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Opinion

Ferrocement - A Versatile Light Weight Construction Material

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Abstract

Socio-economic factors have always influenced construction practices. Man has invariably attempted to compose materials that are not only cheap and easy to employ, but also strong and durable. In the last century cementitious composite has been the choice of the constructions industry across the globe owing to its low cost, easy to mould into typical shapes and high durability. Reinforced cement concrete, fibre reinforced concrete, polymer concrete etc. are to name a few. One such material is ferrocement having light weight and extremely high load resisting capacity. This paper provides a hands-on insight into this emerging construction material.

Introduction

Ferrocement is a composite material in which rich cement-sand mortar (or micro-concrete) is reinforced with layers of continuous and small diameter steel wire meshes. The basic principle in its formulation is that it can undergo large strains in the neighbourhood of reinforcement and the magnitude of strains depends on the distribution and subdivision of meshes in concrete. The uniform distribution and high surface area to volume ratio (specific surface) of the reinforcement results in a good crack arrest mechanism. Ferrocement Model Code (2001) defines ferrocement as a type of reinforced concrete commonly constructed of hydraulic cement mortar reinforced with closely spaced layers of relatively small wire diameter mesh. The mesh may be made of metallic or other suitable materials. The fineness of the mortar matrix and its composition should be compatible with the opening and tightness of the reinforcing system it is meant to encapsulate. The matrix may contain discontinuous fibers [1].

Use of ferrocement

Ferrocement is used in thin walled structures where strength and rigidity are developed through form or shape. It can be tailored with directional strength properties and has the distinct advantage of being moldable and of one piece construction. Other major advantages are its low cost and non-flammability. The confidence in the material has been building up with time resulting in its wider applications. The application areas of ferrocement are both terrestrial and marine. It has been used in housing (particularly roofing elements), water tanks, pipes, water boats, barges, vessels, reservoirs, swimming pools, farming works, silos and warehouses [2-3].

Constituent materials

The basic constituent materials required for ferrocement are cement, sand, water and wire meshes. The cement should normally be of ordinary Portland type. The cement-sand ratio for the mortar varies from 1:1.5 to 1:2.5 and water-cement ratio, from 0.35 to 0.50 by weight. Wire meshes of different types, such as hexagonal (chicken wire mesh), woven, welded, expanded and Watson meshes, have been used. The wire meshes are generally made up of 0.5 to 1.5 mm diameter wires and spaced 5 to 25 mm apart.

Historical Development of Ferrocement

Increased scientific approach to studying and predicting ferrocement properties started in the late 1960's and was encouraged by a panel of the US National Academy of Sciences in 1973. This led to the formation of the American Concrete Institute's Committee on Ferrocement, in 1975, and shortly thereafter, in 1976, the establishment of the International Ferrocement Information Center (IFIC) in Bangkok, Thailand. Publication of the Journal of Ferrocement was then consolidated at IFIC.A RILEM

scientific committee on ferrocement was later formed in 1979. Progress accelerated during the 1980's through fundamental research, publications, symposia, short courses and applications. The International Ferrocement Society (IFS) was founded in 1991 with the objective to foster development, disseminate knowledge, and encourage practical applications of ferrocement [4].

The most urgent need of this new professional society was to develop a building code for ferrocement. The first Ferrocement Model Code was published in 2001 essentially setting the stage for guided expansion, imagineering and developments [5-6]. Since then, there has been an increased activity with ferrocement construction throughout the world particularly in Canada, U.S.A., Australia, New Zealand, U.K., Mexico, erstwhile Soviet Union, Poland, Cuba, Hungary, China, Thailand, India, Indonesia and Israel A large number of experimental and analytical studies have been carried out that deal with ferrocement structural elements, having various shapes and sizes, subjected to different loading conditions. These studies have established the material worthiness for use in diversified applications and prove it to be a strong alternative to conventional construction material.

Improvement in strength of ferrocement has also been suggested through the use of different types of wire meshes and modified mortar. Almost all the aspects involving tension, compression, flexure, shear, torsion, fatigue, impact and dynamic loading has been widely investigated. These research outcomes have proved the worthiness of this material [7-10]. Success of ferrocement, as with other materials, depends largely upon its durability. Few studies exploring the durability aspects of the ferrocement have also been reported [11-14]. Although it has been found to be durable alternative construction material but its long term performance especially in aggressive environment is still under explored.

Conclusion

Ferrocement has proven itself as an extremely versatile light weight low cost housing material having excellent performance under varied loading conditions. For its acceptability as alternative construction material, durability aspects need to be thoroughly explored. Methods that can improve the life of ferrocement composite in every type of exposure condition are still awaited.

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