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Textiles as Structural Element for the Reinforcement of Concrete

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Opinion

Our modern day technologies require materials bearing unusual combination of properties which cannot be present in conventional materials such as metal, ceramics and polymeric materials. It is especially evident with materials in use for construction applications. Composites are emerging as realistic alternatives to the metal alloys in many applications like construction, automobiles, marine, aerospace applications, sports goods, etc.

Composites, which are combination of different materials leading to a new material, are often used in civil engineering. The reason behind use of composites is nonexistence of optimal plain material with regard to structural and economic performance. Thus, it is necessary to combine the advantageous properties of single materials for instance load-bearing capacity, durability, weight and costs, along with elimination of draw backs. The applications related to construction industry have a vital involvement of composite materials over the past decade due to their multifold advantages. Cement concrete composite is the most important building material and its consumption is increasing. It is a combination of, cement which is a binder, concrete which is the composite material, both hardened and mixed with addition of water (or an alkaline solution in the case of geo polymer cement), and stone aggregates. Concrete is quite cheap and has relatively large compressive load-bearing capacity, but the disadvantages of cement concrete is brittleness in behavior, low tensile load-bearing capacity and poor resistance to crack opening , propagation and negligible elongation at break. The structural materials most often used in civil engineering are concrete and steel. Thus, plain concrete is not applicable if significant tensile loading cannot be ruled out in advance, as it is the case in arch structures or short columns where predominantly compressive loading comes into picture. In contrast, steel has relatively high tensile load-bearing capacity but it is quite expensive. Steel is the conventional reinforcing material in concrete. Steel enhances the strength and modulus of concrete. Conventional steel in combination with reinforcement of concrete is most common for construction despite some of the historical disadvantages of vulnerability to corrosion attack and durability. Various remedial methods have been applied to overcome the shortcomings of this building material, such as increasing the concrete cover, which, however, leads to an increased self-weight of the structure [1-2].

In recent past, an attempt to improve sustainability of reinforced concrete came in the shape of development of Textile Reinforced Concrete (TRC), which is by providing non-corrosive textile materials as reinforcement with fine grained concrete matrix. The micro crack formation and propagation can be minimized by usage of textile fibers which consequently will help in improvement of the mechanical properties as well as the durability of the concrete [3]. Textile reinforced concrete (TRC) is an innovative high performance composite material consisting of textiles embedded in a fine-grained concrete matrix. It has evolved as a perfect alternative with excellent properties of thin and light weight structures along with corrosion resistance. Textile composites have certain other advantages such as high strength-to-weight ratio, ease of handling, speed of installation, and visual impact, reversibility etc. [4]. TRC, is gaining popularity within the civil construction sector. Applications like fiber-reinforced concrete, concrete retrofitting, concrete jacketing and internal and external reinforcement of composite concrete structures play an important role.

In ancient times, prehistoric man created and used composite materials. They made and used straw-reinforced clay for bricks in construction and structures as well as pottery. The concept of using fibers to improve the characteristics of construction materials is very old. Historically, horse hair were used in mortar and straw in mud bricks. Asbestos fibers were used in concrete in 1900. In the 1950s, fiber-reinforced concrete gained popularity as concept of composite materials evolved. As soon as the health risks associated with asbestos were found, an urge to find a replacement for building materials was felt and raised. By the 1960s, materials for reinforcement of concrete were Glass, Steel and Synthetic fibers such as Polypropylene [5].

TRC is rapidly replacing conventional materials due to its promising features. The price of construction resources is increasing day by day because of high demand, scarcity of raw materials, and high price of energy. From the standpoint of energy saving and conservation of natural resources, the use of

alternative constituents in construction materials is now a matter of concern across the globe. For this, the extensive research and development works towards exploring new ingredients are required for producing sustainable and environment friendly construction materials.

Extensive research work is carried out to find out new fiber-reinforced concretes [5-7]. Varieties of fibers were used to increase toughness and prevent cracking of cement. Sustainable, energy efficient and eco-friendly construction material is sought around the world. Sustainable, green construction material, natural fiber based reinforcement in a cement matrix is a feasible approach [8]. Despite the fact that TRC based research has revealed many promising attributes, it has yet to reach its recognition due to a lack of available design tools, standards and long-term behavior. Although TRC has been extensively researched, the formalization of experimental methods and design standards is still in progress.

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