Scientific Journal of Impact Factor (SJIF): 4.72
e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406
International Journal of Advance Engineering and Research Development
Volume 4, Issue 5, May -2017

Flexible Behavior of Concrete Using Engineered Cementitious Composites

Tushar R Patil[1], B. V. Birajdar[2]

[1] *Dept of Civil Engineering, TKIET Warnangar, Kolhapur*
[2] *Dept of Civil Engineering, TKIET Warnangar, Kolhapur*

Abstract — *Concrete which can be bend without deformation and cracks while subjected to loading is called as Engineered Cementitious Composite (ECC).It is reinforced with PVA fibers and quipped with superplasticizer and fly ash to offer ductile property. It has strain capacity more than OPC giving more bendable material with a wide variety of application in the field.*

Keywords*-component; Engineered Cementitious Composite, ECC, PVA, Micromechanics, ECC Concrete*

I. INTRODUCTION

Concrete consisting of cement .water, fine and coarse aggregates are widely used in civil engineering constructions. Concrete has brittle behavior towards tensile loading and this is the major drawbacks of this mixture. Concrete produces cracks while loaded and this leads to sudden failure of the concrete specimen. This phenomenon leads to the development of new material as a reinforcement which is fiber. The material specimen reinforced with fibers is called as fiber reinforced cementitious composites. Concrete with conventional mix and materials failed without warning with the ultimate strain of 0.01%.When fibers with a short length are added into the mix then the specimen improves their behavior towards bending.PVA (polyvinyl alcohol)l fibers behaves same as steel towards bending so this material is taken for consideration during last decade.

II. OBJECTIVES FOR THE PROPOSED WORK

It's the foremost preliminary step for proceeding with any research work writing.
1) To analyze the behavior of ECC bendable concrete towards load while subjected to Tensile strength as well as Compressive strength.
2) To study the behavior of ECC bendable concrete while tested to flexure test.
3) To check the ductility of concrete.
4) To study the effect of sand, super plasticizers and PVA fibers on the behavior of ECC bendable concrete

III. INGREDIENTS OF ECC BENDABLE CONCRETE

A. Cement

OPC 53 Grade (Ultratech Cement) is used.

B. Sand (Fine aggregates)

In this process, sand is used which is clear from any other material and impure from any respect. Size of sand is used for this concrete which can pass through 4.36mm and can retain on 2.68mm sieve having specific gravity of 1500cm3 and Zone III as per Indian Standard

C. Superplasticizer-MYK Savemix SP111M

Table 1-Details of MYK Savemix SP111M

Sr No	Particulars	Details
1	Specific Gravity	1.20+0.05 at 27deg C
2	Chloride Content	Nil to BS5075
3	Air Entrainment	Less than 1% additional air is entrained
4	Standard Compliance	MYK Savemix SP111 M complies with IS:9103:1999 & BS:5075 part +3-1985, and ASTM-C494M-99a, 1999 Type 'G' as a high range water reducing admixture.

It can reduce water upto15-20% resulting into decreasing W/C ratio by the same amount.

D. Fly Ash

Class F fly ash which are produced from thermal power stations is used because it is less costly. Fly ash is used because it gets space which is got by cement and water.

E. Water

Water which is used to make the concrete mix in conventional concrete is used for this mix. Water which is not containing acidic, alkalis, motor oil is considered as best for adding in concrete. Water provides the main function in concrete mix in term of the main constitute to hold and collect all other materials and their properties

F. Polyvinyl Alcohol Fibers

PVA fibers are used to cover properties of conventional steel reinforcement which are good in bonding strength, flexural strength and elastic nature. Layer around the PVA fibers plays a major role towards bonding of concrete mixture.

Table 2 -Properties of PVA fibers

Sr No	Properties	Details
1	Length	Multiples of 3/6/12mm
2	Construction	Straight
3	Melting Point	165 Deg C
4	Absorption	Nil
5	Acid Resistance	High
6	Alkali Resistance	Completely Resistant
7	Salt Resistance	High
8	Thermal Conductivity	Low
9	Electrical Conductivity	Low
10	Tenacity	6.5 GPD
11	Elongation	19%
12	Modulus of Elasticity	25 to 45 GPa
13	Fiber Elongation	6-10%
14	Tensile Strength	880-1600Mpa

G. Glass Fibers.

A layer of glass fiber is placed for more bending of concrete material. It can serve as a reinforcing to the concrete with more ductility by reducing cost of concrete member and also it reduces quantity of OPC.

IV. ENGINEERED CEMENTITIOUS MIX DESIGN

In this process of mix design the mix ratio of cement, sand and fly ash is chosen from trail mix so as to it will workable mix. Also, the percentage of fibers, water cement ratio and the amount of superplasticizer is selected which can give us desired requirements. A Trial mix of various ratios was prepared and final 1:1:1 with PVA fiber 1.2%, superplasticizer 600ml/bag, water cement ratio of 0.33 was the most suitable mix proportion is chosen.

V. CASTING OF ECC CONCRETE SPECIMEN

First of all the dry materials are weighted on weighing machine with reference to mix design. Dry materials are to be mixed in batch wise for homogeneity of the mix. Cement, sand, fly ash, should be added 50% of the total quantity. Hand mixing gives extra homogeneous material mix rather than another method. Fibers should be added slowly by separating all the small segments of fibers while mixing. After this process remaining dry material has to be added in the mixture. At the end of this dry mixing the water and superplasticizer should be added with total quantity. Then cubes and concrete plates were casted by the conventional method as per standard practice.

VI. CURING OF SPECIMEN

All specimens have to be cured in curing tank at room temperature of 25deg C for rest of 28 days. Curing process helps to prevent cracks and it controls the initial heat of hydration which is produced in the specimen. Samples are removed from the tank at 7, 14 and 28 days for testing.

VII. TESTING OF SAMPLES

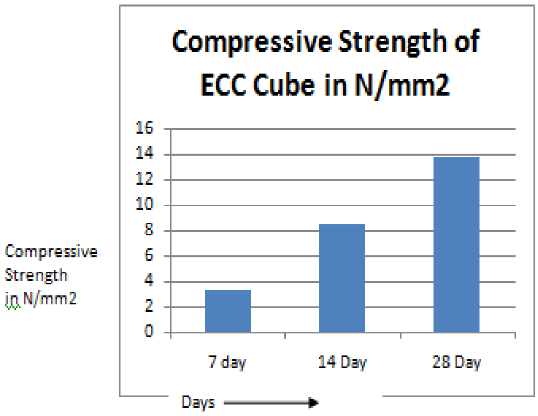
At 7, 14 and 28 days samples are tested under UTM machine Compression testing and Flexural testing includes special arrangement of UTM which gives us directly results

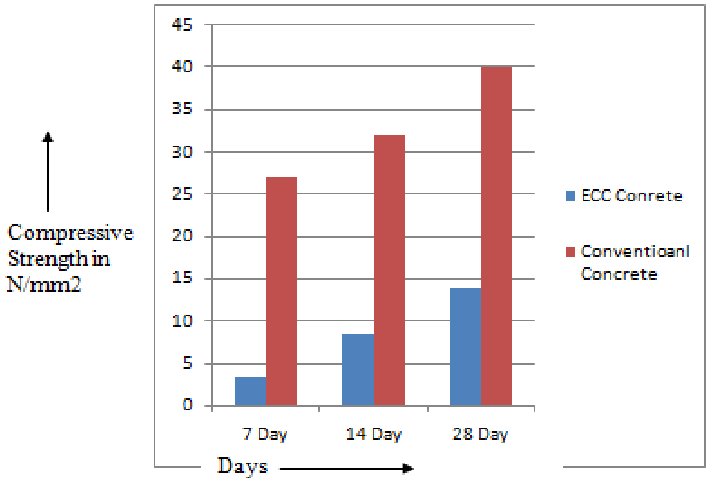
A Crushing Test

The Compressive strength of concrete is calculated with this on hardened concrete, Cube of 75x75x75mm size are tested under load.

B Flexural Strength Test- Three Point test

Three point flexural strength tests were carried out on samples at 7, 14 and 28 days under

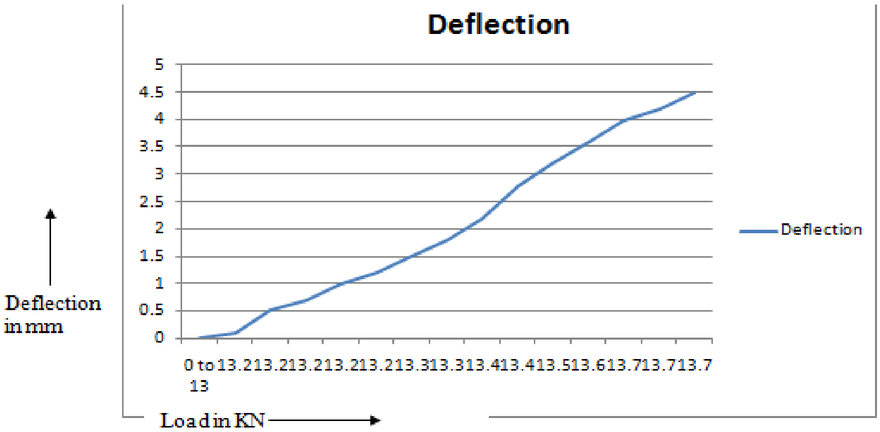




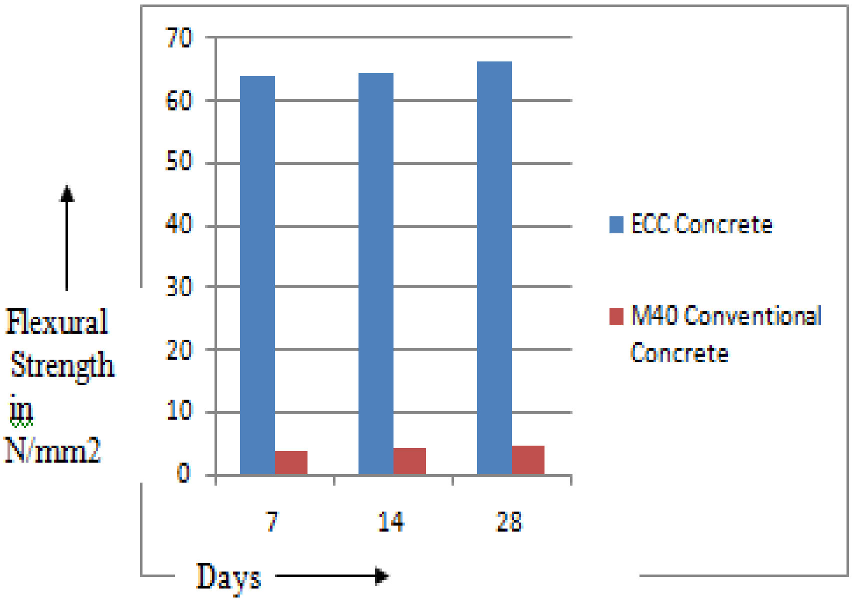
Graph 1-ECC concrete compressive strength at 7, 14, 28 days Graph 2-Comparative Study of Compressive strength of Conventional Concrete v/s ECC Concrete

Diagram 1-Study of Compressive and flexural strength of ECC Concrete

.



Graph 3- Load v/s defection of ECC Concrete



Graph 4-Flexural Strength of ECC Concrete v/s Conventional M40 grade Concrete

Flexural Strength F = pl/bd2
Where, F= Flexural Strength in N/mm2, p=Load applied in N
L=Span in mm, b=breadth in mm, d=depth in mm

Sr No	Days	ECC Concrete	Conventional Concrete M40 Grade Concrete
1	7	63.84	3.63
2	14	64.32	3.95
3	28	66.24	4.42

Table 3- Comparison of Flexural Strength of ECC Concrete v/s Conventional M40 grade Concrete

VIII. CONCLUSION

From our experiment, it is proved that Engineered Cementitious Composite material concrete gives more flexible strength than conventional concrete. Conventional concrete has % of strain capacity but ECC concrete has strain capacity of 3-5%.

Our experiment shows that ECC Concrete has large deformation without fracture like normal concrete without the use of steel reinforcement bars. The Cost of ECC concrete is much higher than conventional but it can be minimized by using a small cross section of member sizes and eliminating reinforcement bars.

Flexural strength and bending towards a load of ECC concrete is much more than conventional concrete by keeping all other properties same as conventional concrete.

REFERENCES

[1] Alberti M G, Enfedaque A, Galvez J C, Canovas M F and Osorio I R (2014), "Polyolefin fib rereinforced concrete enhanced with steel-hooked fibers in low proportions", Journal of Materials and Design, Vol. 60, pp. 57–65.

[2] Jian Zhou, Shunzhi Qian, Guang Ye, OguzhanCopuroglu, Klaas van Breugel and Victor C Li (2012), "Improved fiber distribution and mechanical properties of engineered cementitious composites by adjusting the mixing sequence", Journal of Cement & Concrete Composites,
Vol. 34, pp. 342–348..

[3] Soutsos M T, Le T and Lampropoulos A P (2012), "Flexural performance of fiber reinforced concrete made with steel and synthetic fibers", Journal of Construction and Building Materials, Vol. 36, pp. 704710.

[4] Qian S Z, Zhou J and Schlangen E(2010), "Influence of curing condition and precracking time on the self-healing behavior of Engineered Cementitious Composites", Journal of Cement & Concrete Composites, Vol. 32, pp. 686–693.

[5] Pajak M and Ponikiewski T (2013), "Flexural behavior of self-compacting concrete reinforced with different types of steel fibers", Journal of Construction and Building Materials, Vol. 47, pp. 397408.

[6] Jun Zhang, Zhenbo Wang and XiancunJu (2013), "Application of ductile fiber reinforced cementitious composite in joint less concrete pavements", journal of Composites, Part B, Vol. 50, pp. 224– 231.