Review of Textile Reinforced Concrete

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Abstract— This paper presents the use of textile fibre as reinforcement in the concrete. This textile reinforced concrete provides an added advantage of corrosion free element of thin structure. It is being used increasingly in the modern days construction. The review of some of this work is presented in this paper.

Key words: Textile Fibre, Reinforced Concrete

I. Introduction

A. History of TRC-

The concept of textile-reinforced concrete (TRC) is originated from a German Institute, which focused their attention on Textile technology in 1980. Textile-reinforced concrete is a type of reinforced concrete in which the usual steel reinforcing bars are replaced by textile materials. Instead of using a metal cage inside the concrete, this technique uses a fabric cage inside the concrete. Textile reinforced concretes are extensively increasing in modern days construction. Bridges, Pillars and Road Guards are prepared by Kevlar or jute reinforced concretes to withstand vibrations, sudden jerks and torsion (mechanics). Textile reinforced concrete are Corrosion resistant reinforcement. It can be freely positioned in alignment with the direction of force and close to the surface of the component. Light, thin, load bearing components from approximately 10-15 mm thick can be made using TRC. Using TRC high quality fine grained concrete surfaces can be achieved together with great freedom of design in terms of surface structure and colour.

In 1982 first patent for textile-reinforced concrete design was granted for transportation related safety items which was reinforced with materials other than steel. Also, in 1988, safety barrier made using a rope-like reinforcement made from concrete waste and textiles as its design was awarded a patent. The innovative arrangement and size of the reinforcing fibers inside was notable. In German university two concrete canoes using textile reinforcement using alkali-resistant glass fiber and carbon fiber fabric for the first time in 1996. Typical textile fiber reinforced element is shown in fig. 1.

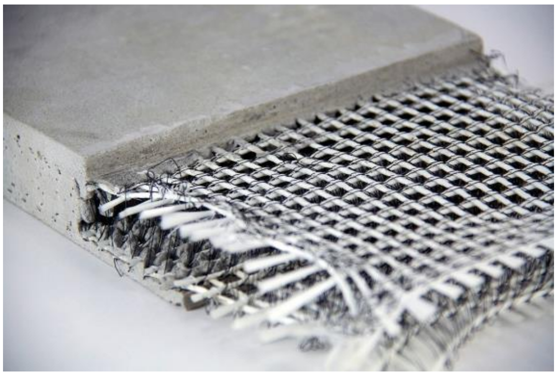

Fig.1: Glass fiber reinforcement

II. Literature review

Sudarshana rao and Ramana (2005) carried out an experimental program to investigate the behaviour of slurry-infiltrated fibrous concrete (SIFCON) slabs under impact loading. Fibre-reinforced concrete (FRC), reinforced cement concrete (RCC) and plain cement concrete (PCC) slabs were also casted and tested for comparison purposes. The impact force was delivered with a steel ball drop weight. The test results revealed that SIFCON slabs with 12% fibre volume fraction exhibit excellent performance in strength and energy-absorption characteristics when compared with other slab specimens. They also have developed regression models to estimate the energy absorption for SIFCON slab specimens.

Hegger et.al (2008) focussed their investigations on widening the application range of TRC to façade systems with large spans and load-bearing structures. In this paper, the investigations on self-supporting and structural sandwich panels regarding production methods, results of bending and shear tests, tests on sound insulation and fire resistance as well as first prototypes of slender frames and shell elements were presented.

Zhu et.al (2009) demonstrated that fabric reinforced composites with bonded Alkali Resistant (AR) glass fabrics exhibit strain-hardening behaviour, tensile strength in the range of 20–25 MPa, and strain capacity of the order of 2–5% under static conditions. Properties of these composite systems were investigated under three-point bending conditions using an instrumented drop weight impact system. Samples were studied from the viewpoint of the variations of impact load, deflection response, acceleration and absorbed energy.

Halit Yazici et al (2010) studied the effects of steel fibre alignment and high-volume mineral admixture replacement [Class C fly ash (FA) and ground granulated blast furnace slag (GGBS)] on the mechanical properties of SIFCON (Slurry Infiltrated Fibre Concrete. Ordinary Portland cement was replaced with 50% (by weight) FA or GGBS in SIFCON slurries, and two different steel fibre alignments (random and oriented in one direction) were used.

Marko Butler et.al (2010) performed experimentation to study time-dependent changes in the mechanical performance of textile reinforced concrete (TRC) made with AR glass fibre and to specify the decisive mechanisms influencing the durability of this composite material. The effect of the matrix composition was investigated by varying hydration kinetics and alkalinity of the binder mix. At first, tensile tests were tested. The results showed a pronounced decrease in the tensile strength and strain capacity for TRC whose matrix was most alkaline (Portland cement was used exclusively as binder in this composition).

Banthia et.al (1987) studied the experimental behaviour under drop weight impact loading of concrete beams, reinforced with both smooth and deformed steel reinforcing bars. Tests were carried out using an instrumented drop-weight impact apparatus, with a 345 kg mass hammer, and drop heights of up to 2.36 m. It was found that, under certain circumstances, the steel reinforcement itself fractured. Colombo et.al (2013) studied about the Textile Reinforced Concrete (TRC), which is an advanced cement-based material in which fabrics used as reinforcement can bring significant loads in tension, allowing architects and engineers to use thin cross-sections. Previous research projects on this area, developed during the last 10 years mainly in Germany, Israel and the USA, have shown the capabilities of such a material. In this paper an extensive experimental investigation of TRC was presented: tensile tests were carried out to obtain a complete mechanical characterization of the composite material under standard conditions, considering the influence of different variables such as reinforcement ratio, fabric geometry, curing conditions, displacement rate and specimen size.

Semsi Yazıcı et.al (2013) investigated the mechanical properties of steel fibre concretes (SFRCs) exposed to impact loading. Impact tests were conducted on these specimens by dropping weights on the cylinders, and their impact fracture energies were determined. As a result of this study, it was found that the loss of mechanical properties in SFRCs exposed to impact loads significantly decreased compared to non-fibrous concretes. Steel fibres partially absorbed the effect of the impact, and diminished the rupturing effect of the impact on the concrete by distributing the impact throughout the specimen.

Elavarasi D. et.al (2017) studied the response of thin slabs of Slurry-Infiltrated Fibrous Concrete (SIFCON) with and without reinforcement under low velocity impacts is explored via drop-hammer impact experiments. For comparison purpose, plain cement concrete (PCC) and reinforced cement concrete (RCC) slabs were also cast and tested. To produce SIFCON slabs made with binary cementitious materials, the pre-determined concrete mixtures were designed with 15% of silica fume, 30% of blast furnace as a partial substitute of cement along with a constant 10% of hooked end steel fibers by volume fraction. The replication of a low-velocity impact on slab was achieved by dropping a steel ball (weighing 4.5 kg), with fall height of 457 mm, via the utilization of a self-fabricated drop-hammer impact test device. The parameters like first crack and ultimate failure energy absorption capacity, ultimate crack resistance, crack resistance ratio, ductility indices, and failure pattern were examined. The test results reported that the incorporation of binary blends of silica fume and slag in SIFCON matrix shows better performance in terms of strength and durability characteristics.

Banthia et.al (1987) presented a detailed description of the instrumented drop weight impact machine. The instrumentation, the calibration, the inertial loading correction, and the dynamic analysis of a concrete beam specimen undergoing three-point impact flexural loading are described.

III. Conclusion

The review of application of textile reinforced concrete suggest that there were few studies, thus giving us the opportunity to explore further.

The performance of specimen prepared with TRC in respect of impact capacity can be studied for its energy absorption capacity.

Failure pattern of TRC specimen subjected to impact can be compared with specimen made from other materials.

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