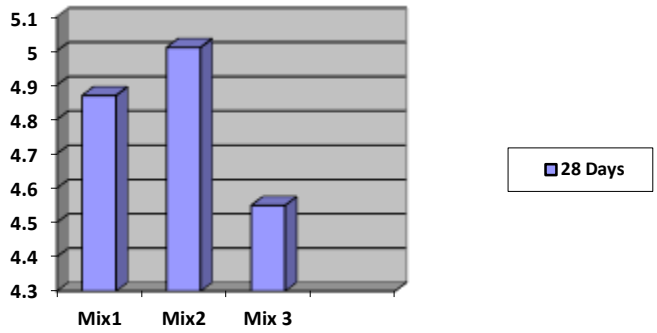

Fig:5.2

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

5.3 SPLIT TENSILE STRENGTH

The of split tensile-strength for various mixes of concrete prepared with natural aggregates and recycled aggregates in both fine and coarse form at the age of 28days with different percentage of demolished concrete waste is shown below

Table 5.3: Split tensile - strength

Curing days	SPLIT TENSILE STRENGTH N/mm^2		
	Mix 1(0%)	Mix 2 (100% RFA & 100% RCA)	Mix 3(100% RFA & 100% RCA &50%flyash)
7 days	2.55	2.58	2.32
14 days	3.47	3.63	2.99
28days	4.1	4.26	3.72

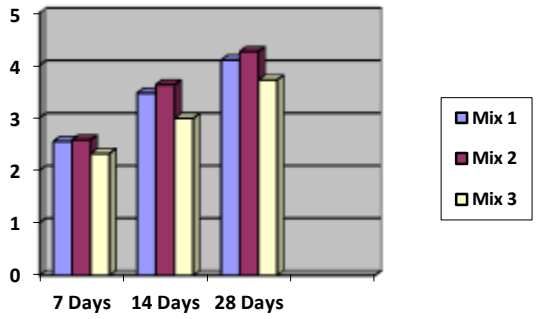

Fig:5.3

VI. CONCLUSION

The Concrete grade used for this research is M35 and the various conclusions drawn from the experimental investigations done are as follows,

1. A considerable increment of compressive strength in the replaced recycled aggregate concrete (Mix 2) was found.
2. In addition of fly ash in the mix with 50% of replacing the cement the compressive strength has decreased by 4% from the nominal mix. This may be overcome by redesigning of water cement ratio (W/C).
3. The flexural strength also increased around 3 % in the replacing aggregate concrete, at the same time when adding the fly ash to the concrete mix the flexural strength decreases by 5%.This can also be overcome by redesigning of water cement ratio.
4. An increase in the split tensile strength was observed in the concrete with 100 % RA whereas for fly ash recycled aggregate concrete as decrease in noticed.
5. The use of demolished waste into useful building product will contribute to solving disposal problems along with fulfilling the criteria of structural concrete properties..

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

VII. REFERENCES:

1. **Murnalini Deshmukh , "**Replacement of fine aggregate by demolished waste concrete **",** Volume:5 , Issue :3.
2. **M.L.V Prasad , P.Rathish Kumar , "** Mechanical properties of fiber reinforced concretes produced from building demolished waste", Volume :2 .
3. **N.Manoj , N.Nandhini ,"**Experimental investigation fibre reinforced concrete with partial replacement of coarse aggregate by steel slag ", Journal :IJIRSET ,Volume :3 ,Issue :2.
4. Hisham Qasrawi, Faisal Shalabi and Ibrahim Asi, "Use of low CaO unprocessed steel slag in concrete as fine aggregate*", Construction and Building Materials,* (2009) 1118–1125.
5. Konstantin Sobolev, "Mechano-chemical modification of cement with high volumes of blast furnace slag", *Cement & Concrete Composites*,(2005) 848–853.
6. D**.Sureshkumar , J.Vikranth** , "Experimental studies on strength and durability characteristics of fibre reinforced recycled aggregate concrete ", Issue :6 , Volume :3 ,Journal :IJERA .
7. **Vaishali .G.Ghorpade** , "Effect of recycled coarse aggregate on workability and shear strength of fibre reinforced high strength concrete. " , Volume :2 , Issue :8 , Journal :IJIRSET.
8. Mustafa Sahmarana, Ismail, O. Yaman and Mustafa Tokyay, "Transport and mechanical properties of self-consolidating concrete with high volume fly ash", *Cement & Concrete Composites* 31 (2009) 99–106.