

Experimental Study on Strength Parameters of Textile Reinforced Concrete under Cyclic Loading

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ABSTRACT: This paper deals with the study of the strength parameters of textile reinforced concrete. The mix design of concrete is M30 grade of concrete with water cement ratio 0.40. An experimental program consisting of two point loading tests on textile reinforced concrete and ordinary conventional concrete beams was conducted under cyclic loading to obtain stability points. The present investigation is an attempt made to evaluate the mechanical properties of textile reinforced concrete. Standard cubes of 150× 150× 150mm has been cast and tested for obtaining 28 days compressive strength. Flexural strength is checked by testing beams of size 1200 ×100 ×150 mm. The experimental investigation is validated with the analytical studies carried out by finite element models using ANSYS.

KEYWORDS: Textile reinforced concrete, cyclic loading, compressive strength, flexural strength, finite element models.

I. INTRODUCTION

Textile reinforced concrete offers innovative technology to strengthen or repair concrete structures with thin layers of textile fibres. Textile reinforced concrete is a type of reinforced concrete in which the usual steel reinforcing bars are replaced by textile materials. Textile fibre are mesh like structures with fibres made up of steel, polypropylene and jute which are used in concrete. The use of textile fibre mineral matrix composites, improve the shear behaviour of the beam. The aim of this project to is to find the mechanical properties of the beam under cyclic loading condition. Therefore this study deals about the properties and behaviour of the textile reinforced concrete, to act as a primary structural member for futuristic technology applications. The textile reinforcement provides enhanced textile strength, ductility and other features to the finished textile reinforced concrete composites. The choice of fibre material used in textile reinforced concrete is based on various factors such as material properties, corrosion, temperature resistance, bond quality and environment impact. Polypropylene fibres are have capacity to absorb large amount of energy and moderate strength improvement and resistance to impact and explosive loading. Material characteristics that are most important for the building trade. The steel fibre are used to improve strength, corrosion and stiffness of the concrete. Steel fiber are fast and perfect mixable high performance fibers and crack resistance. Steel fibers reinforce concrete against impact forces, thereby improving the toughness characteristics of hardened concrete. Steel fibres reduce the permeability and water migration in concrete, which ensures protection of concrete due to the ill effects of moisture.

II. RESEARCH SIGNIFICANCE

- Concrete is most widely used construction material in the world. Textile reinforced concrete (TRC) is a concrete in which small and discontinuous fibres are dispersed uniformly.
- The fibres used in TRC may be of different materials like steel, G.I., carbon, glass, asbestos, polypropylene, jute etc.
- The addition of these fibres into concrete mass can dramatically increase the compressive strength, tensile strength, flexural strength and impact strength of concrete.

- d. This research is aimed - studying the mechanical properties of textile reinforced concrete like compressive strength and flexural strength with different types textile fibers.

III. EXPERIMENTAL PROGRAM

The RC beam is designed based on the load carrying capacity of the testing equipment. The dimension of the beam is 1200mm× 100mm ×150 mm. All the beams after casting are cured at 28 days prior to testing. The test conducted was a cyclic loading test on RC and textile reinforced concrete beams to stability points in which the loading started at zero loads and increased to point coinciding approximately with envelope load- deflection curve. The incremental load and deflection were chosen so that the loading curve, in each cycle attained the envelope curve. This was monitoring the incremental load up to yield and incremental deflection after yield in each cycle

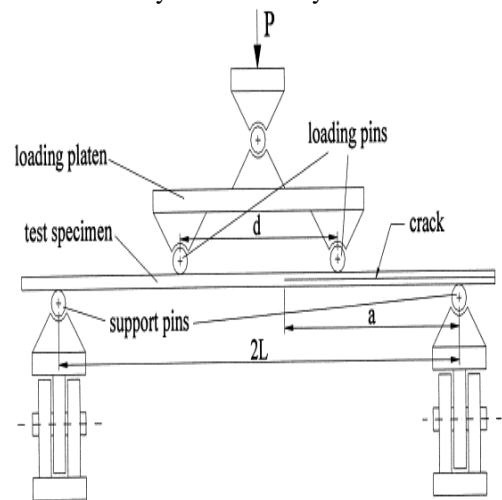


Fig 1 Experimental Setup of Beam

IV. MATERIAL AND METHODS

The materials used in the experimental work listed below were used preparation of the specimens

4.1 MIX PROPORTION

The mix design of concrete is M30 grade with water cement ratio 0.40. The four different fibres, namely crimped steel fibre (CF2,CF3), hooked steel fibre (HF4,HF5), polypropylene fibre(PF6,PF7) and jute fibre (JF8,JF9) were added to the concrete in 1% and 1.5% mix proportions respectively, with the water cement ratio of 0.40. The conventional concrete without fibre was denoted as (CC). The use of higher fibre volume fraction above 1.5% leads to fibre balling and irregular distribution of the fibers within the mix and thus reduces the strength of the matrix

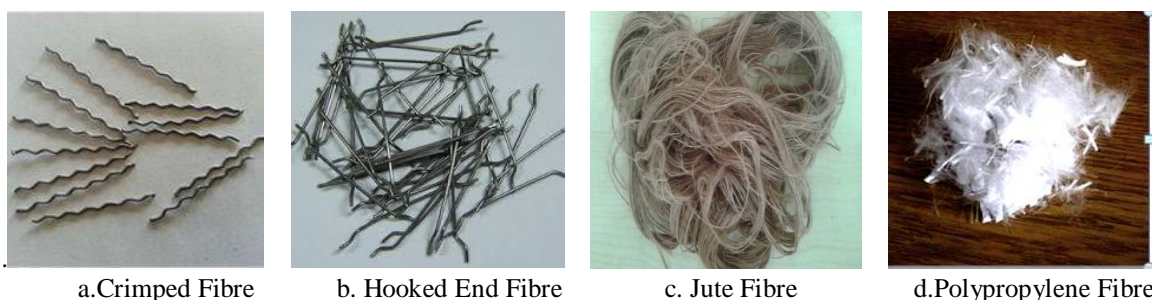


Fig.2 Geometry and Shapes of Textile Fibres

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4.2 CEMENT

The cement used in this experimental work is OPC43 Grade. All properties of cement are tested by referring IS12269-1987 specification for OPC 43 grade.

4.3 WATER

Portable water used for the experimentation.

4.4 FINE AGGREGATE

Locally available river sand used. The size of sand is passed over 4.75mm of IS sieve. The specific gravity of 2.77

4.5 COARSE AGGREGATE

Crushed aggregate available from local sources has been used. The coarse aggregate with a maximum size if 20mm having specific gravity of 2.78

4.6 STEEL FIBERS

Steel fibers are widely used in textile concrete. Steel fibres have a flexural strength of three times greater than conventional concrete. The material is less porous. Shrinkage cracks can be eliminated. Steel fibres are greater resistance to damage in case of heavy impact. The different types of steel fibres are available they are Straight, Hooked, Crimped, Padded, and Deformed steel fibers.

Table -1 properties of steel fibre

S.No	Description	Hooked End Steel Fibre	Crimped Steel Fibre
1	Length	70mm	50mm
2	Diameter	1mm	1mm
3	Aspect ratio	70	50
4	Tensile strength	1186 Mpa	345 to 3000Mpa
5	Young's modulus	210 Gpa	200Gpa
6	Ultimate elongation (%)	4 to10	4 to 10

4.7 JUTE FIBRE:

The most important types of natural fibres used in composite materials are flax, hemp, jute, and sisal due to their properties and availability. Using jute fibre for composites has many advantages. Firstly is has wood like characteristics as it is a bast fibre

4.8 POLYPROPYLENE FIBRE:

Polypropylene also known as a thermoplastic polymer used in a wide variety of applications including package and labelling textiles (e.g., ropes thermal under ware and carpets).

Polypropylene is in many aspects similar to polyethylene, especially in solution behaviour and electrical properties.

The properties are depends on the molecular weight and molecular weight distribution and type.

Polypropylene and nylon fibres are found to be suitable to increase the impact strength.

They possess very high tensile strength, but their low modulus of elasticity and higher elongation do not contribute to the flexural strength.

Table -2 Properties of Polypropylene Fibre

s.no	Descriptions	Polypropylene Fibre
1	Tensile strength	360Mpa
2	Poisson's ratio	0.45
3	Young's modulus	3.45Gpa
4	Shear modulus	1127.4 Mpa
5	Cut length	6 and 12mm

V. RESULTS AND DISCUSSION

5.1 Compressive Strength Test

Standard cube specimens of 150mm×150mm×150mm size were casted. The cube compressive strength for different mixes at period of 7days,14days and 28 days curing was calculated by the following formula:

$$\text{Compressive strength} = P/A$$

Where,

P - Failure Load

A- Cross Sectional Area of cube

5.2 Flexural Strength Test

The size of the beam specimen was 1200mm ×100mm ×150mm casted.

$$\text{Flexural strength} = PL/bd^2$$

Where,

P - Failure Load

L - center to center distance between supports of beam

b - width of specimen

d - depth of specimen

- The experimental testing method has been conducted to test the flexural strength of conventional concrete and textile reinforced concrete under cyclic loading.
- Reinforced concrete yields at 36 kN with a deflection of 0.17mm with ultimate load of 42.87 kN with deflection of 1.00mm.
- Textile reinforced concrete yields at 36kN with a deflection of 0.14mm and fails at 44.87 kN with deflection of 0.19mm.
- Compared to conventional concrete the textile reinforced concrete is eliminate the shrinkage cracks.
- The self-weight of textile reinforced concrete is lower than conventional concrete and it increases the compressive and flexural strength.
- Textile reinforced concrete improves the ductility and impact resistance and also reduces the crack width. Among all the textile fibres steel fibre is exhibits better strength than other fibres.

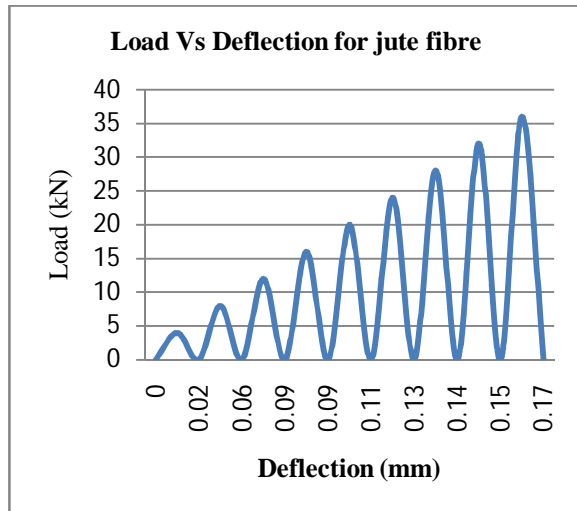
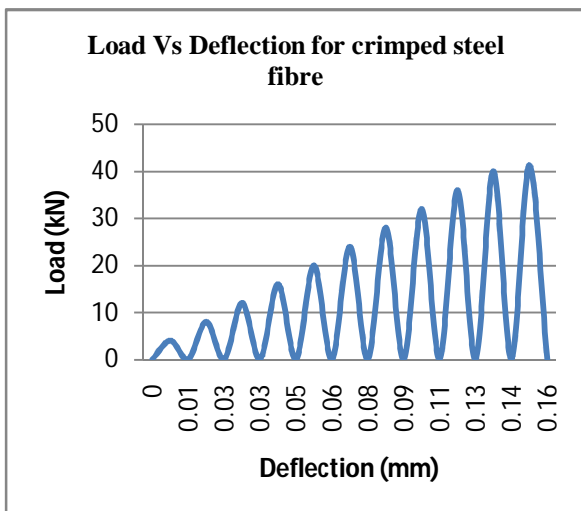
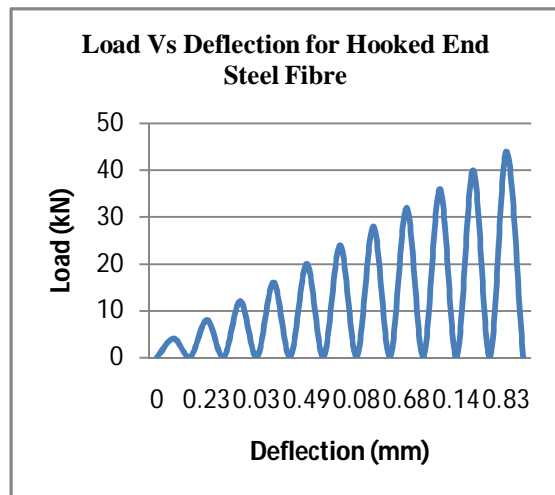
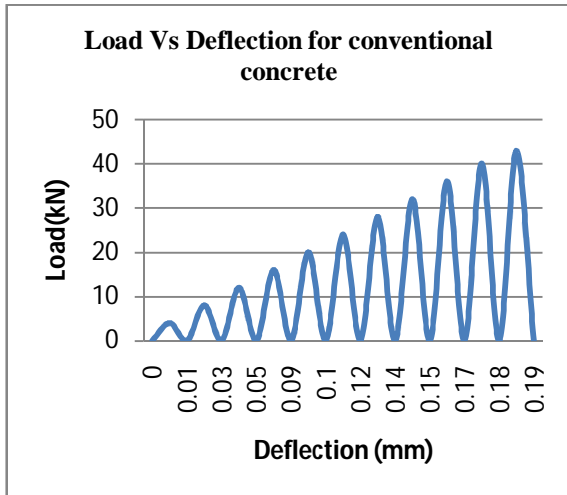


a. Hooked End Steel Fibre



b. Conventional Concrete

Fig.3 Failure Pattern of Beams



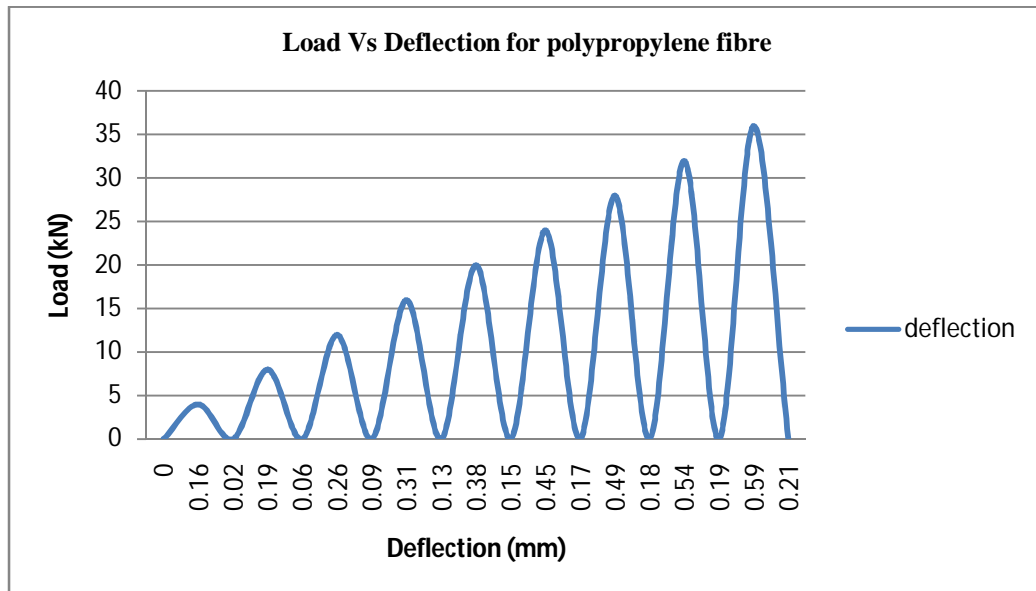


Fig.4 Graphs for Flexural Test Results

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