EXPERIMENTAL INVESTIGATION ON RC COLUMNS USING RECYCLED AGGREGATES AND TETILE FIBRE

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Abstract

Day by day the concrete wastes generation was getting increased. The concrete wastes are getting from the demolished buildings, bridges, and other infrastructure structures. The demolished concrete wastes are difficult to handle, those wastes are cannot be dumped under the soil likewise other wastes. The demolished wastes need some special care to taken care of, by avoiding the wastes to dumping on the soil. At the same time to reduce the fresh aggregate usage, the aggregates from the demolished concrete debris are recycled from the concrete wastes and used as a replacement of the fresh aggregates in concrete. The fresh aggregate resources are not a sustainable resources, so the usage of fresh aggregates are need to be reduced and at the same time the wasting of fresh aggregates are need to be sorted. So, the project is about to replacing the fresh concrete aggregates by the recycled concrete aggregates with textile fibre. Normally textile fibre fabric concrete is used to repair the concrete structure. But in this case the textile fabrics are used to strengthening the recycled aggregate concrete. The textile fabric is added in the recycled aggregate concrete by 0%, 0.5%, 1.0%, 1.5% which proportion going to give the maximum strength is found out by checking the compressive strength of the concrete elements.

Key words: Textile Fabric, Recycled Aggregate, Concrete Columns, Compressive Strength.

I. Introduction

In this rapid industrialization world recycling the construction used is the only solution to reduce the usage of natural resources [1]. The use of recycled construction materials is giving a good result in saving the environment, and the continental countries of Europe, Africa, Asia are generating large amount of construction wastes [2].The usage of recycled aggregates are saving the world form industrial waste for the future generation, many countries giving some relaxations for the infrastructure development due to the large amount of waste generation [3]. The construction industries are expecting sustainable materials and solutions, the novel building materials like Textile Fibre Reinforced Concrete maybe used to meet that demand [4]. The usage of Textile Fibres as a replacement for the reinforcement in concrete may increase the mechanical behaviour of concrete [5]. Sustainable development and environmental protection are become main roles in modern construction, the reduction of pollution and natural resources usage and energy savings are facts of civil engineering[6]. Reducing the construction waste and minimise the natural resource consumption are possibly done by using the demolished wastes in reinforced concrete [7]. The consumptions of

concrete as construction material is increased, as simultaneously the usage of fresh aggregates are also getting increased its clearly lead to exploitation of natural resources so by replacing the natural aggregates by the recycled aggregates [8]. The building demolition wastes consist of crushed concrete wastes and crushed brick wastes. The effect of replacement of recycled aggregates for a certain percent was discussed [9]. The novel construction materials are used not only to economically improvement but for helping the environment [10]. The encouraging method of recycling the aggregates is made up of the searching of sustainable materials in concrete [11]. To decrease the energy produced during the production of concrete is done by using demolished wastes in fresh concrete [12]. The amounts of generation of concrete wastes are increased year by year, the treatment of the concrete wastes are really difficult [13]. The using of recycled aggregates alone are not give the sufficient amount of strength, but by adding micro silica with the recycled aggregate may giving the better results [14]. The concrete wastes may generate every day by day the concrete debris are difficult to handle, so in order to save the environment the concrete debris are used as the aggregates instead of fresh aggregates [16]. The developing of micro crack in the concrete is may evacuated by using the fibre reinforcement instead of RC [17]. To increase the mechanical behaviour of concrete such as ductility, tensile strength is increased by using the nylon fibres [18]. The management of concrete wastes are done by using the concrete waste aggregates instead of fresh aggregates [19].

II. Matrials and Methods

Materials

Recycled Aggregates are main important material used in this project. The recycled aggregates are separated from building demolished waste. By crushing the waste the recycled aggregates are obtained. The recycled aggregates are used to replace the natural aggregates. The recycled aggregates are used to replace the natural aggregates 100%.

Textile fibre is used as a fabric admixture. Nylon is used as a textile fibre. The textile fibre fabric is added in the concrete at the different percentages of 0%, 0.5%, 1%, and 1.5%.

M30 grade concrete is used in this project. OPC is used; Ramco Supergrade brand cement is used. The coarse aggregates are replaced by Recycled aggregates. Fine aggregates of size 2.8mm are used in this experiment.

Testing Methods

The properties of materials such as Specific gravity, water absorption and other Properties are tabulated on Table 1.

Table 1: Properties of Coarse Aggregate

Properties	Natural Coarse Aggregate	Recycled Coarse Aggregate
Specific Gravity	2.6	2.88
Water	0.195%	2.2%
Absorption Impact Value	16.74%	23.15%

The nylon is used in the mortar mix as a textile fibre. The properties of nylon fibre are tabulated on Table 2.

Table 2: Properties of Nylon Fibre

Properties	Values
Tenacity	4-9gm/den(dry)
Elasticity	20-40% breaking extension
Stiffness	20-40gm/den
Moisture regain	3.5-5%
Specific gravity	1.17
Softening point	148^0C
Melting point	215^0C

The experimental analysis was carried out in the concrete mixtures and the mixtures with full replacement of natural coarse aggregate with recycled coarse aggregate with textile fibre. The concrete cubes were casted in moulds of dimensions (150 mm x 150 mm x 150 mm) by hand and after 24 hours, the concrete cubes were consequently cured in water for 7 days and 28 days. The textile fibre is mixed with concrete at 0%, 0.5%, 1% and 1.5% respectively by weight by the method of replacement. The samples were mixed thoroughly and compressive strength test was done. The concrete cylinders were casted in the moulds of dimensions (150 mm x 300 mm) for split tensile test for 28 days; concrete columns that are considered to as short columns are casted on moulds of dimensions (150 mm x 300 mm) for compressive strength test for 28 days.

III. Results

Compressive Strength of Concrete Cubes

The compressive strength test results for concrete cubes containing fully replaced coarse aggregate with textile fibre was tabulated in the Table 3 and shown in Fig: 2. Thus, there was an increase in the compressive strength of the concrete up to 1.5% when compared to the normal (plain) concrete and then the compressive strength decreases in both 7 days and 28 days. The compressive strength of the concrete cubes was increased from 16.72 N / mm^2 to 17.42 N / mm^2 at 7 days and 25.73 N / mm^2 to 26.8 N / mm^2 in 28 days compressive strength of concrete cubes.

Split Tensile Test of Concrete Cylinders

The split tensile strength test results for concrete cylinder containing fully replaced coarse aggregate was tabulated in Table 5 and shown in Fig: 3. Thus there was an increase in split tensile strength of the concrete up to 1.5% when compared to normal concrete in 28 days. The split tensile strength of the concrete cylinders was increased from 1.23 N / mm^2 to 1.44 N / mm^2.

Compressive Strength of Concrete RC Columns

The compressive strength test results for concrete RC columns containing fully replaced coarse aggregate was tabulated in Table 6 and shown in Fig: 4. Thus there was an increase in compressive strength of the reinforced concrete columns up to 1.5% when compared to normal concrete in 28 days. The compressive strength was increased from 45.16 N / mm^2 to 55.46 N / mm^2.

Table 3: Compressive Strength of Concrete Cubes

Textile Fibre	Compressive Strength 7 days (N/mm^2)	Compressive Strength 28 days (N/mm^2)
0%	13.20	20.40
0.5%	16.72	25.73
1%	16.80	25.86
1.5%	17.42	26.80

Table 4: Sieve Analysis of Fine Aggregate

I.S. Sieve Size (mm)	Weight Retained (gm)	Cumulative Weight Retained (%)	Cumulative Percentage Retained (%)	% of Passing
4.75	5	5	0.05	99.5
2.36	45	50	5	95
1.18	235	285	28.5	71.5
600µ	182	467	46.7	53.5
300µ	237	704	70.4	29.5
150µ	246	950	95	5
75µ	42	992	99.2	0.8
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Table 5: Split Tensile Strength on Concrete Cylinders

Textile Fibre	Compressive Strength 28 days (N/mm^2)
0%	38.7
0.5%	45.16
1%	47.5
1.5%	55.46

Table 6: Compressive Strength on Concrete RC Columns

Textile Fibre	Compressive Strength 28 days (N/mm^2)
0%	38.7
0.5%	45.16
1%	47.5
1.5%	55.46

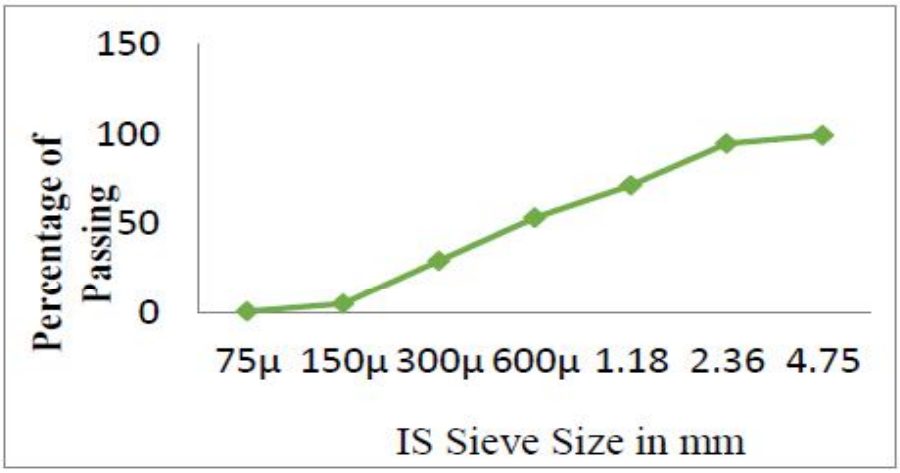

Fig 1: Sieve Analysis of Fine Aggregate

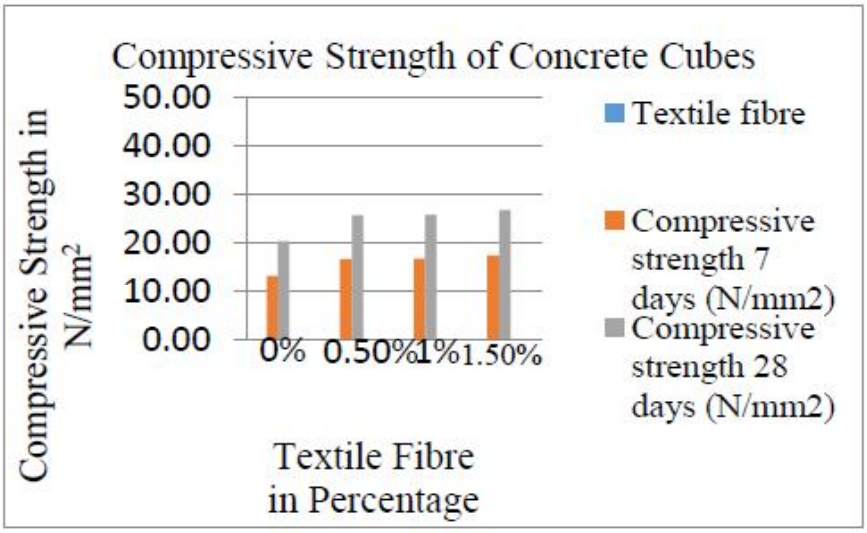

Fig 2: Compressive Strength of Concrete Cubes

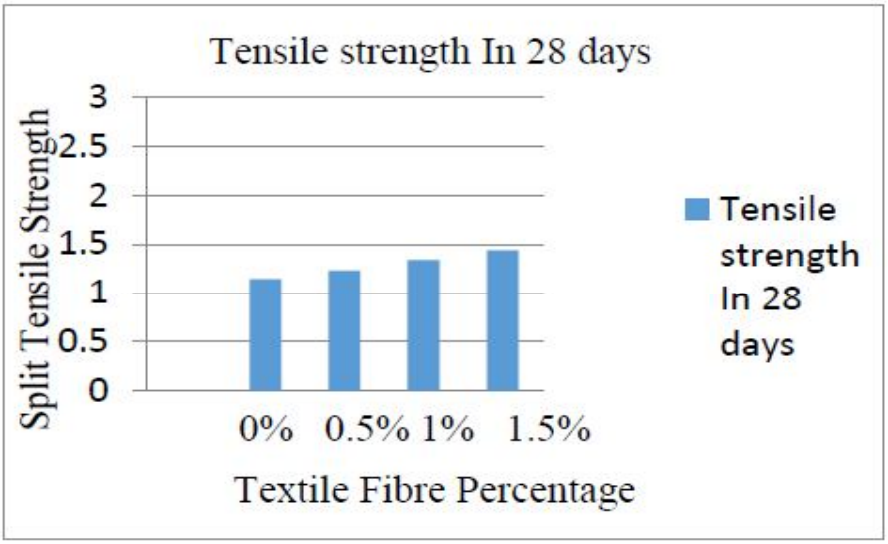

Fig 3: Tensile Strength of Concrete Cylinders

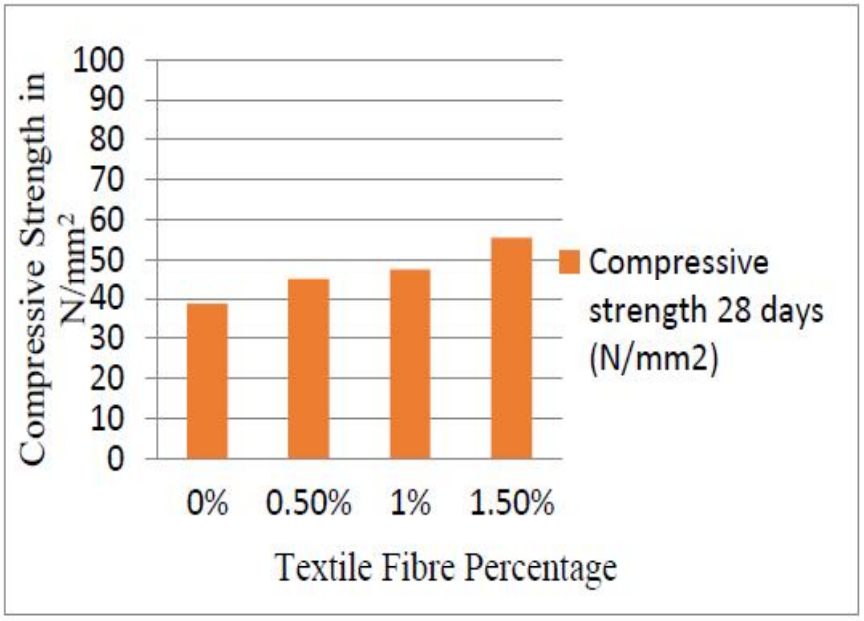

Fig 4: Compressive Strength of RC Columns

IV. Conclusions

From the various investigations on the reinforced columns using recycled aggregate and textile fibres, the following conclusions were made.

1. There was a gradual increase in the compressive strength of both columns and cubes due to the usage of textile fibres and recycled aggregate.
2. At an addition of 1.5 % of textile fibres to the concrete, there was a good strength both in columns and cubes.
3. The optimum usage of textile fibres in recycled concrete was found to as 1.5%.

References

1. Yong.P.C and Teo.D.C.L, "Utilization of Recycled Aggregate as Coarse Aggregate in Concrete", UNIMAS E-Journal of Civil Engineering, Vol.1: Issue 1/August 2009.
2. Sayyam D. Raigandhi, Sagar S. Mane, Shripad B. Kore, "Use of Recycled Concrete Aggregates", International Journal for Research in Applied Science & Engineering Technology[IJRASET], Volume 3 Issue VII, July 2015.
3. Mr. Tushar R Sonawane ,Prof. Dr. Sunil S. Pimplikar, "Use of Recycled Aggregate Concrete", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), ISSN: 2278-1684, PP: 52-59.
4. Natalie Williams Portal; Karin Lundgren; Holger Wallbaum ; and Katarina Malaga, Ph.D., A.M.ASCE, "Sustainable Potential of Textile-Reinforced Concrete", 10.1061/(ASCE)MT.1943-5533.0001160. © 2014 American Society of Civil Engineers.

5. K.Thamizharasan,S.R.Srinivasan, P.Varutharaju and V.Sathishkumar, "Study on Characteristic of Textile Fibre Reinforced Concrete", Singaporean Journal of Scientific Research (SJSR) Issue of International Journal of Applied Sciences (IJAS) Vol.8.No.1 2016 Pp.41-57.
6. Minna Roselin Cherian , Praveen Mathew, "Structural Applicability Of Recycled Concrete With Both Recycled Coarse And Recycled Fine Aggregate", International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2163Volume 1 Issue 9 (October 2014).
7. Asif Ali Bhatti , Bashir Ahmed Memon, "Strength, Deflection and Cracking Behavior of Concrete Slab Using Demolished Concreteas Coarse Aggregates", International Journal Of Engineering Sciences & Research Technology, June 2014.
8. Deepa P.R, Anup Joy, "Strength Parameters of Concrete Containing Recycled Aggregate", International Journal of Recent Trends in Engineering & Research, Volume 02, Issue 0X; Month - 2016 [ISSN: 2455-1457].
9. R. Kumutha and K. Vijai, "Strength of Concrete Incorporating Aggregates Recycled from Demlition Waste", APRN journal of Engineering and Applied Science, VOL. 5, NO. 5, MAY 2010 ISSN 1819-6608.
10. Mr. Hardhik M. Nakrani, Mr. Bharat B. Nathani, "Performance Evaluation of Textile Reinforced Concrete", International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 03 Issue: 04 | April-2016.
11. Legae M. Ngwenya, Shodolapo Oluyemi Franklin, "Influence of RecycledCoarse Aggregate on some Properties of Fresh and Hardened Concrete", IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 2 Issue 12, December 2015.
12. G. Murali , C.M. Vivek Vardhan , Gabriela Rajan , G.J. Janani , N. Shifu Jajan and R. Ramya sri, "Experimental Study on recycled Aggregate Concrete", International Journal of Engineering Research and Applications (IJERA), Vol.2, Issue 2, May – April 2012
13. D.V. Prasada Rao and P.L. Sindhu Desai, "Experimental Investigation of Coarse Aggregate Recycled Aggregate", International Jounrnal of Advances in Engineering & Technology, Nov – 2014.
14. Ajibola I. Tijani , Jian Yang , and Samir Dirar, "Enhancing the Performance of Recycled Aggregate Concrete with Microsilica", International Journal of Structural and Civil Engineering Research Vol. 4, No. 4, November 2015.
15. Ajibola I. Tijani, Jian Yang, and Samir Dirar, "Enhancing the Performance of Recycled Aggregate Concrete with Microsilica", International Journal of Structural and Civil Engineering Research Vol. 4, No. 4, November 2015.
16. S. Muthu Lakshmi & R. R. Nivedhitha, "Effect of Partial Replacement of Aggregates By Recycled Concrete Debris On Strength Of Concrete", Malaysian Journal of Civil Engineering 27(2):250-259 (2015).

17. Amit Rai , Dr. Y.P Joshi, "Applications and Properties of Fibre Reinforced Concrete", Amit Rai et al Int. Journal of Engineering Research and Applications www.ijera.com ISSN : 2248-9622, Vol. 4, Issue 5(Version 1), May 2014.
18. Saravanakumar Jagannathan, Selvaraj Rangasamy & Karthikeyan Kumarasamy, "An Experimental Investigation on Nylon Fibre (Textile Waste) Reinforced Concrete", International Journal of Recent Research and Applied Studies, Volume 3, Issue 1(15) January 2016.
19. I.R. Isan Raj , B. Shanmugavalli, "A Study On The Effect Of Silica Fume On The Properties Of Recycled Aggregate Concrete", IJRDO-Journal Of Mechanical And Civil Engineering ISSN: 2456-1479, Volume-1(Issue-3) March,2015 | Paper-5.