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Strength and Behavior effects of Steel Fibers RC Wall Panels under different Loadings

Choudhary Sumit Mukund, Abhijeet Kishore
Civil Engineering Department, Mewar University, Chittorgarh, Rajasthan, India

ABSTRACT

Design Steel Fiber Reinforced Concrete (SFRC) wall panel, which may superior performance characteristics compared to conventional RC wall. Steel fibers widely used material with concrete but along vertical component makes it relatively new product. Experimental behaviors of SFRC wall panel which subjected flexural and impact action with capacity interaction and Simulation with normal concrete panels.

Casting numbers of wall panels, which include variations in percentage of adding steel fiber hooked type and without adding it. Giving flexural loading till wall panels hit the failure with deflection. Impact loading through drop weight impact condition till ultimate resistance. Performing testing on drop weight machine and universal testing machine. In flexural action identical panels is less than three points loading with gradually load increment. Impact action consist sudden loading at center portion.

Keywords: Steel Fiber Reinforced Concrete, Steel Fibers, Impact Loading, Flexural Loading, Concrete, Aggregate, Ultimate Resistance.

I. INTRODUCTION

The concrete is considered to be second consumption of mankind, first being water. Concrete reinforced with steel fibers, uniformly distributed across its entire mass and gets strengthened, concrete behave as a composite material with properties significantly different from conventional concrete. Strengthened improvements achieved by the addition of fibers to concrete. There are several applications where Fibers Reinforced Concrete (FRC) can be beneficially used. These fibers have already been used in many large projects involving the construction of industrial floors, pavements, highway-overlays, etc. in India. These fibers are also used in the production of continuous fibers and are used as a replacement to reinforcing steel.

The randomly-oriented steel fibers assist in controlling the propagation of micro-cracks present in the mixture, first by improving the overall cracking resistance of concrete itself. later by bridging across even smaller cracks formed after the application of load on the member, thereby preventing their widening into major cracks.

The concept of using fibers as reinforcement is not new; Fibers have been used as reinforcement since ancient times. From 1960s, steel, glass (GFRC), and synthetic fibers were used in concrete. Research of new fiber-reinforced concretes continues today. SFRC wall panels are relatively a new construction path which still under develops through extensive researches. The efficiency of steel fibers as concrete macro-reinforcement is in proportion to increasing fiber content, fiber strength, aspect ratio and bonding efficiency of the fibers in the concrete matrix. The efficiency is further improved by deforming the fibers and by resorting to advanced production techniques.

Any improvement in the mechanical bond ensures that the failure of a SFRC specimen is due mainly to fibers reaching their ultimate strength, and not due to their pull-out. Further development in the field of fiber like glass and carbon fibers. The initial studies showed deterioration of glass fibers due to corrosive alkali environment of the cement paste. Steel fibers reinforced concrete (SFRC) has an untapped potential application capacity and relatively simple construction technique. to tap such a potential , the existing body of knowledge on SFRC must be expand.

Figure 1. Facture of SFRC [SIKA.COM]

One of the requirements of the graduate Science, Engineering and Technology courses is that you conduct research and write a research paper on some aspects of software engineering. The paper may present original work, discuss a new technique, provide a survey and evaluation of recent work in a given area, or give comprehensive and taxonomic tutorial information. The paper must emphasize concepts and the underlying principles and should provide authentic contribution to knowledge. If your paper does not represent original work, it should have educational value by presenting a fresh perspective or a synthesis of existing knowledge. The purpose of this document is to provide you with some guidelines. You are, however, encouraged to consult additional resources that assist you in writing a professional technical paper.

II. METHODS AND MATERIAL

Fibers and its Types:

Steel fibers intended for reinforcing concrete are defined as short, discrete lengths of steel having an aspect ratio (as short, discrete lengths of steel having ratio of length to diameter) from about 20 to 100, with any of several cross-sections, and that are sufficiently small to be randomly dispersed in an unhardened concrete mixture using usual mixing procedures.

ASTM A 820 provides a classification for four general types of steel fibers based upon the product used in their manufacture:
Type 1. Cold-drawn wire
Type 2. Cut sheet
Type 3. Melt-extracted
Type 4. Other fibers
The Japanese Society of Civil Engineers (JSCE) has classified steel fibers based on the shape of their cross-section:

Type 1. Square section.
Type 2. Circular section.
Type 3. Crescent section.

The composition of steel fibers generally includes carbon steel stainless steel. Different applications may require different fiber compositions.

Types of Fibers based on Material type

According to terminology adopted by the American Concrete Institute (ACI) Committee 544-2R, “Measurement of properties of Fiber Reinforced Concrete”, there are three categories of FRC based on fiber material type.

- Steel fibers
- Natural fibers
- Glass fiber

Properties of Steel Fibers

The fiber strength, stiffness, and the ability of the fibers to bond with the concrete are important fiber reinforcement properties. Bond is dependent on the aspect ratio of the fiber. Typical aspect ratios range from about 20 to 100.ACI

Steel fibers have a relatively high strength and modulus of elasticity, they are protected from corrosion by the alkaline environment of the cement mixture, and their bond to the matrix can be enhanced by mechanical anchorage or surface roughness. Long term loading does not adversely influence the mechanical properties of steel fibers. In particular environments such as high temperature refractory applications, the use of stainless steel fibers may be required. Various grades of stainless steel, available in fiber form, respond somewhat differently to exposure to elevated temperature and potentially corrosive environments.

ASTM(American Society for Testing and Materials)A 820 establishes minimum tensile strength and bending requirements for steel fibers as well as tolerances for length, diameter (or equivalent diameter), and aspect ratio.

The minimum tensile yield strength required by ASTM A 820 (Standard Specification for Steel Fibers for Fiber-Reinforced Concrete) is 345 n/mm^2, while the JSCE (Japanese Society of Civil Engineers) Specification requirement is 552 MPa.

Mild steel hook end fiber	
Density	7.85 g/cm3
Diameter	0.50mm
Length	30mm
Aspect ratio	60
Minimum tensile strength (ASTM A820)	345Mpa
Modulus of elasticity	210,000Mpa
Strain at failure	0.5-1.0% Approx.
Manufacture company	Stewols Pvt.Ltd., Nagpur, maharastra.
Price	200 rs./kg

Table No. 1: Properties of Steel fibre

Figure 2: Steel Fibres

Wall Panels

Adopted size of Wall Panels:

An exterior non-load bearing wall in framed contraction wholly supported in each story but subjected to lateral load.

600 X 400 X 40mm adopted for flexural and impact test. IS 1905 Appendix D, guidelines for approximate design of wall panels. And also referred related research paper which recommended for size adoption.

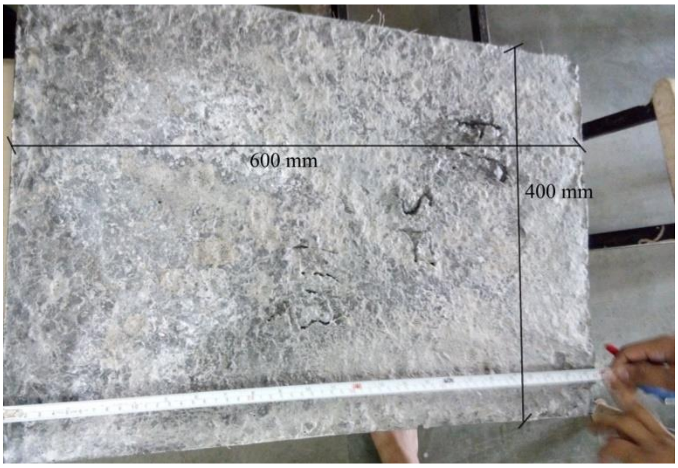


Figure 3 : PANELS SIZE

Adopted Steel Fiber contents

Steel fiber contents increase as 0%, 1%, 1.75%, 2.5% in wall panels which are high percentage fibers.

Testing Overview:

Test for compression Strength

Aim of concrete mix design to achieve notable strength, workability and durability. Testing adopted in CTM machine procedure as per IS 516.

Test for flexural Strength

Flexural strength, also known as modulus of rupture, bend strength, or fracture strength is a material property, defined as the stress in a material just before it yields in a flexure test. The transverse bending test is most frequently employed, in which a specimen having either a circular or rectangular cross-section is bent until fracture or yielding using a three-point flexural test technique.
Aim to get flexural strength of wall panels. Testing adopted as per IS 516 procedure. UTM machine is adopted for generating graph which is Load vs. Deflection. Three-point loading is adopted and average value is executed for accurate results.

Test for Impact Strength

There are two types of impact testers used in industry
- Pendulum impact test
- Drop weight impact test.

A mass is dropped vertically on to a test specimen. A tube or rails are used to guide the falling mass. Since the mass either stops dead on the specimen or breaks it, the test was essentially pass/fail.

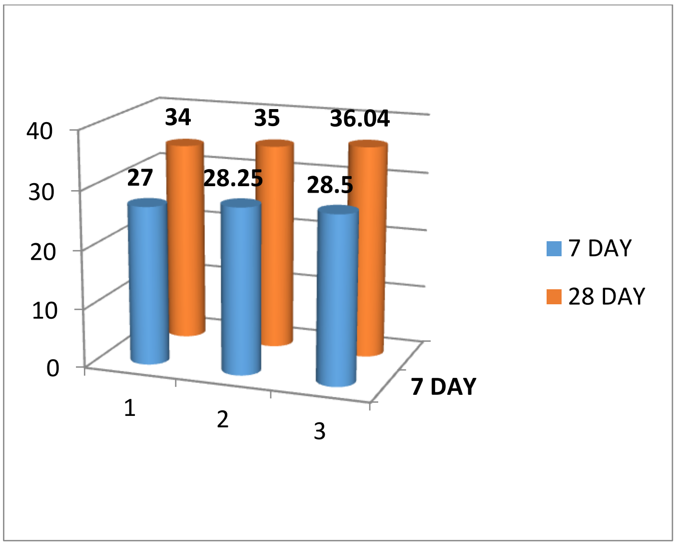
However, the energy absorbed by a specimen when it breaks can be estimated: the mass is dropped from increasing heights until the specimen fractures or breaks further tests are carried out on other samples to get more accurate value. This can involve anything up to 100 test samples. Both the mass and the drop height can be varied. The impact energy is the kinetic energy of the mass at impact. The energy absorbed by the test specimen is the impact energy required to just fracture or break the specimen. I manufactured a number of drop weight impact testers. Mass 7.6kg impact energy variable up to 50 J

Figure 4: CTM Machine

III. RESULTS AND DISCUSSION

A. Compressive strength of Mix Design

As graph shows the positive results of mix design as I achieved the desirable strength con concrete. The compressive test has been done through the CTM machine and as per IS 516. So, further I have adopted this mix design data to construct wall panels to achieve desirable results.

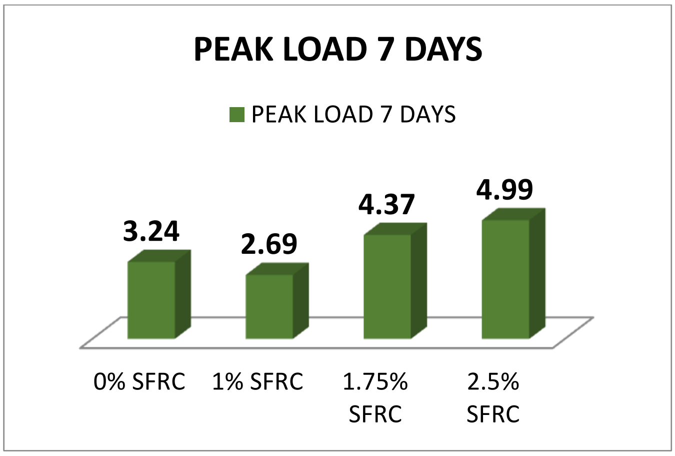


Graph 1: Compressive Strength

Figure 5: Formwork for SFRC walls

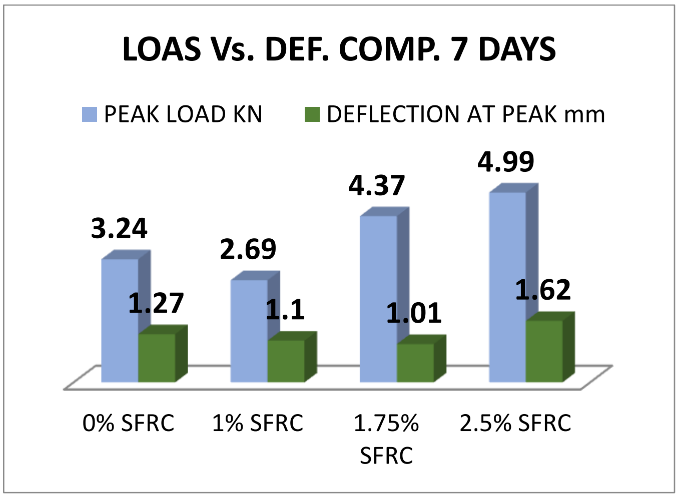
Steel Fiber Wall Panels

Peak load and deflection graphs (7 days):



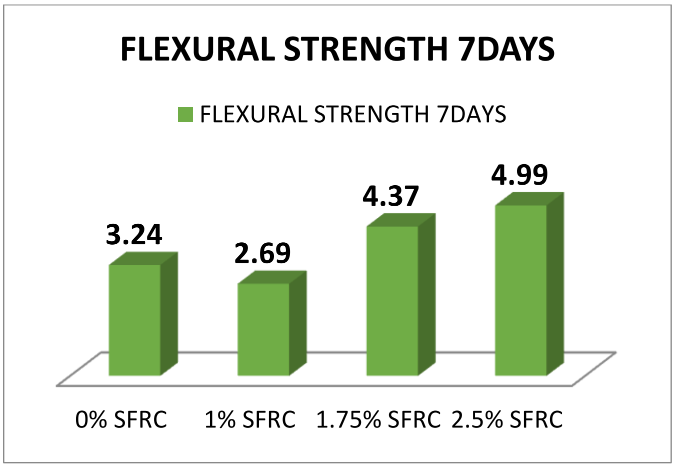
Graph 2: Peak Load

Comparison of Peak load and deflection at peak (7 Days):



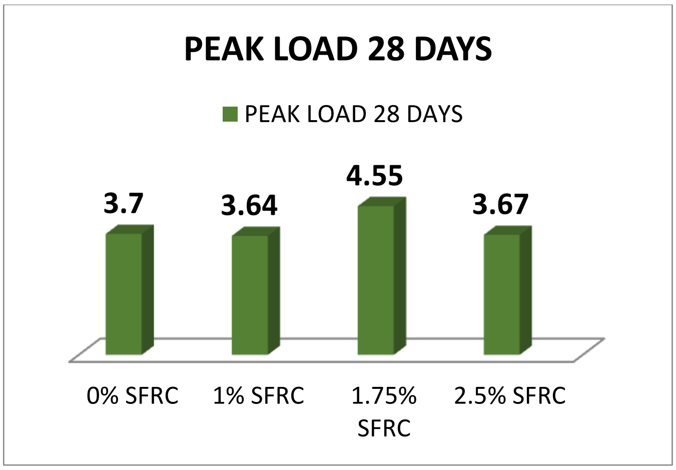
Graph 3: Peak load vs Deflection

Flexural Strength Comparison (7 Days):



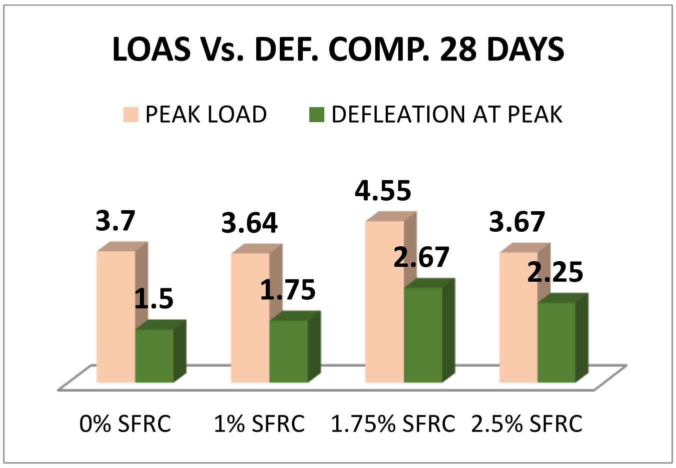
Graph 4: Flexural Strength Comparison

Peak Load Comparison (28 Days):



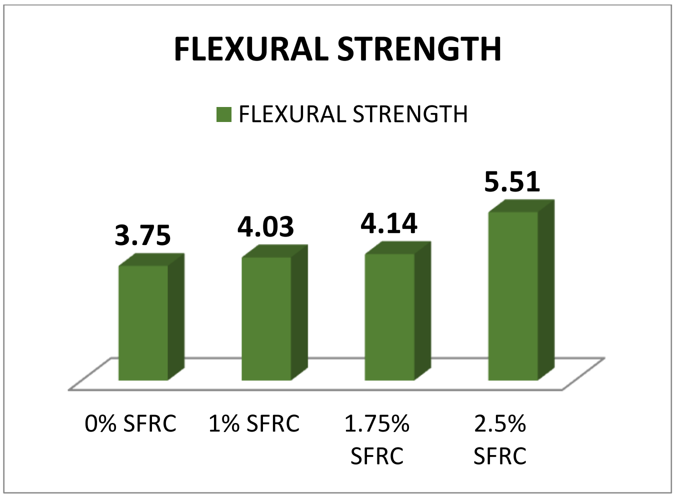
Graph 5: Peak Load

Comparison of Peak load and deflection at peak (28 Days):



Graph 6: Peak load vs Deflection

Flexural Strength Comparison (28 Days):



Graph 7: Flexural Strength Comparison

IV. CONCLUSION

After analysis of flexural results it seems that the graph average with peak load & deflection was well established in 1.75% SFRC wall panels.

0% SFRC met sudden failure.
1% SFRC wall panels results were not up to the mark.
2.5% SFRC wall panels shows vary uncertainty in deflection as well as in peak load, so the results are not reliable.

These uncertainties established due to which it produced balling effect while mixing the concrete it reduces workability of concrete.

Balling effect occurred when long steel fiber shaken together with an aspect ratio more than 100.

1.75% SFRC wall panels gives,

- Adequate workability
- Consolidation
- Finishing with minimum effort
- Allow to provide uniform distribution of SF
- Minimum segregation & bleeding

V. REFERENCES

[1] Vasudev R, Dr. B G vishnuram. studies on steel fiber reinforced concrete, International journal of scientific & Engineering Research May 5 2013.

[2] Ronald F. Zollo Fiber reinforced concrete: an overview after 30 Years of development Cement and concrete composites ELSEVIER Oct 21 1996.

[3] Amin Abrishambaf, Joaquim A.O. Barros a, Vitor M.C.F., Cunha Relation between fiber distribution and post-cracking behaviour in steel fiber reinforced self compacting concrete panels ,Cement and Concrete Research ,August 21 2012

[4] Ali ad elhakam aliabdo, Mohamed Hamdy, Effect of internal short fibers, steel reinforcement and surface layer on impact and penetration resistance of concrete, Construction and Building material (ELSEVIER), 6 june 2013

[5] l.van beers, p. spiesz, h.j.h. , Impact resistance of a sustainable ultra-high performance fiber reinforced concrete, Construction and Building material (ELSEVIER), 22. dec 2015

CODES

- State-of-the-Art Report on Fiber Reinforced Concrete, ACI committee 5442002
- Standard Specification for Steel Fibers for Fiber-Reinforced Concrete, ASTM A 820
- IS 10262.2002: Mix design of concrete
- IS 1905
- brazilian international code