International Journal of Scientific Research in Civil Engineering
© 2020 IJSRCE | Volume 4 | Issue 3 | ISSN : 2456-6667

A Study on Glass Fibre as an Additive in Concrete to Increase Compressive Strength

Prof. Rajendra S. Khamkar[1], Mohini A. Khamkar[2], Ganesh R. Pathare[3]

[1]Assistant Professor Department of Civil Engineering, HSBPVT'S Group of Institution, College of Engineering, Kashti, Ahmednagar, Maharashtra, India.

2 Student Department of Civil Engineering, HSBPVT'S Group of Institution, College of Engineering, Kashti, Ahmednagar, Maharashtra, India.

3Student Department of Civil Engineering, HSBPVT'S Group of Institution, College of Engineering, Kashti, Ahmednagar, Maharashtra, India.

ABSTRACT

Concrete paver blocks were invented in Holland, in the fifties as replacement of paver bricks which had become scarce due to the post-war building construction boom. These blocks were rectangular in shape and had more or less the same size as the bricks. During fifty year, the block shape has steadily evolved from non-interlocking to partially interlocking to fully interlocking shapes. Consequently, the pavements in which no interlocking blocks are used are designated as "Concrete Block Pavement (CBP)" or non-interlocking CBP, and those in which partially, or fully interlocking blocks are used are designated as "Interlocking Concrete Block Pavement."

Keywords : Conventional Blocks, Compressive Strength, Paver Blocks, coir fibre, Fly Ash.

I. INTRODUCTION

Interlocking Concrete Block has been presented in India in development, 10 years prior, for particular requirement to be specific footpaths and parking areas and so on. Presently Interlocking Concrete Block Pavement is being received broadly in various uses where the traditional development of pavement utilizing hot bituminous blend (for flexible pavement) or cement concrete (for rigid pavement) is not desirable or attractive. The construction industry is revolutionizing in two major ways. The other is the advancement in high-performance construction materials, such as the introduction of high strength concrete. Among these high-performance materials, fibre reinforced concrete (FRC) is gradually gaining acceptance from civil engineers. In recent years, research and development of fibres and matrix materials and fabrication process related to construction industry have grown rapidly. Their advantages over other construction materials are their high tensile strength to weight ratio, ability to be moulded into various shapes and potential resistance to environmental conditions, resulting in potentially low maintenance cost. These properties make FRC composite a good alternative for innovative construction. The aim of this study was to identify the improvement in strength characteristics of concrete with the addition of coconut fibre. In the study, coconut fibre is added to concrete and Plain Cement Concrete (PCC) is used as reference to study its effect on flexural, compressive and tensile strength properties and also drying shrinkage. Fibre is coated with oil so as to decrease the water absorption. Some of the advantages being observed are low-cost, low density, reasonable specific strength, good thermal insulation, reduced wear and ability to be recycled with minimal impact on environment

II. NEED FOR STUDY

Coconut fibre with a tensile strength of 21.5 MPa is the toughest among all natural They are capable of taking strains4–6 times higher than other fibres. Although it is a cheap and efficient a major hindrance towards its wide scale use is the high rate of water absorption, which can be reduced by coating it with oil. The advantages of coconut fibre are: low cost, reasonable specific strength, low density, ease of availability, enhanced energy recovery, biodegradability, and ability to be recycled in nature in a carbon neutral manner, resistance to fungi moth and rot, excellent insulation to sound, flame, moisture and dampness, toughness, durability, resilience.

III. OBJECTIVES AND SCOPE

The aim of this study is to investigate the effect of oil coated coir fibre on physical properties of concrete
The objectives of this work are:

1. To find out variation in compressive, tensile and flexural strengths of CFRC using processed fibre strands and raw fibre meshes at varying fibre contents and to compare it with that of conventional concrete.
2. To determine the influence of shape of fibres on strength of concrete

IV. Literature Review

1) S. Revathi et. al. (May 2015)

The main objective of this paper is to use waste products like groundnut husk ash for the production of Paver Blocks which will useful in construction. Use of concrete Paver Blocks in road pavements is more common nowadays. Concrete Paver Block is a better option in road construction when compared to the conventional road which is made by bitumen and gravel from the point of view of cost and better suitability. As India is a developing country, construction of roadways and buildings plays an important role. In the present investigation paver blocks were prepared using M40 mix using 10 mm Coarse aggregates, Ordinary Pozzolana Cement and Fine Aggregates .The dimension of the paver block is 215 x 170 x 55 mm. The fine aggregates were partially replaced using Groundnut husk ash in percentage of 0, 10, 20, 30, 40, 50, and 60. Density of paver blocks is within the range of 1888-2202 kg/m3. Density values decreases with increase in Groundnut husk ash.

2) Joel Santhosh et. al. (April 2015)

In this paper investigation, concrete paving blocks may be produced with locally available cement, aggregates, fly ash and waste glass powder as the mineral admixture. Different mix proportions are prepared using cement replaced by equal quantity of fly ash and waste glass powder. The study indicated that fly ash and waste glass powder be used as cement replacement without substantial change in strength The increase in strength up to 20% replacement of cement by fly ash and glass powder may be due to pozzolanic reaction of fly ash and glass powder. Fly ash increases in strength over time, continuing to combine with free lime. Increased density and long term pozzolanic action of fly ash which ties up free lime results in fewer bleed channels and decreases permeability. Fly ash combines with alkalis from cement that might otherwise combine with silica from aggregates, thereby preventing destructive expansion. The ball bearing effect of fly ash in concrete creates lubricating action when concrete is in its plastic state. Waste glass when ground to a very fine powder, SiO_2 react chemically with alkalis in cement and form cementitious product that help contribute to the strength development. Thus it can be concluded that 20% was the optimum level for replacement of cement with fly ash and glass powder.

3) R. C. Yeole et. al. (Oct.2014)

This paper on study concrete paving blocks are ideal materials on the footpaths and roads for easy laying, better look and finish. In this paper, a parametric experimental study for producing paving blocks using waste steel aggregates (the form of rounded bearings of size 6.35 mm) is presented. Waste steel bearings are added in concrete of paver blocks in various percentages. Rubber pads are also used below the paver blocks. Impact strength of paver blocks with various percentages of waste steel aggregates and using rubber pads is investigated. Test results show that combination of using rubber pads and adding various percentages of waste steel aggregates in paver blocks gives upto 50% more impact strength than ordinary paver blocks.

4) Som Nath Sachdeva et. al. (2014)

This paper discusses the use of fly ash in concrete paver blocks is aimed at reducing cement content and heat of hydration leading to better economy and durability. Results of an experimental study conducted on Fly Ash Concrete with the aim to report its suitability for concrete paver blocks. In this study, the effect of varying proportions of fly ash, 20% to 40%, on compressive strength and flexural strength of concrete has been evaluated. The mix designs studied are M-30, M-35, M-40 and M-50. It is observed that all the fly ash based mixes are able to achieve the required compressive and flexural strengths. In comparison to control mixes, the compressive and flexural strengths of the fly ash based mixes are found to be slightly less at 7-days and 28 days and a little more at 90 days.

5) B.K. Kashiyani et. al. (May 2013)

In this paper study addition of polypropylene fibers in paver block to show the change in the Abrasion Resistance and Flexural Strength of paver blocks with compare to standard paver block and reduces the maintenance cost of paver block. Also it's helpful to improve the life span of paver block. In this paper represent the results of the concrete paver block with the mix proportion of1:3 (Cement: dolomite powder) and polypropylene fibre with the different percentage rate in the top layer of paver block and 1:1:2:3.75 (Cement: Fine aggregate: Semi Grit: Quarry dust) in the bottom layer of paver block. In only both layers contain the polypropylene fiber (PPF) of 0.1%, 0.2%, 0.3%,0.4%, and 0.5% in each mixes proportion by weight. Both tests were determined at 28 days. Test results indicate that by the addition of PPF by 0.3% and 0.4% it gives good results for abrasion resistance and flexural strength at 28days respectively. The paper also shows the cost comparison per block for the each mix proportion.

V. Material and Methodology

Based on the previous research work, a comparison of strength properties of fibre reinforced concrete is made with respect to conventional concrete and the influence of shape of fibres on strength are also studied. Tests are conducted using processed coconut fibres of length 5cm and raw fibre meshes of size 5cm x 5cm after coating them with coconut oil at varying fibre contents of 4%, 5%, 6% .Material tests were carried out initially to determine the suitability of materials to be used in concrete. The mix was designed as per IS 10262 : 2009 at a suitable water content and design mix was obtained. The cubes were then cured for 7 and 28 days and were properly dried in sunlight before testing.

The materials used in this study are:
Portland cement (PPC) : Shankar cements
M-sand : POABS M sand
Coconut fibre :- Procured from coir mattress manufacturing unit near Pune, where the material is available as waste
Water : Collected from local fresh water sources
Coarse aggregate : Aggregates passing through 20mm IS sieve
Admixture : BASF Rheobuild-918, Pune.

Materials	Mix 1 (Plain Concrete)	Mix 2 (4% Coir fibre) CF1	Mix 3 (5% Coir fibre) CF2	Mix 4 (6% Coir fibre) CF3
Cement (Kg)	9.5	9.5	9.5	9.5
Water (Kg)	4.75	4.75	4.75	4.75
Coarse Aggregate (Kg)	27	27	27	27
Fine Aggregate (Kg)	16.5	16.5	16.5	16.5
Fibre (Kg)	-	0.38	0.475	0.57
Super Plasticizer	-	0.2%	0.4%	0.6%

VI. RESULTS & TABLES

Cube compressive strengths at 7-days and 28 days for all the four mix designs with different proportions

COMPRESSIVE STRENGTH OF CONVENTIONAL CONCRETE BLOCKS

Specimen	Specimen	Slump Value (mm)	7day strength (N/mm2)	28 day strength (N/mm2)
1			14	24.88
2	0.5	120	14.4	25.1
3			14.2	25.1
4		Average	14.2	25.03

INFERENCE

For the table the average of value from the 3 observations is 25 N/mm2, is taken as compressive strength of plain concrete cube

COMPRESSIVE STRENGTH OF CFRC

Coconut fibre reinforced concrete was added to concrete at varying proportions (4% , 5%, 6% of that of weight of cement) at a water cement ratio of 0.5 The desired slump value and compressive strength was obtained for conventional concrete at this ratio . However, when fibre is added to the mix low workability was observed. Hence superplasticizer was added at different proportions of cement to get a concrete mix of suitable workability. The result of compressive strength of fibre reinforced concrete and slump test results are shown in Table 5.3 and is shown graphically in Fig 5.9 and Fig 5.10.

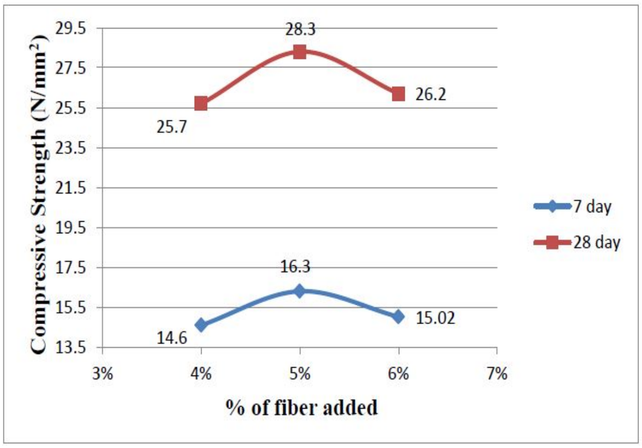

Figure 5.1 : Finished fibre reinforced concrete cubes

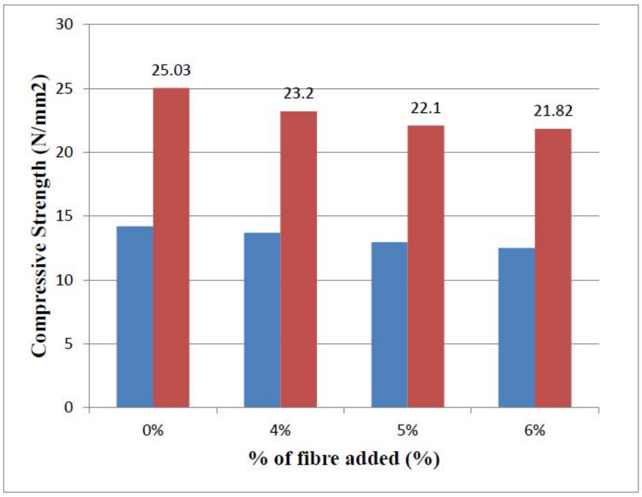

Figure 5.2 graph showing variation of compressive strength at varying percentages of fibre

INFERENCE

The value obtained for 5% addition of coconut fibre water cement ratio 0.5 yielded highest results for compressive strength. However, the compressive strength decreased on the increase in fibre addition. This may be due to the fact when fibres are added initially the finer sized fine aggregates enter into the surface pores in the fibre creating a better bonding between the fibre and mix, however further addition of fibres causes formation of bulk fibre in the mix decreasing the bonding. Hence there is an optimum value of fibre to cement ratio, beyond which the compressive strength decreases. Hence 0.5 was taken as the optimum water cement ratio and optimum fibre content was taken as 5%

VII. CONCLUSION

Coconut fibre is available in abundance at the test site, which makes it quite viable as a reinforcement material in concrete. Further, it acts as a source of income for the coconut producer who gets the benefits of the new demand generated by the construction industry.

1 At 5% addition of coconut fibre with a water cement ratio of 0.5, compressive strength tests yielded best results. However, the compressive strength decreased on further fibre addition.

2. When the fibre content is increased there is an increase in split tensile strength with a maximum at 5%. However when the fibre content is increased beyond this value a reduction in tensile strength is observed.

3. fibre content is increased there is an increase in flexural strength with a maximum at 5% of fibre. However when the fibre content is increased beyond this value a downward slope of the graph is observed.

4. The tensile properties and cracking pattern of CFRC shows that it can be particularly useful in construction activities in seismic zones due to its high tensile strength and post peak load behavior, which offers sufficient warning to the inhabitants before complete collapse of the structure.

5. A decreasing trend in compressive strength was observed in concrete with mesh shaped fibres

VIII. REFERENCES

[1]. Majid Ali, Nawawi Chouw (2012),"Experimental investigations on coconut-fibre rope tensile strength and pullout from coconut fibre reinforced concrete", Construction and Building Materials, 41, 681–690

[2]. Reis J.M.L (2005),"Fracture and flexural characterization of natural fiber-reinforced polymer concrete", Construction and Building Materials 20 (2005) 673–678

[3]. Majid Ali, Anthony Liu, HouSou, Nawawi Chouw (2011),"Mechanical and dynamic properties of coconut fibre reinforced concrete" Construction and Building Materials 30 (2011) 814–825

[4]. Noor Md. Sadiqul Hassan, Habibur Rahman Sobuz (2012),"Use of coconut fibre in production of structural light weight concrete", Journal of applied sciences 12(9) 831- 839, 2012

[5]. Vijay Chavada, A.A Parikh (2013), "An application review of coir fibre reinforced concrete", Vol. 2 Issue 4 ISSN: 2278-7844
[6]. A Zuraida, H Zahurin, I Sopiyan (2011),"Effect of fibre length variation on physical and mechanical properties of coir fibre reinforced concrete" ,Materials Physics and Mechanics 16 (2013) 107-117
[7]. P Nibasumba, X L Liu (2011),"Recent developments in fibre reinforced concrete and their effect on concrete columns analysis", Construction and Building Materials 2011;18(7):549–58
[8]. Joanna M Ferraz, Sabrina A Martins, Claudio H.S Del Menezzi (2013), "Effect of coir fibre treatment and coir-fibre ratio on properties of cement bonded composites", Bio Resources 6(3), 3481-3492
[9]. Dr. M. Sivaraja (2009), "Application of Coir Fibres as Concrete Composites for Disaster prone Structures" International Journal of Civil and Environmental Engineering Sci., Vol. 33, No. 6, December 2009, pp. 719–729.
[10]. Izad Amir Bin Abdul Karim (2012),"Effect of coconut waste on concrete structure component" ARPN Journal of Engineering and Applied Sciences, 30(2012). 2538 – 2547.
[11]. Yalley, P. P. and Kwan, A.S K (2008), "Use of coconut fibre as an enhancement of concrete", International Journal of Sustainable Construction Engineering &Technology, 27(5), 2008, pp. 575-582.
[12]. Kamel K.Alzboon and Khalid N.Mahasneh (2009), "Effect of Using Mattress Waste on the Compression Strength and Slump Characteristics of Concrete", Construction and Building Materials 2009;23(2):865–71.
[13]. Nanayakkaza N.H, (2011) "Characterisation and determination of properties of Sri Lanka coconut", Journal of Natural Fibres, 2(1), 2011, pp 69-81.
[14]. Bhowmick B.B. and Debnath C. R. (2007), "Properties of coir", Indian coconut journal, 15, (5), 2007. p.12

Cite this article as :

Prof. Rajendra S. Khamkar, Mohini A. Khamkar, Ganesh R. Pathare, " A Study on Glass Fibre as an Additive in Concrete to Increase Compressive Strength", International Journal of Scientific Research in Civil Engineering (IJSRCE), ISSN : 2456-6667, Volume 4 Issue 3, pp. 28-33, May-June 2020.
URL : http://ijsrce.com/IJSRCE20437