TEXTILE REINFORCED CONCRETE

LOKESHWARA KRISHNA U, ROHIT KUMAR C.S, YASHWANT G.H, MOOLA PURUSHOTHAM REDDY,

ROSHAN S

Department of Civil Engineering

SRM Institute of Science and Technology, Chennai

ABSTRACT:

Concrete is one of the most common building materials and has been for hundreds of years. Concrete has a high strength when subjected to compression forces but is not yearly as a strong when subjected to tensile forces. Because of that concrete is combined with a different material with high tensile strength, reinforced concrete. There are several concepts for reinforcing concrete, one of them is a relatively new concept, textile reinforced concrete.

Textile reinforced concrete (TRC) is an innovative high performance composite material consisting of open multi-axial textiles embedded in a fine-grained concrete matrix. Despite the fact that TRC-based has revealed many promising attributes, it has yet to reach its recognition due to a lack of available design tools, standards and long-term behaviour. To be able to reach this next stage, consistent test methods and reliable models need to be established to reduce uncertainty and the need for individual and extensive experimental studies.

Repairing and strengthening concrete structures with carbon-epoxy composites is of considerable interest; however, there is room for improvement regarding existing methods like bonding of fiber reinforced polymer (FRP). The main objective of this study is to show alternatives to these FRP composites, such as textile reinforced concrete (TRC). Feasibility, performance and behaviour of TRC are examined. A parametric analysis conducted using an experimental approach focuses on the influence of the nature and configuration of the textile reinforcement ratio of the TRC, the pre-impregnation product of the textile and the process for the contact moulding. This study enabled the development of a TRC suitable for repairing reinforced concrete beams by in-situ contact moulding. The composite is made of a cementitious matrix reinforced with grids of alkali-resistant glass fiber mesh. This study focuses on the development of a TRC for the repair of reinforced concrete beams by in situ contact moulding.

Keywords: Textile reinforcement, Flexural strength, Compressive strength

I.INTRODUCTION

The use of appropriate material for the strengthening and rehabilitation of structure is the major challenge faced all over the world. Due to the relatively exceptional properties of fiber reinforced polymer (FRP), it becomes a popular material for rehabilitation and strengthening of RC structures. Numerous studies show that rehabilitation using FRP currently in use has some drawbacks. Difficulty of application at low temperature moisture incompatibility, abrupt failure, emission of toxic fumes, flammability is the issue in using epoxy for FRP strengthening. Hence an alternate material, which can overcome these disadvantages of FRP will always be welcomed in the field of retrofitting.

Upgrading structural components with cement based bonding agents and high performance fiber materials give a more compatible strengthening system and prevent the disadvantages associated with the systems with use organic binding agents. Related studies on cement based composites especially textile reinforced concrete, used for strengthening and repair of RC beams is gaining popularity. The strengthening technique using TRC is comprised of Cementitious matrix as the bonding agent and textile fabric is reinforcement. Relatively thin structure elements can be produced with this material. When textiles with relatively complicated yarn shapes are used, these enhance the performance of the composite.

The use of textile reinforced mortar for strengthening existing RC members has been widely studied during the last decade. Textile reinforced mortar combines advanced fiber in the form of textiles having open mesh configuration along with inorganic matrices, such as cement based mortars. TRC is a low cost, resistant at high temperatures, compatible to concrete and masonry substrates and friendly for manual workers material, which can be applied at low temperatures or on wet surfaces. For all these reasons, the use of TRC is becoming more attractive for repair and strengthening of RC and masonry structures than the widely used fiber reinforced polymers.

The bond between TRC and concrete substrates has been studied by several researchers in the last decade. The TRC system has also been investigated for flexural strengthening, confinement or seismic retrofitting of RC elements and strengthening of masonry elements and has been found to be a promising solution. Thus, the development of reliable and accurate design models for shear strengthening of concrete members using TRC is required for enabling their wider use.

II. TYPES OF TEXTILE FIBER

Though there are large varities of textile fibers, the main kind of fibers used for textile reinforced concrete are

- Carbon fiber,
- Alkaline resistant glass fiber,
- Aramid fiber and
- Bassalt fiber.

1) AR GLASS FIBER

AR-glass filament yarns are designed especially for the reinforcement of concrete made of standard cement. To resist the corrosive alkaline solution in the concrete, AR-glass contains more than 15% (mass) of zircon. Another cement resistant glass is Z-glass, which includes higher shares of silicon dioxide and zircon oxide.

Glass fiber development is relatively mature. It was clear from the first incarnations of glass-FRC that E-glass fibre (as used by the FRP industry) would be chemically unstable in the highly alkaline cement matrix. Alkali-resistant (AR) glass was developed in the 1970s by Pilkingtons, based on silica-sodacalcia galss with the addition of about 16% zirconia, and marketed as Cem-FIL. Glass-RFC made from AR fibers was not immune to degradation, however, and further developments were made to the soluble coating or 'size' applied to the fiber (originally applied for manufacturing purposes).

The basic materials silica sand, clay and limestone are melted at temperatures up to 1350 C and pulled off the spinning nozzle with a speed between 25 and 150m/s and diameters ranging from 9 to 27 µm. After spinning a size (0.5 to 1.5 mass-% of the fiber) of organic polymers dispersed in water is applied on the filaments, 400 to 6600 of whom are combined to yarn without twisting.

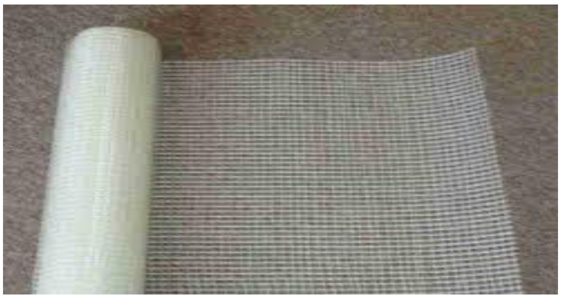


FIG.1. AR GLASS FIBER

III. APPLICATIONS OF TEXTILE REINFORCED CONCRETE:

Due to their material characteristics, glass and carbon reinforcements are already being used in numerous fields of application in the building trade, for example as reinforcement for facades, sandwich elements and for bridge building. Generally possible fields of application are:

- ✓ Ventilated façade systems in small, midsize and large formats.
- ✓ Modules (e.g. garages, transformer stations)
- ✓ Storage units (tanks, silos and similar)
- ✓ Bridges (new construction and maintenance)
- ✓ Free-form surfaces
- ✓ Load-bearing shell structures
- ✓ Balcony slabs
- ✓ Building elements with high chloride exposure
- ✓ Load bearing structure reinforcements
- ✓ Concrete remediation
- ✓ Sprayed concrete applications.

IV.STRENGTHENING OF RC BEAMS WITH TEXTILE REINFORCED CONCRETE OVERLAYS:

- Strengthening of the RC beam is done after 28days of curing of the beam.
- The tension face of the beam is grinded with the help of the grinding machine.
- The AR Glass fibermesh is measured and cut based on the surface area of the tension face.

FIG.2.STRENGTHENING OF SPECIMEN

- Based on the mix proportions, the cementitious binder is prepared.
- The cementitious binder is applied on the tension surface of the beam followed by which, the AR Glass fiber mesh is impregnated onto the surface.

Fig.3. PREPARATIONS OF BINDER

FIG.4. PASTING OF BINDER FOR BEAM

The final layer of binder is applied on the top of the impregnated mesh.

TWO POINT LOAD TEST:

- The two point load test is used to find the flexural strength of the beam.
- The beam is white washed and grid lines are marked on the compression face of the beam.
- The load from load cell is split into two point load and load is uniformly loaded over the cross section of the beam.
- Three LVDT's are placed at 1/3rd distance of beam length.
- Strain gauge is placed on the compression face of the beam.
- As the loading takes place, the cracks formed on the compression face of the beam are marked with the help of a black marker.

SI.NO	COMPRESSIVE STRENGTH
1	43.31KN

TABLE 1:COMPRESSIVE STRENGTH FOR TEXTILE REINFORCED CONCRETE:

- The first crack load and ultimate crack load is noted.
- The load pattern is obtained and the graph is prepared.

V. COMPRESSIVE STRENGTH OF CUBES:

One of the significant properties of concrete is its capability to resist compressive loads. The compressive strength of concrete is articulated as load per unit area. Cubes of size 150mm are usually adopted for determining the compressive strength.

The compression test were performed in accordance with IS standard 516 "Methods of Tests for Strength of Concrete" in the compressive testing machine. Tests were conducted at 7 days of curing.

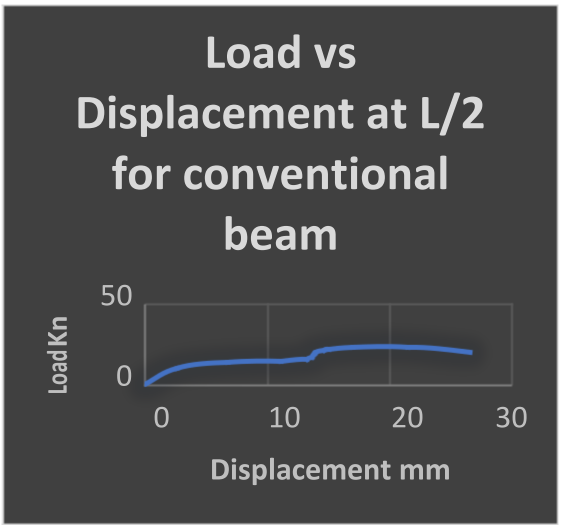
The test was carried out on 150×150×150mm cube in the compressive strength testing machine with a capacity of 200 tones. The load was applied at a rate of 2.5kN/s as agreed in IS:516-1959. The test was performed post 7 days curing.

The following tables and figures are for compressive strength of cubes and compression testing machine and result analysis of the compressive strength for 7 and 28 days. And evaluation of results of both 7 days and 28 days.

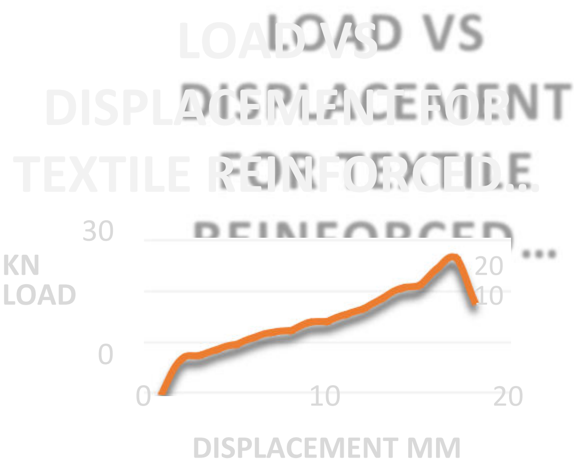
VI. FLEXURAL STRENGTH OF BEAMS AFTER 28 DAYS WITH REINFORCEMENT:

The Flexural tests achieved in this project were accomplished in agreement with IS standard 516 "Methods of Tests for Strength of Concrete". The device used to determine the flexural strength of concrete in this project was a Loading Frame. For this study examples were tried for flexural testing at 28 days of curing.

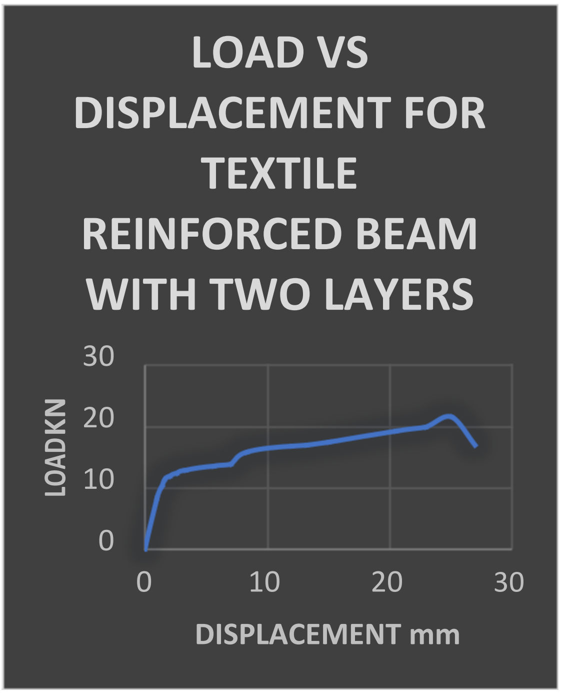
The conventional RC beam and two TRC beams have been tested for their flexural strength after 28 days of curing. The size of the specimen casted was 150mm×300mm×3m.



GRAPH 1: CONVENTIONAL BEAM



GRAPH 2: TEXTILE REINFORCED BEAM



GRAPH 3. TEXTILE REINFORCED BEAM FOR TWO LAYERS

VII. CONCLUSIONS

The following conclusions were made from this research study with addition of textile fiber to the beams on the concrete properties.

- Compressive strength of cube is analyzed after 28 days of curing.
- The addition of Textile fiber on the beam surface has shown an increase in flexural strength of beams.
- The maximum compressive strength observed was 41.33N/mm²
- Beams reinforced with textile fibers were tested for its flexural strength.
- When compared with conventional beam, TRC beam with single layer has better strength.
- When compared with conventional beam, two layered TRC beam has lower strength due to delamination binder matrix and textile layer.

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