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Experimental Investigation on Flexural Behaviour and EMI Shielding Effect in Stainless Steel Fiber Reinforced Concrete

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ABSTRACT—*Concrete is relatively brittle, and its tensile strength is typically only about one tenths of its compressive strength. Conventional concrete is therefore normally reinforced with steel reinforcing bars. Steel reinforced concrete normally suffer from corrosion of the steel by the salt, which results in the failure of those structures, and decrease the life of the structure. Electromagnetic interference is an undesirable and uncontrolled off-shoot of explosive growth of electronics and widespread use of transient power sources. EMI makes the environment increasingly be exposed to the electromagnetic pollution. People who have been exposed to a high electromagnetic environment for a long duration become more susceptible to leukemia and brain tumors. Carbon, Mu-metal, metal filling materials. In order to overcome these problems, Stainless Steel fiber can be adopted. The Stainless Steel fiber acts similar to that of steel fiber but it will not be subjected to corrosion. The paper deals with the effects of addition of various percentage of stainless steel fiber (0-1.5%) in addition with M30 grade of concrete. An experimental program was carried out to explore its effects on compressive, tensile, flexural strength, EMI shielding behavior. The optimum strength is found and beam is casted and then the strength is calculated. The experimental strength of beam is compared with ANSYS result and graph is drawn. A notable increase in flexural, tensile and compressive strength was found.*

Keywords— Stainless Steel Fiber (SSF), Electromagnetic interference (EMI), ANSYS.

1, INTRODUCTION

Concrete is the most widely used construction material. Because of its specialty of being cast in any shape it has replaced stone and brick masonry. It has major disadvantages such as low tensile strength and low strength to weight ratio, and it is liable to cracking. Micro cracks are present in concrete and because of its poor tensile strength the cracks propagate with the application of load leading to brittle fracture of concrete. In this regard, steel is no doubt a useful reinforcement material for concrete whether it is in the form of a steel fiber or a reinforcing bar. The addition of steel fibers to concrete can improve the tensile strength and ductility. In developing the concrete mix for high strength concrete, it is important to select proper ingredients, evaluate their properties and understand the interaction among different

material for optimum usage. The ingredients used for this investigation were cement, fine aggregate, coarse aggregate, water, stainless steel fiber.

1.1 Stainless Steel

Stainless steels are chromium containing steel alloys. The minimum chromium content of the standardized stainless steels is 10.5%. Steel with lower chromium content should not be termed "stainless". Chromium is the main alloy which provides the steel with improved corrosion resistance. The four major types of stainless steel are:

- Martensitic
- Ferritic
- Austenitic
- Austenitic-Ferritic (Duplex)

1.1.1 Specification Of SSF

Table.1 Details of fiber

Type	Austenitic 304
Length (l)	25-32 mm
Diameter (d)	0.45 mm

Table.2 Chemical Composition of stainless steel fiber

C	Si	Mn	P	S	Cr	Ni
0.4	0-3.5	2.0	0.05	0.01	14.0-18.0	0-0.5

1.2 Electromagnetic Interference

Electromagnetic interference (EMI) is an undesirable and uncontrolled off-shoot of explosive growth of electronics.EMI affects the human body and creates the electromagnetic noise and pollution. Electronic devices are used more and more widely in our daily life and induce higher strength of electromagnetic waves than traditional electrical devices. Electromagnetic interference (EMI) is an undesirable and uncontrolled off-shoot of explosive growth of electronics and widespread use of transient power sources. Electromagnetic interference makes the environment increasingly be exposed to the very serious electromagnetic pollution. people who have been exposed to a high electromagnetic environment for a long duration become more susceptible to leukemia and brain tumors. In addition, that electromagnetic waves of over

60 Hz will cause damage and variations to the human body's DNA structure. It is important to recognize this at an early stage.

1.3 Objective

To experimentally investigate flexural behaviour and EMI shielding effect in stainless steel fiber reinforced concrete. And compare the beam results by using ANSYS software.

2, MIX DESIGN

The Mix proportion ratio for M_{30} Grade of Concrete is as shown in Table 2.

Table.3 Mix Proportion ratio

Water (litre/m³)	Cement (Kg/m³)	Fine Aggregate (Kg/m³)	Coarse aggregate (Kg/m³)
186	442.8	629.532	1180.89
0.42	1	1.42	2.6

3, EXPERIMENTAL RESULTS

The various specimens were tested after 28 days and their results are given as below,

Table.4 Test results of the cube, cylinder and prism

Specimen	Compressive strength at 28 days (N/mm²)	Split tensile strength at 28 days (N/mm²)	Flexural strength at 28 days (N/mm²)
SSF0	33.06	2.987	3.42
SSF0.5	40.15	4.619	5.05
SSF1.0	41.01	4.520	4.62
SSF1.5	40.86	4.187	3.96

Table.5 Test Results of the Beam

Parameter	Conventional Beam	SFRCC Beam
First Crack Load (KN)	92.25	112.3
Ultimate Load(KN)	146.5	179.9
Crack Width(mm)	27.8	24.6
Deflection(mm)	3.4	2.7

Table.6 EMI shielding results

Specimen	Transmission GHz	Reflection GHz
Conventional concrete	22	13.47 – 66.57
SSF concrete (0.5%)	22	13.56 – 70.48

4, ANSYS RESULTS

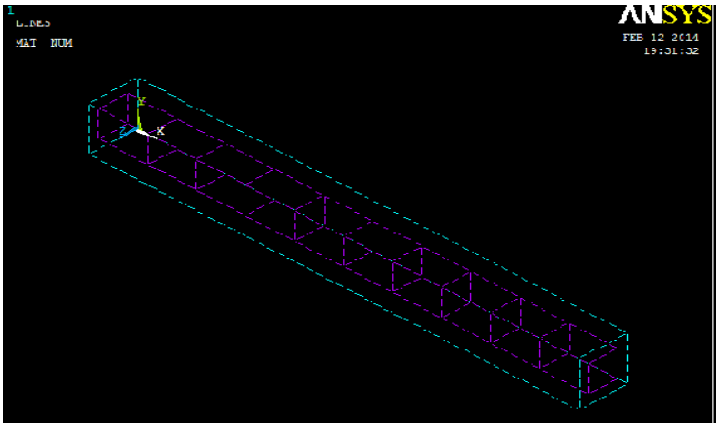

Figure.1 Reinforcement detail

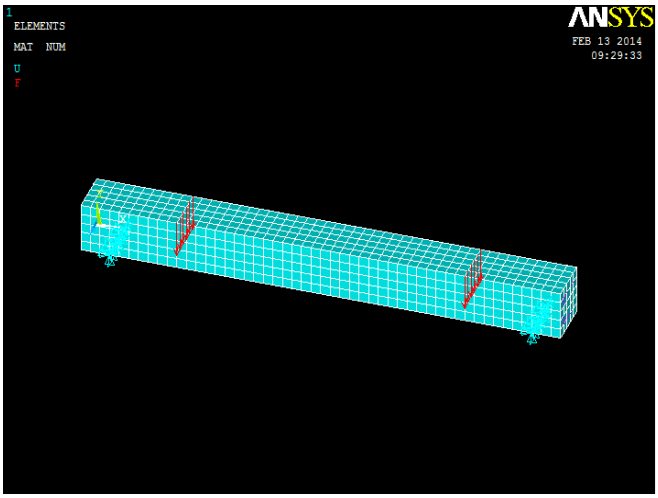

Figure.2 support and loading condition

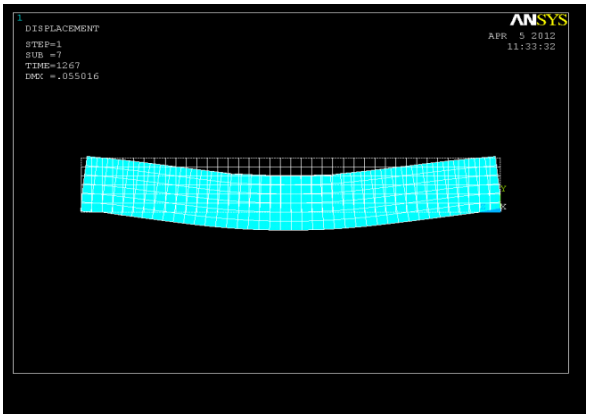

Figure.3 Deformation shape

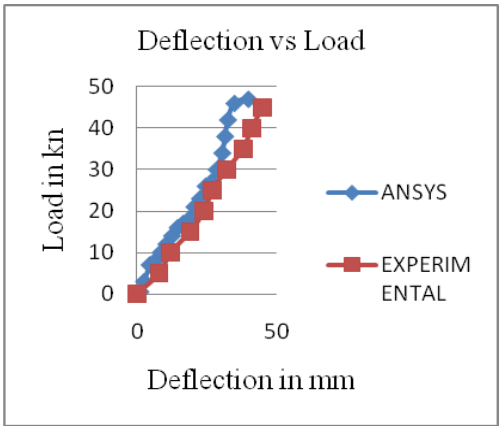

Figure.4 Comparison between ANSYS and experimental results

5, DISCUSSION

The compressive strength increases by increasing the percentage of SSF in concrete up to 1% further increases of SSF will reduce the compressive strength of concrete.The results show that there is a little bit variation between 0.5% and 1%. And also the tensile strength of the concrete is increases up to 0.5% further increases of SSF will reduce the tensile strength and also the shielding effect is decreases little bit.

6, CONCLUSION

The test results of hardened concrete are shows that there is a considerable increase both in compressive strength and also in tensile strength.

Hence the 0.5% will be an optimum percentage of the SSF for high strength concrete. The failure mechanism of a reinforced concrete beam is modeled quite well using ANSYS, and the failure load predicted is very close to the failure load measured during experimental testing. And also EMI test was conducted only for 0.5% of fiber.

As we know that the stainless steel is not affected by the corrosion. So by using the stainless steel in concrete we can make a corrosion free concrete even at in the corrosive environment. Even though the stainless steel fiber little bit high cost but it increases the life time of the structure so it is Cost-effective on account of long life.

REFERENCES

[1]. J. W Adams, E. J. Vanzura, Standard Test Method for Measuring the Electromagnetic Shielding Effectiveness of Planar Material, ASTM, Designation: D4935 – 10, 2011

[2]. Ehab Ellobody , Mariam F. Ghazy, Experimental investigation of eccentrically loaded fibre reinforced concrete-filled stainless steel tubular columns, Journal of Constructional Steel Research, 2012

[3]. Fei-Shuo Hung , Fei-Yi Hung et.al.., Electromagnetic Interference Shielding Characteristics of Sn-Al Powder Coating Layer, Materials Transactions,Vol. 49, No.3, 2008, pp. 655 to 660

[4]. H. Castro, C. Rodriguez et.al.., Mechanical properties and corrosion behavior of stainless steel reinforcing bar, Journal of Materials Processing Technology 143–144, 2003

[5]. Hongtao Guan, Shunhua Liu et.al.., Cement based electromagnetic shielding and absorbing building materials, Cement & Concrete Composites 28, 2006

[6]. I.W. Nam, H.K. Lee et.al.., Electromagnetic interference shielding/absorbing characteristics of CNT-embedded epoxy composites, Composites: Part A 42, 2011

[7]. John D. Wenzlick, Xinge (Julie) Yin, Evaluation of Stainless Steel Reinforcement, Construction Report, National Technical Information Center, Springfield, Virginia 22161, 2003

[8]. Jingyao Cao, D.D.L. Chung, Use of fly ash as an admixture for electromagnetic interference shielding, Cement and Concrete Research 34, 2004