ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 2, Issue 5, September 2013

Effect of Pozzolanic Material on Split Tensile Strength of Recycle Aggregate Concrete

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Abstract. — It can be consider as a call of nature to use the recycled aggregate in construction. Further, if the recycled coarse aggregate are used in conventional construction work it would saves the cost of materials. The aim of this research is to assess the feasibility of inclusion of flyash (as replacement of Cement) for RCA based concrete to improve its quality and secondly, to evaluate the effect of various percentages flyash, RCA, on split tensile strength of concrete. The mix designing is done for two different water cement ratios i.e.0.38 and 0.45. Cylinders are casted using virgin coarse aggregate and replacing virgin aggregate with 20%, 30%, 40%, 50% and 100% recycle coarse aggregate, total sixteen batches are made. Obtained results are than used for multi-linear regression manually and by using SPSS software. Results shows that recycle aggregate up to 40% can be used with 10% flyash for making concrete.

Key words—**Natural Aggregate, Recycle Aggregate, Pozzolanic Material-Fly ash, Split Tensile Strength, Flexural Strength.**

I. INTRODUCTION

In the present Era, the rapid construction growth and growing environmental concerns are the two major issues in construction Industry. A construction industry faces a challenge when it comes to dump the constructional demolished waste. The major part of this constructional waste consists of coarse aggregates. Earlier these waste coarse aggregate were used for land filling or thrown outside locality or in water bodies. On the other hand to reconstruct a demolished structure again, the virgin coarse aggregate are used. This practice depletes the parent rocks. Now, the rate of formation of parent rock is much less than the rate of depletion. Therefore, it can be consider as a call of nature to use the recycled aggregate in construction. Further, if the recycled coarse aggregate are used in conventional construction work it would saves the cost of materials. To address the problem of waste management in the country the Ministry of Environment and forests, Government of India constituted a committee to evolve a road map for the management of waste in India and to suggest a policy and strategy for achieving the same.**1** Recycling of demolished concrete is gaining importance because it protects natural resources and eliminates the need for disposal by using the readily available concrete as an aggregate source for new concrete or other applications.**2** The aim of this research is to assess the feasibility of inclusion of flyash (as replacement of Cement) for RCA based concrete to improve its quality and secondly, to evaluate the effect of various percentage flyash, RCA, on split tensile strength of concrete. Recycling of concrete is a relatively simple process. It involves breaking, removing, and crushing existing concrete into a material with a specified size and quality.**2**The quality of concrete with RCA is very dependent on the quality of the recycled material used. In the process of manufacturing such recycled aggregate, the manufacturing cost and amount of CO2 emissions is likely to rise sharply, consequently limiting the extent to which recycled aggregate concrete is used**.**

II. EXPERIMENTAL PROGRAMME

Materials Used:-

Portland Pozzolana Cement of grade **53MPa** conforming to **IS: 1489 (Part-I)** is used. **Sand** available from the local source is used which conforms to **zone-II** as per **IS: 383-1970**. **Water** available within the Institute from the bore well is used and conforms to **IS- 456:2000 Low Calcium Flyash**is obtained from the **Korari Thermal Power Plant**, Nagpur **Coarse Aggregate** from the local available source is used; they were classified as basalt, **Recycle Coarse Aggregate** is obtained from the demolished specimen of concrete at the laboratory of the Institute respectively. Since, there is no IS code conformation is used for standardizing the type of recycle aggregate. The particle size distribution curve is shown in figure-1 below for the virgin coarse aggregate and recycles coarse aggregate.

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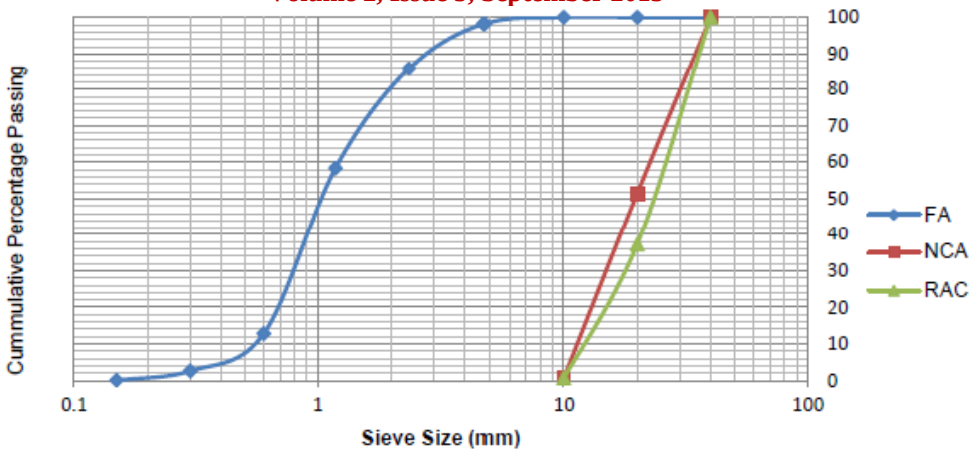

Figure 1: Grade Curve

Chemical Composition	Cement (%)	Flyash (%)
SiO_2	20	66.82
Fe_2O_3	3	6.33
Al_2O_3	6	20.97
CaO	64	2.43
MgO	3.5	0.80
SO_3	2	2.51
Alkalies	0.6	0.34

Table no.1: Shows the composition of cement and Flyash

III. METHODOLOGY

At first the material properties are found from laboratory test. These properties are required for the mix designing **M30** grade concrete according to **IS 10262:1983**, further to compare the properties of recycle coarse aggregate and virgin coarse aggregate the properties are required. The mix designing is done for two different water cement ratios i.e.**0.38** and **0.45.** The first one is designated as **Mix A** and later is designated as **Mix B**. After, the mix designing the cylinders of 150mm dia and 300mm long are casted for the split tensile test. A total of 144 cylinders are casted using virgin coarse aggregate and replacing virgin aggregate with **20%, 30%, 40%, 50%** and **100%** recycle coarse aggregate, total sixteen batches are made. Test is done after **7 days, 28 days and 90 days.**

IV. RESULTS

A. Result of Split tensile Strength test

The results obtained in split tensile test of cylinders are shown in the figure-2 and figure-3 for Natural Coarse aggregate and varying percentage of recycle Aggregate. The split tensile strength of mix A for Natural Coarse Aggregate concrete after 28 days of curing is **3.4 N/mm2** and for recycle aggregate concrete with 100% replacement is **3.1 N/mm2**. And for 90 days of curing it is **3.89 N/mm2** for NCA and **3.57 N/mm2** for RAC100. Again, for mix B the split tensile strength at 28 days is **3.22 N/mm2** for **NAC** and at 90 days is **3.81N/mm2**. Split tensile strength after 28 days of curing is **2.75N/mm2** for RAC100 and at 90 days is **3.39N/mm2**.

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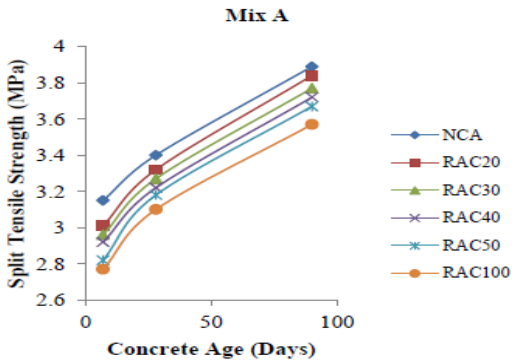

Figure-2

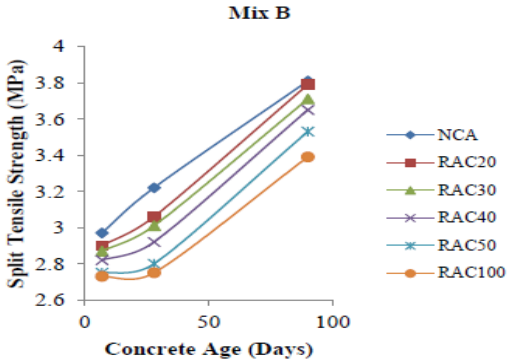

Figure-3

When pozzolanic material i.e. Fly ash is added to the recycle aggregate at about 10% of cement replacement, the split tensile strength of Mix A after 28 days of curing of RAC100 is **2.73 N/mm2** and for 90 days it becomes **3.65 N/mm2** in figure-4. Similarly, for Mix B the strength after 28 days of curing of RAC100 is **2.58 N/mm2** and for 90 days it becomes **3.55 N/mm2** in figure-5.

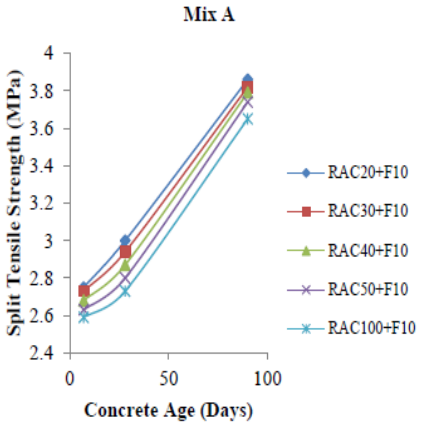

Figure-4

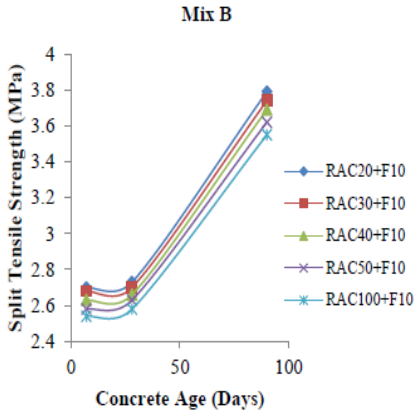

Figure-5

With **20% Flyash**the split tensile strength of **RAC100** for 28 days is **2.45 N/mm2** and for 90 days is **3.28 N/mm2 for** Mix A. And for Mix B the split tensile strength of **RAC100** for 28 days is **2.28 N/mm2** and for 90 days is **3.13 N/mm2.** The obtained results are then used for multi-linear regression analysis

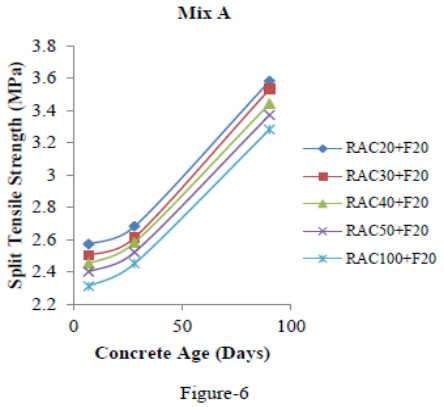

Figure-6

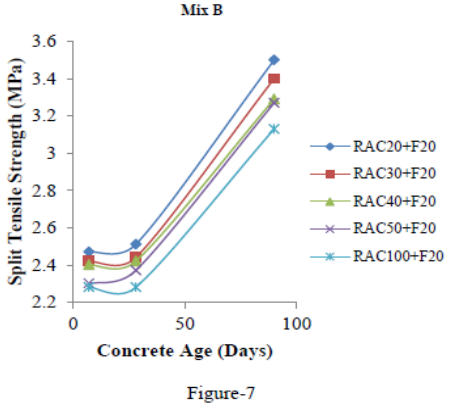

Figure-7

B. Result of Multi Linear Regression:-

To investigate the effect of various parameters mix, a multi linear regression and SPSS software are used on experimental value. Both methods yield the same value for coefficients for parameters. The parameters

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considered for the analysis are percentage of recycle aggregate, percentage of flyash, water cement ratio, age of concrete. The relation obtained after regression is shown below:

Y = 3.68 - 0.003 X1 - 0 .0222X2+ 0.0117X3- 1.92X4 --------- (1)

In equation (1) **Y** is predicted Split tensile strength in N/mm2, **X1** is the percentage of recycle aggregate, **X2** is the percentage of flyash, **X3** is the age factor, and **X4** is w/c ratio of concrete in days.

The figure-8 shows the comparison between the experimental value and predicted value.

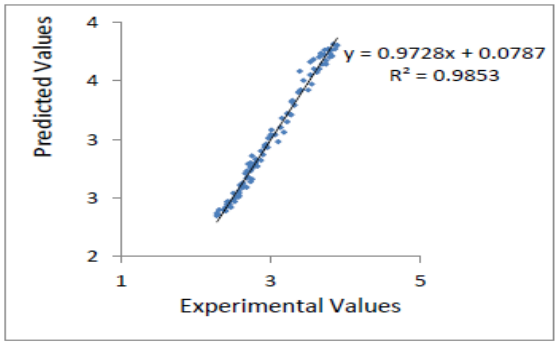

Figure-8

V. CONCLUSION

From the results obtained experimentally following conclusion can be made:

1. The strength of concrete decrease with the increase in the percentage of RAC. This may be because of the less adhesion between the cement matrixes and recycle aggregate.
2. The 28 days split tensile strength decreases more with increase in water cement ratio as compare to the 90 days split tensile strength. This may be due to use of pozzolana cement which develops its strength on later stage.
3. At 20% RAC the both mix shows results much nearer to the results of NCA based concrete.
4. At 100% RAC and 10% flyash shows the results which can be accepted as per the rules of design according to IS Code for test result.
5. The maximum Split tensile strength is obtained for mix A with RAC40 and F10.
6. The recycle aggregate require to be cleaned well before use, it may increase the transition bond strength between cement matrix and aggregate surface and may yield better results.

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