AN EXPERIMENTAL STUDY ON BENDABLE CONCRETE USING RECRON 3s FIBRE

Dr. Sudhikumar g.s , Anusha C, Chethan N.P, Bharath H.G, Kotaiah B,N

Professor and Students, Department Civil of Engineering, Channabasaveshwara Institute of Technology, Gubbi, Tumkur,India.

Abstract - The present day world is witnessing the construction of very challenging and difficult civil engineering structures. Quite often, concrete being the most important and widely used material is called upon to possess very high strength and sufficient workability properties. . Efforts are being made in the field of concrete technology to develop such concretes with special characteristics. Today, the construction industry is in need of finding cost effective materials for increasing the strength and ductility of concrete structures. Bendable concrete, also known as Engineered Cementitious Composites (ECC) is a class of ultra-ductile fibre reinforced cementitious composites, characterized by high ductility and tight crack width control. . ECC has a strain capacity of more than 3% and thus acts more like a ductile metal rather than brittle material. Addition of fibres improves the mechanical properties and also enhances the durability, shrinkage, impact, and serviceability characteristics of concrete. . In this project, An experimental study is carried out for bendable M25 grade concrete using Recron 3s fibres and the test results were compared with conventional M25 grade concrete..

Keywords — Bendable concrete, ECC,Cementitious, strain capacity , ductile .

i. Introduction

The world's construction rate is increasing day by day and the nation's economy is dependent on the construction industries. Concrete is a material made of cement, water, fine aggregate and coarse aggregate, which has very good compressive strength and poor tensile strength. In order to provide tensile strength to concrete usually steel has been provided as reinforcement, which is called reinforcement concrete. There are many ways to minimize the failure of the concrete structures made of steel reinforce concrete. The customary approach is to adhesively bond fibre polymer composites onto the structure. This also helps to increase the toughness and tensile strength and improve the cracking and deformation characteristics of the resultant composite Processes involved in this project are mix design, preparing samples with and without fibre, testing of cubes, cylinders,prism and analysis of results. In the experimental work, recron 3s fibres in varying percentages, 0.5%, 1%, 1.5%, 2% were added. Cubes of size 150 x 150 x 150 mm, cylinders of 150mm diameter and 300 mm length and 100 x 100 x 500 mm for , After 7, 14, 28 days of curing the cubes, cylinders and prism are tested for the compressive , flexural & tensile strength of concrete respectively and results are compared. Recron 3s fiber was used as a secondary reinforcement material. It arrests shrinkage cracks and increases resistance to water penetration, abrasion and impact. It makes concrete homogenous and also improves the compressive strength, ductility and flexural strength together with improving the ability to absorb more energy. Use of uniformly dispersed recron 3s fibres reduces segregation and bleeding, resulting in a more homogeneous mix. This leads to better strength and reduced permeability which improves the durability Recron 3s prevents the micro shrinkage cracks developed during hydration, making the structure / plaster / component inherently stronger.

Further, when the loads imposed on concrete approach that of failure cracks will propagate, sometimes rapidly. Addition of Recron 3s to concrete and plaster arrests cracking caused by volume change expansion and contraction, simply because 1 kg ofRecron 3s offers millions of fibres which support mortar/concrete in all directions.. Recron 3s is a triangular polyester fibre in cross section with cut length of 6mm & 12mm which is being widely used in the Indian Construction industry market. It is much cheaper than any other imported construction fibres. At the specified dosage of 0.25% by weight of cement there are millions of fibres which form a mesh in the concrete.

ii. Literature Review

Kallepalli Bindu Madhavi and Mandala Venugopal : In their paper entitled "EXPERIMENTAL STUDY ON BENDABLE CONCRETE",. Test results indicated that enchance the mechanical properties of Concrete. Following are the conclusions made by authors

- Fracture controlled failure is exhibited by the ECC under flexural loading, and a bend is obtained because of crack controlling nature.
- In the bendable concrete for the mixeshaving 30% replacement of cement with fly ash, the best mix obtained is cement/sand ratio 1:0.5 and having 3% volume of fibres.
- Workability aspect of Recron fibre reinforced ECC is an appreciable issue as satisfactory workability is observed with use of any chemical admixture with dosage of 1.5%.
- The compressive strength of M30 ECC which is having 3% volume of fibre is greater when compared with 2% volume of fibre.
- The maximum compressive strength in bendable concrete having 30% replacement of cement with fly ash and having 3% volume of fibre.is 38 MPa
- The maximum flexural strength and split tensile strength in bendable concrete having 40% replacement of cement with fly ash and having 3% volume of fibre is 7 MPa, 5MPa.
- Dr sunil v desale and bhagyashri sisode : in their paper entitled "use of industrialwaste and recron 3s fibre to improve the mechanical properties of concrete" test results indicated that enchance the mechanical properties of concrete. Following are the conclusions made by authors.
- From the results, it is found that the optimal replacement percentage of cement with fly ash is 30% when Recron 3s fibers are not added
- On addition of Recron 3s fiber with cement matrix, the compressive strength and split tensile strength decrease with increase in Recron 3s fiber content, however the flexural strength increases with increase in Recron 3s fiber content.
- When sludge and Recron 3s fiber are added, the optimum dosage of fly ash is 20% and optimum Recron 3s fiber contentis 0.4%.
- The usage of fly ash will reduce the ill effects on the environment. It is recommended over the ordinary concrete as it considerably saves cement and also prevents environmental pollution.
- Usage of Recron 3s fiber will reduce the cost of maintenance by reducing the micro cracks and permeability and hence the durability will increase. It is found that use of Recron 3s fiber reduces the segregation.

Anusha Chowdry., Mrs Chaitra N and Dr. Chethan K : In their paper entitled "A Study on IMPACT OF POLYPROPYLENE (RECRON 3S)FIBRE COMPRESSIVE AND TENSILE STRENGTH OF CONCRETE", Test results indicated that ductility properties of Concrete. Following arethe conclusions made by authors

- For concrete without addition of polypropylene (Recron-3s) fibers,concrete has high workability and goodslump for all the mix proportions.
- For concrete with addition of polypropylene (Recron-3s) fibers, as the amount of fibers content increases (0.25%, 0.5%, 0.75% 1%) the workability decreases.
- For 20% and 30% fly ash content the compressive and split tensile strength is more for 0.5% and 0.25% fibers addition respectively and for 40% fly ash the compressive and split tensile strength is more for 0.75% fiber content. Beyond 0.75% addition of fibers there is no significant increase in the strength for all the mixes containing fly ash.
- Usage of polypropylene (Recron-3s) fibres will reduce the cost of maintenance by reducing the micro-cracksandpermeability and hence the durability will increase.

- It also reduces the segregation. or 28 days and 56 days curing, there is no significant change in compressive and split tensile strength.

Prathamesh D Pawaskar and Vaibhav Shirodkar : In their paper entitled "EXPERIMENTAL STUDY ON BEHAVIOUR OF RECRON 3S" has discussed that behaviour of recron 3s fibre Following are the conclusions made by authors.

- The workability of concrete measured from compaction factor test, as the percentage of Recron 3s fiber increases in mix the compaction factor decreases. Hence it can be concluded that with the increase in the fiber content, workability decreases.

- With the addition of 0.5% addition of fibres, the maximum compressive, flexural and split tensile strengths are 24.75N/mm^2 , 96 N/mm^2, and 1.710N/mm^2 respectively.

- It is found that the compressive , flexural and split tensile strength is the higher at 0.50%.

- addition of fibers and reduces when the percentage of fiber added exceeds beyond 0.50%.

Preeti Verma., Amritpal Kaur and JagbirSingh In their paper entitled "COMPARITIVE STUDY OF RECRON 3S & POLYPROPYLENE

FIBRE IN BENDABLE CONCRETE" has discussed the failures that occur in concrete infrastructures are catastrophic in nature without giving any type of warning. But ECC having tensile property can give a lot of time to act to deal with the infrastructure failures. The conclusions are as under developed in PP fibre and Recron 3s fibre specimens were as small as the human hair. This can be used in areas where normal compressive strength is required.

- By adding fibres, compressive strength was less than M-45 grade concrete, but crack Four Point loading test, specimens with fibres works better than the M-45 concrete as beam of M-45 was broken in two pieces but fibre specimens werehaving cracks of smaller thickness.

LITERATURE SUMMARY

- The literature study shows that the significant studies are being made on the properties of Fibre Reinforeced Concrete and Engineered Cementious Concrete. But the literature is quite about the ductility property. The mechanical properties of bendable concrete like compressive, flexural and split tensile strength are not investigated deeply. This failure in literature of concrete is the main reason for carrying out few investigation on Ductility and Mechanical properties of bendable concrete using Recron 3s fibre.

iii. OBJECTIVES OF PRESENT STUDY

Fibers reinforced concrete may be useful where high tensile strength and reduced cracking are desirable or when conventional reinforcement cannot be placed

It improves the impact strength of concrete, limits the crack growth and leads to a greater strain capacity of the composite material

For industrial projects, macro-synthetic fibers are used to improve concrete's durability. Made from synthetic materials, these fibers are long and thick in size and may be used as areplacement for bar or fabric reinforcement

Adding fibers to the concrete will improve its freeze-thaw resistance and help keep the concrete strong and attractive for extendedperiods.

Improve mix cohesion, improving pump abilityover long distances

The main objectives of the present study is to find the purpose ECC of its suitability as special building materials

Improve the mechanical andductility properties ofconcrete.

To compare the strength parameters of concrete withconventional concrete

iv. MATERIALS ANDMETHODOLOGY

This chapter deals with the description of various materials used in the experimentation, also it describes briefly the methodology adopted to carrying out the different tests as per relevant IS codes.

MATERIALS USED

1. Cement

The cement use in the experimentation was ordinary Portland cement of 53-grade. The physical properties of the cement are given in Table.

Table 4.1.1 : Physical properties of ordinary Portlandcement-53 grade

Properties	Results
Specific gravity	2.76
Fineness	8
Initial setting time	35 min
Final setting time	600 min
Normal consistency	33%
Compressive strength 07 days	
14 days	24.50
28 days	35.50
	44.45

2. Fine Aggregate

The locally available M sand, passing through

4.75 mm will be used as the fine aggregate inthe mix. The test on fine aggregate was conducted in 6accordance with IS: 650-1966,IS 2386-1968 to determine the tests given in the below table.

3. Recron 3s Fibers

In this experiment Recron 3s fibre is used

.Recron 3s is a triangular polyester fiber in cross section with cut length of 6mm & 12mm, which is being widely used in the Indian construction industry market. It is much cheaper than any other imported construction fibers. At the specified dosage of0.25% by weight of cement there are millions of fibers which form a mesh in the concrete. The spacing is approximately less than 1mm between any two fiber filaments in any co- ordinate of the matrix. This describes the general properties and application of recron 3s fiber reinforced concrete used in construction. The thinner and stronger elements spread across entire section, when we used in low dosage arrests cracking.

Sl No	Properties	Polypropylene
1	Cut length	12mm
2	Diameter	25 – 40microns
3	Specific gravity	0.90 - 0.91
4	Tensile strength	4 – 6 Gpd
5	Aspect ratio	300

4. Super plasticizer :

fig 4.1.4:

Conplast SP 430

In this experiment Conplast SP 430 (fosroc chemicals) is used as super plasticizer. Fosroc conplast is a dark brown liquid based on lingosulphonates which mixes readily with water and therefore disperses evenly.

4.1.5. CASTING OF SPECIMENS

The required quantity of the materials for cube / cylinder and slab specimens was calculated. The calculated quantity of cement and sand ratio ie, 1:2 for each mould is taken and thoroughly mixed in the tray. Then the calculated quantity of Recron 3s fibers were uniformly dispersed on the dry cement mortarand thoroughly mixed, and calculated quantity of water (w/c = 0.5) with the 2% admixture is added to the dry mix and thoroughly mixed and placed in the oiled moulds in layers and compacted. The mould iskept over the vibrating table for thorough compaction. The moulds were covered with gunny bags for 24 hours. After 12 hours, the specimens were demoulded and kept in water for curing. After curing, the specimens were tested for 7 days, 14 days an 28 days respectively. For compressive strength, specimens of dimension 150x 150 x 150 mm, for split tensile strength, cylinders of 150 mm diameter and 300 mm long and for flexural strength test, slabs of size 600 x 200 x 60 mm were casted.

iv. TESTING OF SPCIMENS

- Compressive strength test
- Split tensile strength test
- Flexural strength test

1. Compressive strength test

- The compressive strength test was conducted after 7, 14, 28 days of curing. The compressive strength can be calculated in accordance with IS 521-1959 using the formula.

$$f_c = P/A$$

Where f_c - compressive strength of concrete.

P - maximum load applied to thespecimen.

A - cross sectional area of thespecimen.

1. Split tensile strength test:

Split tensile strength test was conducted after 7,14,28 days of curing. The split tensile strength can be calculated in accordance withIS 5816-1999.

$$T = 2P/\pi DL$$

Where D – is the diameter of specimen.

L – Length of the specimen

P - Maximum load applied to thespecimen.

T – Split tensile strength of theconcrete.

2. Flexural strength test

Flexural strength also termed as modulus of rupture is a measure of its ability to resist bending. The specimen casted for flexural strength test were dimensions of600×200×60mm.The effective span was

…….mm and the specimens were subjected to two point loading, the distance between the loads was ……mm. The test procedure was carried out in accordance with IS 516-1959.

The flexural strength of the specimen shall be expressed as modulus of rupture and shall be calculated using the for

$$f_d = P \times L/bd^2$$

P – Maximum load applied tothe specimen

L – c/c distance between thetwo supports

b – Width of the specimend – Depth of the specimen

v. RESULTS

Table 6.1.7 : Overall results of compressivestrength of ECC M25 with Recron 3s fibers

Percentage ofaddition offibers	Average Compressive strength (MPa)		
	7 days	14 days	28 days
0.0	17.77	18.73	22.56
0.5	20.09	21.70	26.03
1.0	20.03	20.42	24.70
1.5	18.36	20.20	22.85
2.0	15.86	17.00	18.57
2.5	14.90	18.20	18.55
3.0	14.06	15.13	17.55

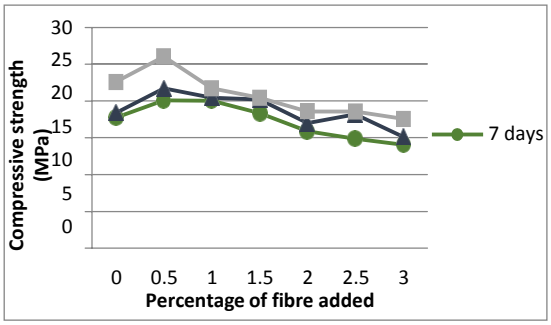

Fig 6.2.D : overall results of compressive strength atthe age of 7,14,28 days

Table 6.1.7 : Overall results of compressive strengthof ECC M25 with Recron 3s fibers

Percentageof addition of fibers	Average Split tensile strength (MPa)		
	7 days	14 days	28 days
xura0l.0streng	th3.74	4.40	5.38
0.5	3.85	4.51	5.50
1.0	4.07	4.73	5.28
1.5	4.35	4.84	5.72
2.0	4.66	5.06	6.05
2.5	3.60	4.35	4.62
3.0	3.56	4.18	4.40

where, f_d – Fle

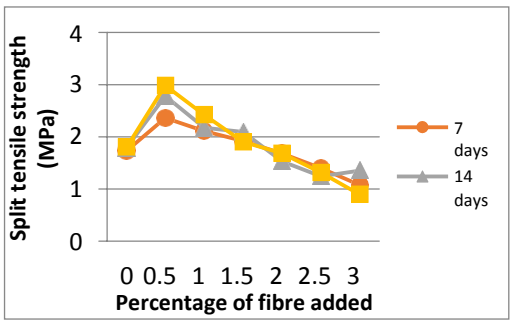

Fig 6.2.D : overall results of split tensile strength atthe age of 7,14,28 days

Table 6.3.7 : Overall results of Flexural strength ofECC M25 with Recron 3s fibers

Percentageof addition of fibers	Average Flexural strength (MPa)		
	7 days	14 days	28 days
0.0	1.73	1.79	1.80
0.5	2.36	2.78	2.98
1.0	2.11	2.17	2.42
1.5	1.92	2.09	1.90
2.0	1.68	1.53	1.68
2.5	1.40	1.24	1.31
3.0	1.07	1.35	0.89

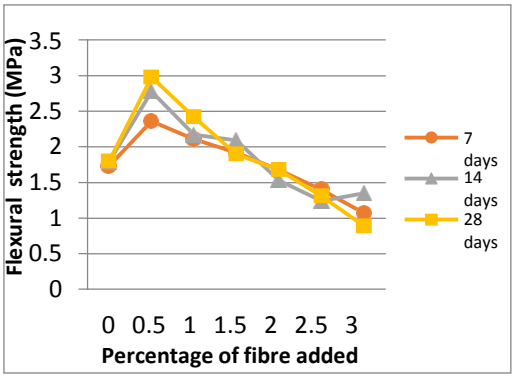

Fig. 6.3.D : Overall results of flexural strength at theage of 7,14,28 days

CONCLUSION

Based on the experimental investigation thefollowing conclusions are drawn with the limitations of test results.

- It observed that 0.5% addition of recron 3s fibres has given the higher compressive strength and there after with the increase of fibres, the strength decreases
- The percentage increase in compressive strength is 13.05,15.85 and 15.38 percent for 7 days , 14 days , 28 days with refuse toreference mix (0% addition of fibre)

- It observed that 2% addition of recron 3s fibres has given the higher split tensile

References

[1] Preeti Verma, Amritpal Kaur and Jagbir Singh, "COMPARITIVE STUDY OF RECRON 3S & POLYPROPYLENE FIBREIN BENDABLE CONCRETE", International Conference on Advances in Construction Materials and Structures (ACMS- 2018) IIT Roorkee, Uttarakhand, India, March 7-8, 2018**.**

[2] Prathamesh D Pawaskar., and Vaibhav Shirodkar, "EXPERIMENTAL STUDY ON BEHAVIOUR OF RECRON 3S", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) ISSN(e) : 2278-1684, ISSN(p) : 2320–334X, PP : 32- 38.

[3] Kallepalli Bindu Madhavi., and Mandala Venugopal, "EXPERIMENTAL STUDY ON BENDABLE CONCRETE", October 2016 IJEDR, VOLUME 05, ISSUE 10.

[4] C Neeladharan, A Muralidharan (2020), "BEHAVIOUR OF FIBRE REINFORECED CONCRETE USING RECRON 3S", International Journal of Advanced Research in Manegement, Aechitecture, Technology and Engineering (IJARMATE) Vol.6,Issue 6, June 2020.

[5] B Venkat Narsimha Rao, M Mahesh, Satya Sri, "THE RECRON FIBRE REINFORECED CONCRETE PAVEMENTS", 2016 IJEDR , Volume 4, Issue 4,ISSN: 2321-9939.

[6]**. Akim choudappa yallappa, Marabathina maheswara rao and vinod nagpure**. "Experimental Investigation of Recron 3s Fiber reinforcedConcrete." International Journal of Emerging strength and there after the addition of fibres decreases the split tensile strength.

- The percentage increase in split tensile strength is 15.20,15.0 and 12.45 percent for 7 days , 14 days , 28 days respectively with the reference mix (0% addition of fibre)
- It observed that 0.5% addition of recron 3sfibres has given the higher flexural strengthand there after the addition of fibresdecreases the split tensile strength.
- The percentage increase in Flexural strength is 36.41, 55.30, and 65.33 percent for 7 days , 14 days , 28 days respectively with the reference mix (0% addition of fibre)

Trends in Engineering and Development. Vol. 6, Issue 5(Oct.-Nov. 2015).

[7] Dinesh G Shelavale, Ketan R Patil, Kalpesh R Patil and Ab hijit M Bombe."Testing on use of Hypo sludge and Recron 3s Fibre in Cement Concrete". International Journal on Recent and Innovation Trends in Computing and Communication Vol – 4, Issue 4 (April 2016).

[8] Dr. M. Devi. "Significance of Fibres in Enhancing Strength and Corrosion Resistance of Fly Ash Blended Quarry Dust Concrete". International Conference on Biological, Civil and Environmental Engineering (BCEE-2014) March 17-18, 2014.

BIOGRAPHIES

Dr. Sudhikumar G.S
Professor & Head
Depart of Civil Engineering
Channabasaveshwara Institute of Technology, Gubbi.

Anusha c
BE Final year student
Civil Department
Channabasaveshwara Instituteof Technology, Gubbi

Chethan NP
BE Final year student
Civil Department
Channabasaveshwara Institute of Technology, Gubbi

Bharath H.G
BE Final year student
Civil Department
Channabasaveshwara Institute of Technology, Gubbi

Kotaiah B.N
BE Final year student
Civil Department
Channabasaveshwara Institute of Technology, Gubbi