International Journal of Research (IJR)
e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 05, May 2015
Available at http://internationaljournalofresearch.org

Studies on the Mechanical Properties of Glass Fiber Reinforced Concrete with Using Recycled Aggregate

Perumal raja V [1]; Ganesan P[2]

[1]Assistant Professor , Dept of Civil Engg, UCET, Tamil Nadu,India,vpraja.civil@gmail.com
[2]Assistant Professor , Dept of Civil Engg,, UCET ,Tamil Nadu. ganeshpec2011@gmail.com

Abstract

The use of Recycled Concrete Aggregate is gaining importance throughout the globe due to the depleting source of natural aggregate and disposal problem of demolished waste. Concrete is a versatile material with numerous applications thus by using recycled aggregate in it we can achieve economy and sustainability, but the only problem is its brittleness. Thus this brittleness in concrete can be overcome by dispersing fibers discretely in the concrete. The aim of this research work is to determine the suitability of glass fibers for use in structural recycled aggregate concrete of high strength. In this research work we have partially replaced recycled aggregate concrete (0%, 20%, 40%, 60%) with varying percentages of glass fibers (0.02%, 0.04%, 0.06%) and have compared it with the corresponding conventional aggregate concrete. Thus the mechanical properties of M20 grade concrete with various replacements levels of coarse aggregate were studied and it was found that Recycled Aggregate Concrete (RAC) had lower strength compared to Natural Aggregate Concrete (NAC) and showed an increase in strength with the addition of fiber.

Keywords:-
High strength concrete; Recycled Aggregate Concrete; Glass Fiber Reinforced Concrete

1. Introduction

Recycled aggregates are generally comprised of crushed inorganic materials that have been used in the construction and demolition debris. The aim for this on – going project is to determine the strength characteristic of recycled aggregates for application in high strength concrete, which will provide a better understanding on the properties of concrete with recycled aggregates, as an alternative material to natural aggregate in structural concrete [1]. Recycling is the process of using the waste material to produce new products. Due to the advancement in the infrastructure area and to reduce the usage of natural aggregate, the usage of recycled aggregate is getting more and more intense. The recycled aggregates are generally from roads, buildings, bridges, and sometimes even from certain unpredicted disasters such as, wars and earthquakes. Due to the critical shortage of natural aggregate, the usage of demolished recycled concrete aggregate (RCA) is increasing. Using this waste aggregate as RCA, it conserves natural aggregate by decreasing the energy consumption and provides cost saving. Recycled aggregates are truly the material for the future. The application of RCA has been started in many countries for construction projects.

2. Significance of the present work

It is known from the literature that proper introduction of fibers in conventional concrete improves both mechanical properties and durability. Therefore an attempt has been made, in the present work to assess the mechanical

International Journal of Research (IJR)
e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 05, May 2015
Available at http://internationaljournalofresearch.org

properties of high strength recycled aggregate concrete mixes Containing glass fibers and to arrive at the optimum dosage of glass fibers. In our work three different fiber contents were used to study the effect of addition of fibers on the properties of high strength recycled aggregate concrete. The results of the present work are encouraging and substantiate the use of the recycled aggregates and glass fibers in the construction.

3. Experimental investigation

3.1Materials and method

a)Cement

Ordinary Portland cement (OPC) of 43 grade confirming to IS 8112-1989was used for the experimental work. The physical properties of cement are shown in Table 1.

S.NO	Property	Test Method IS 4031	Test Result
1.	Normal Consistency	Vicat apparatus	32%
2.	Specific gravity	Specific gravity bottle	3.14
3.	Initial setting time	Vicat apparatus	35 mins
4.	Final setting time	Vicat apparatus	320 mins
5.	Fineness	Seive test on sieve no.9	5%

Table 1: Physical properties of cement

b) Fine Aggregate

The fine aggregate used in this experimental investigation was natural river sand confirming to zone IIIof IS 383-1970 and having specific gravity 2.61

c) Natural Coarse Aggregate

Machine crushed well graded aggregates of nominal size 20mm and specific gravity 2.79 was used as natural aggregate

d) Recycled Coarse Aggregate

Recycled aggregate from demolished waste was chipped and was used as recycled coarse aggregate.

e)Water

Portable water available in laboratory was used for mixing and curing the concrete specimens.

f)Pre Soaking Treatment

The recycle aggregates were crushed and soaked in acidic environment for 24 hours and then washed water soaked for 24 hours and dried [2].

4.Testing Procedure

In this experimental work the concrete specimens were casted and tested according to the standard procedure. The specimens consisted of 150 mm x150 mm x 150 mm cubes, 500 mm x 100 mm x 100 mm prisms and 300 mm x 150 mm cylinders. The mix design of concrete was done according to Indian standard guidelines for the target mean strength of 27.6 N/mm^2 and the water-cement ratio is 0.5. The present study was carried out on natural aggregates by replacing with Recycled coarse aggregate. Recycled aggregate was procured from a demolished building at Tindivanam. The experimental work consists of three phases; first phase consists of casting and testing of conventional concrete specimens. In the second phase natural aggregates were replaced by recycled aggregates and tested. In the third phase to increase the strength of the RCA specimens

International Journal of Research (IJR)
e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 05, May 2015
Available at http://internationaljournalofresearch.org

glass fibers were added discretely and the strengths of the specimens were studied.

5. Results and discussions

The test results such as compressive strength, split tensile strength and flexural strength with different proportions of recycled aggregate and glass fibers are discussed below,

5.1. Compressive Strength

Compressive strength is the major parameter which influences other properties of concrete. The compressive strength of conventional aggregate concrete at 7 & 28 days were observed to be 19.33Mpa and 28.7Mpa. The test results for the different proportion of mixtures are listed in the table below. From above test results it is clear that when the natural coarse aggregate is substituted with RCA, the compressive strength reduced by 4.45%. This may be due to the fact that the failure of normal strength concrete is caused by mortar failure. Thus this decreasing strength is improved by the addition of 0.06% optimum glass fiber content.

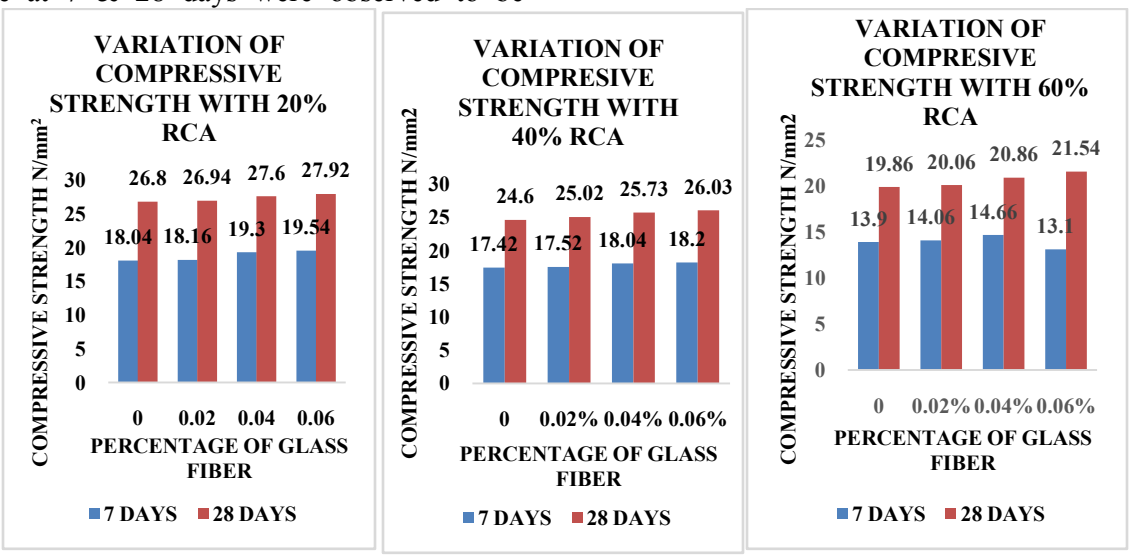

Figure 1: variation of compressive strength

5.2. Split Tensile Strength

Spilt tensile strength of the conventional aggregate concrete at 7 & 28 days were observed to be 2.90 Mpa and 3.96 Mpa. The strength results of the different proportion of recycled aggregate (0%, 20%, 40%, and 60%) for the fiber content 0.02%, 0.04% and 0.06% are listed in the table below.Here,when the natural coarse aggregate is substituted with 60% RCA, the tensile strength reduces by 33.85% and optimum fiber content of 0.06% was added to enhance it.

International Journal of Research (IJR)
e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 05, May 2015
Available at http://internationaljournalofresearch.org

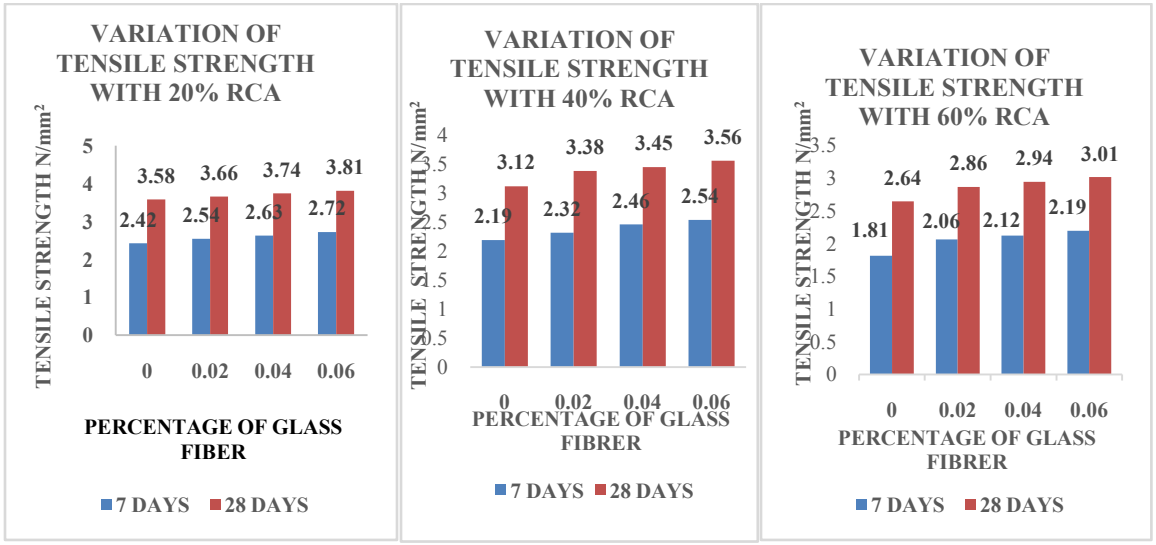

Figure 2: variation of split tensile strength

5.3. Flexural Strength

Flexural strength of the conventional aggregate concrete at 7 & 28 days were observed to be 4.63 Mpa and 6.44 Mpa. The strength results of the different proportion of recycled aggregate (0%, 20%, 40%, and 60%) for the fiber content 0.02%, 0.04% and 0.06% are listed in the table below. When the natural coarse aggregate is substituted with 60% RCA, the flexural strength reduced by 20.82 % and so fiber content of 0.06% was added to enhance it.

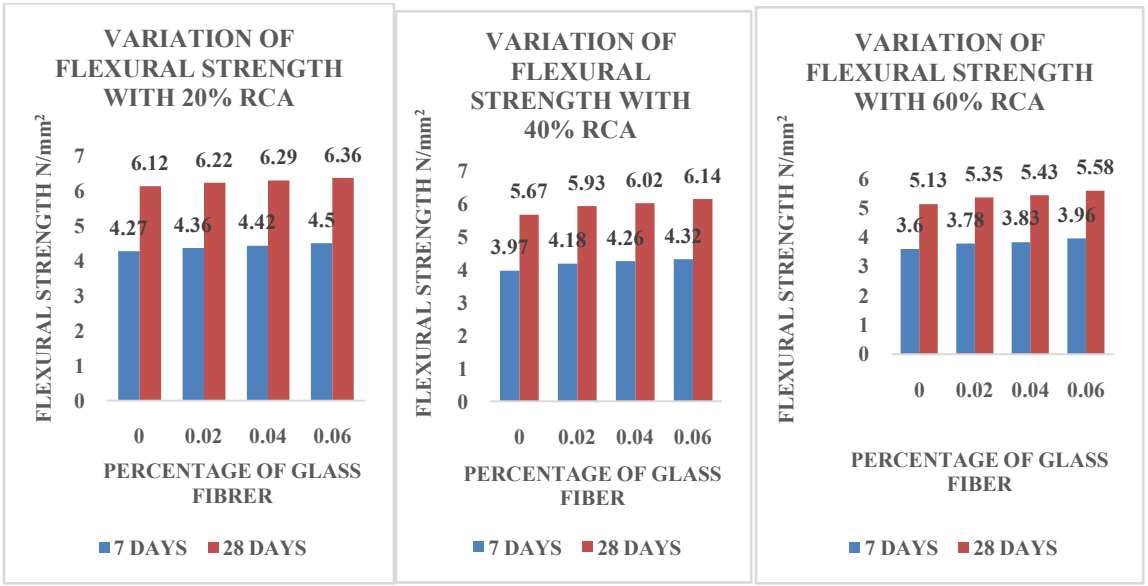

Figure 3: variation of Flexural strength

6.Conclusions

Based on the experimental investigations carried out on high strength glass fiber reinforced concrete with partial replacement of natural coarse aggregate by recycle coarse aggregate, the following conclusions are drawn:

Thus the mechanical properties such as the compressive strength, flexural strength and split tensile strength were enhanced with the increase in fiber content from 0.00% to 0.06% the volume of the concrete.

The ductility character of the conventional concrete beams were improved by adding glass fiber, thus indicating an improvement in the tensile strength of concrete beams.

The strength of RCA concrete at all fiber content are comparable to those of concrete with conventional aggregate. Thus it clearly suggests the use of glass fibers in high strength RCA concrete.

Reference

[1]V.Bala Krishna, M.K.M.V.Ratnam, Dr.U.Ranga Raju., (2014)An experimental study on compressive strength of Fiber Reinforced High Strength Concrete Using recycled Coarse Aggregate*, IJERD* Volume 10 Issue 12, PP.45-51,2014

[2].G.Murali, C.M. Vivek varadhan, Gabreila Rajan, G.J. Janani, N.Shifu Jajan and R.Ramya sri,(2012) Experimental study on reinforced aggregate concrete,*IJERA*, Vol.2, Issue 2, PP.407-410,2012

[3].K.Jagannadha Rao and T.Ahmed Khan, Suitability of glassfibers in high strength recycled Aggregate concrete-an experimental investigatin. Asian *journal of civil engineering(Building and Housing)*, Volume 10, No. 6, PP 681 – 689,2012

[4]IS:383-1970, Specifications for Coarse and Fine aggregate from natural sources for concrete(Second revision).

[5]IS:10262-2009, Recommended guidelines for concrete mix design, *BIS,* Newdelhi, India 2009.

[6]IS:456-2000, Specifications for plain and reinforced concrete.

[7]IS:516-1959, method of test for strength of concrete, *BIS indian standards* ,NewDelhi, India.

[8]IS:5816-1999, method of test for spliting tensile strength of concrete, *BIS,* NewDelhi.india.

[9]IS:9399-1979, Specifications for apparatus for Flexural testing of concrete *BIS* ,NewDelhi.india