Abinas S, Jeeva K, et. al. International Journal of Engineering Research and Applications
www.ijera.com
ISSN: 2248-9622, Vol. 10, Issue 6, (Series-III) June 2020, pp. 42-46

RESEARCH ARTICLE OPEN ACCESS

Experimental Investigation on Green Concrete Using Partial Replacement of Fly Ash and Reused Agreegate

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ABSTRACT
The amount of construction wastes is recently increased in this decade, because demolition of old buildings. The waste concretes are generally useless, they were disposed by earth embankments and landfills. The availability of natural aggregates are decreased during construction activities. So we need to identify the replacements for aggregates.This paper discussion about the usage of Recycled Concrete Aggregate (RCA) 50% replace the natural coarse aggregate in Concrete. Due to usage of Recycled concrete aggregate strength will be reduced, to improve the strength of concrete admixtures will be added. Fly Ash added in 4 differentpercentages0%,10%,15%,20%. Compressive strength calculated for 7days, 14days, 28days and split tensile strength calculated for 14 days and 28 days. This paper mainly focus about which
percentage of silica fume gives the required strength
Keywords: Compressive Strength, Concrete, Fly Ash (FA),Natural Coarse Aggregate (NCA), Recycled Coarse Aggregate (RCA).

Date of Submission: 21-05-2020 Date of Acceptance: 07-06-2020

I. INTRODUCTION

1.1General

Green concrete is revolutionary topic in the history of concrete industry, this was first invented In Denmark in year 1998. It represents the environment, which is our surrounding. Concrete which is madefrom concrete wastes that are eco-friendly are called as "Green concrete".Energy saving, CO2 emissions and waste water.

The central goal of Green Concrete is to reduce the environmental impact of conventional concrete.

Several factors which enhances the suitability of green concrete in structures include

- Reduction of emission of CO_2 by 30%.
- Increased concrete industries use of waste products by 20%.
- Good thermal and fire resistance, sound insulation then the traditional concrete.
- Flexural strength of the green concrete is almost same as conventional concrete.
- Improve damping resistance of the building.

1.2 METHODOLOGY

- Study of material
- Collection of material
- Test on materials
- Casting of cube and curing
- Flexural test and compression test
- Report submission

II. LITERATURE REIVEW

Dhoka (2013), carried out "green concrete: using industrial waste of marble powder, quarry dust and fly ash" The green concrete is prepared by using industrial waste of marble powder, quarry dust and with fly ash proper proportions".

Garg and Jain (2014), studied on green concrete: efficient & eco-friendly construction materials. It presents the

feasibility of the usage of by product materials like fly ash, quarry dust, marble powder/granules,plastic waste and recycled concrete and masonry as aggregates in concrete. It concluded that, itfocuses on known benefits and limitations of a range of manufactured and recycled aggregates. Use of concrete product like green concrete in future will not only reduce the emission

of CO2 in environment and environmental impact but it is also economical to produce.

Arun Borsaikia (2015), studied about the fly ash & its properties and comes to the conclusion that various parameters of both fresh and hardened concrete are getting changed due to fly ash content. Following conclusions can be made. 1. Workability of concrete improves with addition of fly ash up to certain limit. 2. Ultimate compressive strength of concrete increases with replacement of cement by silica at certain specified limit. 3. Ultrasonic Pulse Velocity increases with increase in compressive load initially and the decreases with increase in compressive load due development of micro cracks in concrete. Abrupt decrease in Ultrasonic Pulse Velocity occurs at 70-80% of failure load

Praveer Singh (2016), studied about the silica fume and comes to the conclusion that cement is becoming a scarce resource all over the world because of increase in demand day by day. The use of silica fume as a pozzolana material has increased in recent years because when mixed in certain proportions it enhances the properties of both fresh and hard concrete. Addition of silica fume in proper proportion improves durability attack by acidic waters and improving concrete conditions.

III. MATERIAL COLLECTION

3.1 Fly ash

Fly ash is a fine powder which is a byproduct from burning pulverized coal in electric generation power plants. Fly ash is a pozzolanic ,a substance containing aluminous and siliceous material that forms cement in the presence of water. When mixed with lime and water it forms a compound similar to Portland cement.

The fly ash produced by coal-fired power plants provide an excellent prime material used in blended cement, mosaic tiles, and hollow blocks among others.

Fly ash can be an expensive replacement for Portland cement in concrete although using it improves strength, segregation, and ease of pumping concrete. Nonetheless, the amount of fine aggregate should be reduced to accommodate fly ash additional volume.

FIG.1.FLY ASH

3.2Fly Ash Applications

Fly ash can be used as prime material in blocks, paving or bricks; however, one the most important applications are PCC pavement. PCC pavements use a large amount of concrete and substituting fly ash provides significant economic benefits. Fly ash has also been used for paving roads and as embankment and mine fills.

3.3 Recycled Concrete aggregates

They were derived from waste concretes either manually or mechanically. It has less durability and strength when compared to normal aggregates. The shape and size of RCA is uneven and the water absorption is also high.

3.4 Normal Materials

a) Cement It is very fine powder with adhesive properties. It has better binding property and hence used as a binder in concrete. The Ordinary Portland Cement is used for construction worldwide. The Ordinary Portland Cement of 33 grade (Ultra-tech OPC) conforming to IS:8112-1989 is used.

b) Natural Coarse aggregate The size between 20 mm to 4.75 mm are named as coarse aggregate. It gives the strength to concrete. The Coarse Aggregates are manufactured from Basalt rock. The properties of coarse aggregate conforming to IS: 383 are used.

Reused Aggregates

Demolished bricks were collected from the demolished building of age 50 years. The collected sample were broken manually into pieces of size passing through 4.75mm IS sieve and retained on 150 micron IS sieve.

S.No	TESTS	STANDARD VALUES	OBTAINED VALUES
1.	Specific Gravity	1.80 – 2.0	1.96
2.	Water	28% - 30	30%

	Absorption	%	

Table No. 1: Properties of Demolished Brick Wastes

c) Fine aggregates Fine aggregates are used as filler material in concrete. It reduces the amount of voids presents in the concrete. The fractions between 4.75 mm to 150 micron are named as fine aggregate. The crushed sand is used as fine aggregate conforming to the requirements of IS:383.

d) Super plasticizer It is a chemical admixture added with water during mixing of concrete. The super-plasticizers are used for the reduction of the water content and involves in the setting time of concrete. Conplast SP430 is used for this project.

IV. MIX DESIGN

M20[IS 10262:2009]
Cement = 372 kg/m3
Fly ash = 66 kg/m3
Water = 197 kg/m3
Fine aggregate = 702 kg/m3
Coarse aggregate = 1084 kg/m3
Reused aggregate=738 kg/m3
W/C Ratio 0.45

V. PREPARATION OF CONCRETE

The mix design for the M20 grade of concrete was carried out based on the guidelines given in IS 456-2000. Volume batching method is used for the project. The water cement ratio of 0.45 is used. The Recycled Concrete Aggregate is 50% replace the natural coarse aggregates in all samples. Totally 4 samples of silica fume is added in 6 different percentages 0%,10%,15%,20% in concrete. Workability of concrete is calculated, without super-plasticizer the workability is not obtained, but after adding the super- plasticizer the workability is good.The Compressive strength is calculated for 7days, 14days, 28days and the split tensile strength is calculated for 14 days and 28 days.

COMPOSITION: (50% NCA + 50% RCA) + FA + (various percentage of cement and flyash)

CUBE 1: A conventional cube made of normal M20 concrete.

CUBE 2: A cube with 90% cement and 10% fly ash

CUBE 3: A cube with 85% cement and 15% fly ash

CUBE 4: A cube with 80% cement and 20% fly ash

VI. TEST SPECIMEN

6.1 COMPRESSIVE STRENGTH TEST

Compressive Strength Of Concrete Can Be Defined As The Measured Maximum Resistance Of A Concrete To Axial Loading. The Strength Of The Concrete Specimens With Different Percentage Of RCA And FA Replacement Can Be Indicating Through The Compression Test.

The Specimens Used in The Compression Test Were 150mmx150mmx150mm And Placed For Curing At Two Different Ages (7 Days, 28days). Three Specimens Were Casted For Each Ages And Average Value Is Taken. The Test Was Conducted On Compression Testing Machine Having Capacity 2000 KN. The Maximum Load Applied To The Specimen Until Failure Was Recorded. In This Test The Strength Obtained In KN/m2.

Fig 6.1 Compressive test specimen of conventional concrete cube

6.2 SPLIT TENSILE TEST

Test specimens of concrete cylinder having dimensions150mm diameter and 300mm length in 4 nos. of cylinders were casted for each replacement. They were demoulded after 24 hours and kept in curing tank for curing. They allowed for 28 days. At the end of curing period specimens were taken out and surface water was wiped off from specimens. After that cylinder specimens were tested using universal testing machine. The cylinders are placed in the universal testing machine in such manner that the load is applied to

the cylinder. Split tensile test was carried out on the specimens after 7th and 28th of curing.

Fig 6.2 Split tensile test specimen of conventional concrete prism

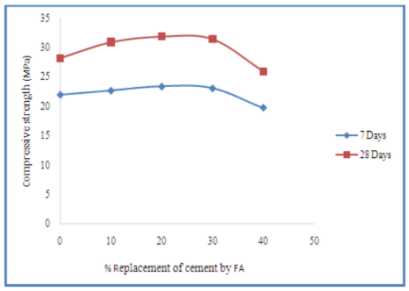
VII. RESUTS

7.1.Compressive test

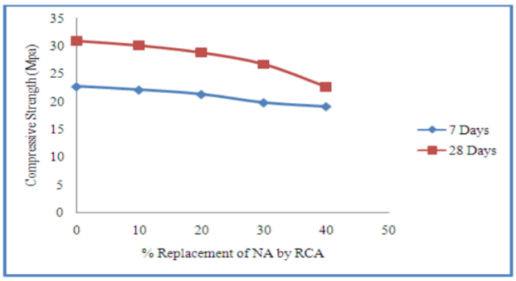
The compression test for fly ash and recycled concrete are conducted at the end of 7 days, 14days and 28 days using compressive testing machine. The cube was casted at room temperature and cured well with water. Water cement ratio of 0.45 is used.

Table 2. Compressive Strength Results

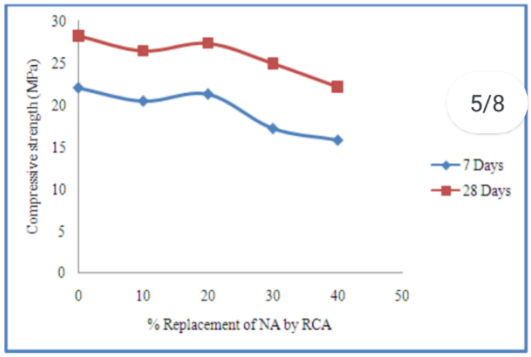
Amount of fly ash	Compressive strength in N/mm^2	
	7day	28 day
0%	14.63	21.64
10%	12.29	18.96
15%	13.87	20.38
20%	12.82	17.75



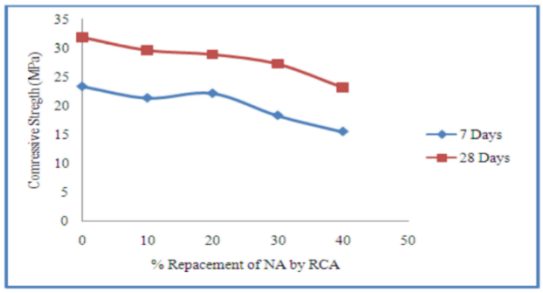
7.1 Compressive strength vs % Replacement of Cement by FA



7.2. Compressive strength vs % Replacement of NA by RCA For0 % FA

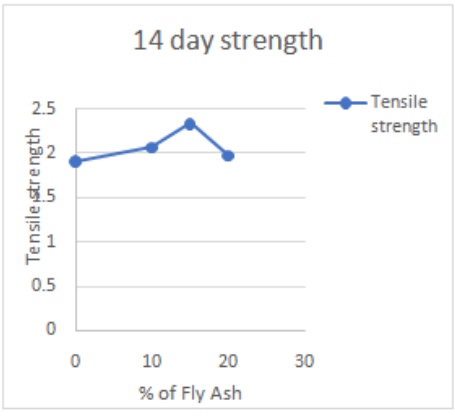


7.3. Compressive strength vs % Replacement of NA by RCA For10 % FA

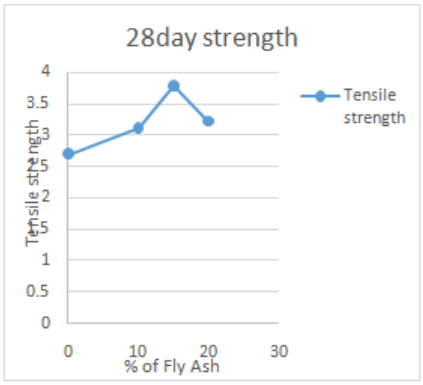


7.4. Compressive strength vs % Replacement of NA by RCA For 20 % FA

7.2.SPLIT TENSILE SRENGTH



7.5 14day tensile strength



7.6 28 day tensile strength

The RCA reduce the tensile strength of concrete, but Fly Ash improve the strength of concrete. Tensile strength increased upto 15% replacement of Fly Ash, After increasing Fly Ash amount tensile strength will be decreased. The optimum amount of Fly Ash is 10 to 15%.

VIII. DISCUSSION

Generally, the compressive strength were decreased as containing RCA without FA in the mixes regardless the curing ages, while the development of compressive strength was observed as increasing amount of FA in the mixes. Compatible compressive strength was developed over the age of 56 days even containing the RCA in the mixes.

IX. CONCLUSION

1. The general properties of RCA including Aggregate impact value, Aggregate crushing value and specific gravity show hardly any noticeable difference from NA, and thus it is proven that RA size affected the workability and strength of concrete and can be seen especially in water absorption. Recycled aggregate concrete may be an alternative to the conventional concrete.
2. Density of RCA concrete is less than of concrete with NCA. This is an advantage in the design of structures where the light weight concrete is performed.
3. The specimens up to 30% replacement of FA get the strength more than ordinary strength.
4. Up to 30% of NCA replaced by RCA gave strength closer to the strength of plain concrete cubes and strength retention is in the range of 88.29-93.61% as compared to conventional concrete.
5. Optimum compressive strength is obtained at percentage replacement of FA (30%) and RCA (20%).
6. The FA and RCA are used as 30% or below 30% replacement of cement and natural aggregate get the strength more than targeted strength.
7. Use of fly ash in concrete can save the coal & thermal industry disposal costs and produce a „greener" concrete for construction.

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