© 2018 IJSRSET | Volume 4 | Issue 1 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section : Engineering and Technology

Review on Ferrocement

Priyanka Patil, Akshay Salve , Bharat Ghuge, Saurabh Kamble, Prof. Sachin Kumbhar
Department of Civil, VOGCE, Mumbai University, Aghai, Thane, Maharashtra, India

ABSTRACT

Ferrocement is suitable for the construction of roofing/floor elements, precast units, manhole covers, and construction of domes, vaults, grid surface and folded plates. It can also be used for making water tanks, boats, and silos. It is concluded that the first crack and ultimate loads increase with the increases number of layer wire mesh. From the studies, it is observed that the load carrying capacities, deformation at ultimate load and energy absorption capacities are high in the case of increasing the number of wire mesh layers. Ferro- means iron although metal commonly used in Ferro-cement is the iron alloy steel. Today cement usually means Portland cement, Mortar is a paste of a binder (usually Portland cement), sand and water; and concrete is a fluid mixture of Portland cement, sand, water and crushed stone aggregate which is poured into formwork (shuttering) Prefabricated elements are used In construction industry as an alternative system to overcome the formwork problems in addition to getting better quality control. The prefabricated elements made of reinforced concrete are extremely heavy and difficult to transport, placing in position and to construct. Alternatively, fibrocement panels are being used in construction industry due to its good structural performance and low cost. This paper concludes that fibrocement can be a best suitable material in upcoming years with a large no of applications. In this paper review work is presented on fibrocement as a construction material and its properties. This paper also focuses on structural behavior of fibrocement when used along with different structural members.
Keywords : Ferrocement, Concrete

I. INTRODUCTION

Ferrocement is commonly used as repairing & strengthening material, apart with this character fibrocement is found to be very good solution for fire protection because of its post –fire flexural strength and toughness with plain mortar or concrete cover. The increase in wire mesh content significantly improved the mechanical properties of fibrocement to under normal conditions. Ferrocement is a type of thin wall reinforced concrete commonly constructed of hydraulic cement mortar reinforced with closely spaced layers of continuous and relatively small size wire mesh which may be made of metallic or other suitable materials. Since fibrocement possess certain unique properties, such as high tensile strength-to-weight ratio, superior cracking behavior, lightweight, mold ability to any shape and certain advantages such as utilization of only locally available materials and semi-skilled labour workmanship, it has been considered to an attractive material and a material of good promise and potential by the construction industry, especially in developing countries. It has wide range of applications such as in the manufacture of boats, barges, prefabricated housing units, biogas structures, silos, tanks, and recently in the repair and strengthening of structures. Ferrocement is suitable for low-cost roofing, pre-cast units and man-hole covers.

It is used for the construction of domes, vaults, grid surfaces and folded plates. It can be used for making

water tanks, boats, and silos. Ferrocement is the best alternative to concrete and steel. Generally, fibrocement shells range from 10 mm to 60mm in thickness and the reinforcement consists of layers of steel mesh usually with steel reinforcing bars sandwiched midway between. The resulting shell or panel of mesh is impregnated with an extraordinarily rich (high ratio of cement to sand) Portland cement mortar. Ferrocement is a highly versatile construction material and possess high performance characteristic, especially in cracking strength, ductility, and impact resistance

II. LITERATURE REVIEW

Nassif and others [1] conducted experimental study on flexural behavior of on fibrocement/concrete composite beams made of reinforced concrete over laid on a thin section fibrocement has been concluded that addition of a thin layer of fibrocement to a concrete beam enhances the durability as well as cracking strength; increases as the number of mesh layer increases the cracking stiffness of the composite beam.

Bong J. H. L and Ahmed E [2] based on the results from the experiment carried out, it can be concluded that fibrocement can increase and thus strengthen the beam in terms of its cracking load as well as deflection. It reduces the beam's mid-span deflection and increases its strength as compared in the experiment carried out. Deflection measured in the beam strengthened with fibrocement is roughly 70% less than the deflection found in control beam within the elastic limit. And also Ferrocement laminate increases the ultimate load of the beam by about 17%. Elavil and Chandrasekhar [3] did a research on this and has come to the conclusion that finite element models represented by load-deflection plot at mid-span shows good agreement with the experimental and theoretical results. The research also shows that load carrying capacity as well as the ultimate load of fibrocement strengthened beam is higher than that of the control beam. The mid-span deflection at any given loads is also lower than that of control beam. In addition to that, fibrocement allows the existing conventional concrete material and practices to be used and thus, is more practical as a strengthening material compared to others.

One and et.al [4] studied the behavior of fibrocement. Different mesh arrangement and layers were considered in beam. Based on the above they have concluded that (I) fibrocement elements of beam tested have a good behavior under working load due to the fact that the width of crack appears to the very small than in reinforced concrete; (ii) the good behavior at failure regarding the aspect of the ultimate

III. SPECIFICATIONS

This construction require some of the basic materials which ensures a stable, and also results in cheap construction as compared to conventional method. Materials used for casting are:

1. Sand
2. Cement
3. Fine aggregate
4. Water
5. Wire mesh

1. Cement

Ordinary Portland cement is used in making of mortar. The cement should fresh and free from Lumps.

2. Aggregates

Normal-weight fine aggregate is the most common aggregate used in fibrocement. The aggregate consists of well graded fine aggregate that passes a 2.34 mm sieve; and since salt free source is recommended, sand should preferably be selected from river-beds and be free from organic or other deleterious matter and relatively free from silt and clay. Good amount of consistency and compaction is achieved by using a well-graded, rounded, natural sand having a maximum top size about one-third of the small

opening in the reinforcing mesh to ensure Proper penetration (ACI Committee 549R-97). The moisture content of the aggregate should be considered in the calculation of required water.

3. Water

The mixing water should be fresh, clean, and potable

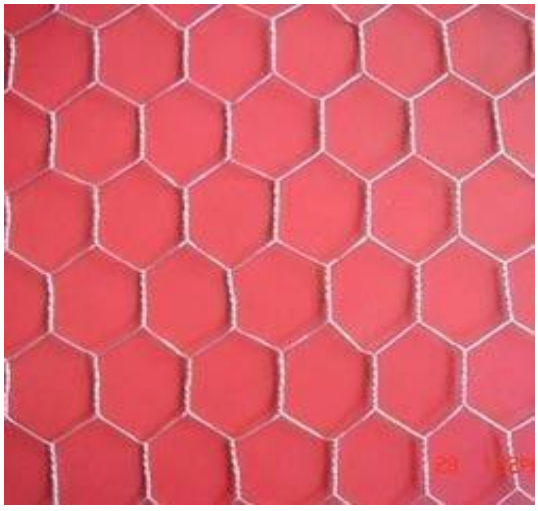
4.Matrix Mix Proportioning

The mix proportion ranges of the mortar for ferrocement application are sand/cement ratio by weight, 1 to 2.5 and Water-cement ratio by weight, 0.30 to 0.5. The amount of water used should be the minimum consistent with compatibility. This is commonly achieved by using a well-graded, rounded, natural sand having a maximum top size about one-third of the smallest opening in the reinforcing system to ensure proper penetration. Sand passing a 1.16 mm sieve has given satisfactory results in many practical applications. The mix should be as stiff as possible, provided it does not prevent full penetration of the mesh. Normally the slump of fresh mortar should not exceed 2 in. (50 mm). For most applications, the 28-day compressive
Strength of 75 by 150-mm moist-cured cylinders should not be less than 35 MPa.

B. Reinforcement For Ferrocement

Different types of meshes are available almost in every country in the world. Two important reinforcing parameters are commonly used in characterizing ferrocement and are defined as Volume fraction of reinforcement; it is the total volume of reinforcement per unit volume of ferrocement. Specific surface of the reinforcement, it is the total bonded area of reinforcement per unit volume of composite. The principal types of wire mesh currently being used are given below: Hexagonal wire mesh Welded wire mesh, Woven wire mesh, expanded metal mesh and three dimensional meshes.

1. Hexagonal or Chicken Wire Mesh



This mesh is readily available in most countries and it is known to be the cheapest and easiest to handle. The mesh is fabricated from cold drawn wire which is generally woven into hexagonal patterns. Special patterns may include hexagonal mesh with longitudinal wires.

2. Welded Wire Mesh

In this mesh a grid pattern is formed by welding the perpendicular intersecting wires at their intersection. This mesh may have the advantage of easy molding into the required shape; it has the disadvantage of the possibility of weak spots at the intersection of wires resulting from inadequate welding during the

manufacture of the mesh. Welded-wire fabric normally contains larger diameter wires 2 mm or more spaced at 25 mm or more. Welded-wire fabric could be used in combination with wire mesh to minimize the cost of reinforcement. The minimum yield strength of the wire measured at a strain of 0.035 should be 414 MPa.

3. Woven Wire Mesh

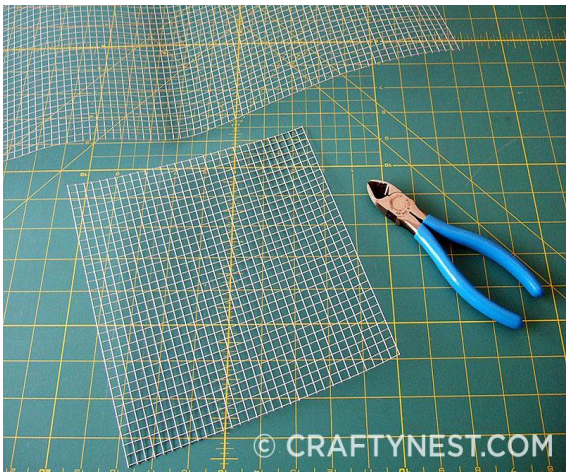
In this mesh, the wires are interwoven to form there required grid and the intersections are not welded. The wires in this type of mesh are not straight. They are bent in the shape of zigzag Lines and large angle of bending might cause cracks along the mesh However, the molding performance of this mesh is as good as the hexagonal and the welded wire mesh.

4.Expanded Metal Mesh

This mesh is formed by cutting a thin sheet of expanded metal to produce diamond shape openings. It is not as strong as woven mesh, but on cost to strength ratio, expanded metal has The advantage. This type of mesh reinforcement provides good impact resistance and crack control, but they are difficult to use in construction involving sharps curves.

IV. CONSTRUCTION PROCESS

4.1. Preparation Of Mesh



At first, the length and height of the structural element was measured. From the measurement wire mesh was cut accordingly. Two set of wire meshes were prepared as per the measurement. Necessary splices were provided where there was a joint with columns and beams. The lap length was considered as minimum as three inches.

4.2. Surface Preparation

Firstly the area was cleaned by brush and water before starting the construction. Because the strength of the structure should also be depended upon the how the preparation done. The oily space should be well clean. Before the casting it's necessary that there shouldn't be any crack on as surface.

4.3. Casting Procedure

After the surface preparation the material is carried out for the casting. In the casting the different wire mesh layers are used for the better result. First of all the surface is prepared with mortar paste as a thickness then wire mesh is properly laid on mortar. And after above that wire mesh again mortar paste is laid. Is continue as per requirement. And then finally casting is complete.

4. 4. Curing Procedure

After 24 hour of casting and curing by water were started. It was maintained for 28 days to find strength.

4.5. Finishing

After 28 days of curing, the structural element was left for three days to dry. Then it was cleaned by sand paper and stone and after proper brushing it was ready for testing. After that the structural element was carried out for test and find the strength.

V. ADVANTAGES

The major advantages of Ferro cement are as following:

1. It can be fabricated into any desired shape.
2. The tensile strength of Ferro-cement is very high than conventional concrete.
3. The structures made with Ferro-cement are thin and lightweight.
4. Construction procedure is easy, quick and no skilled labors are required.
5. Formwork is also not required in such construction.
6. Precast members can be suitably manufactured by using this type of concrete.
7. Maintenance cost is very low, almost nil.
8. It is fire, corrosion, and earthquake resistance.
9. It is economical.

VI. APPLICATIONS

Due to its various advantages, the application of fibrocement in construction is increasing day by day. The application of fibrocement are as follows:

1. Mobile home,
2. Modular housing,
3. Water tank,
4. Swimming pool,
5. Wind tunnel,
6. Marine work
7. Used in making boats
8. Used as planks for shelves in housing projects replacing costly wooden planks
9. Used in construction of boxes for water and electrical meters
10. Used in construction of sewage manhole covers115. Ferro-cement components are used in rural areas for low cost housing
11. Recently Ferro-cements are used in some residential and industrial buildings also.

VII. DISADVANTAGES

1. Excessive shrinkage due to higher cement content. Needs constant curing for a period of 7 days to avoid any shrinkage cracks
2. Prone to corrosion of MS rods and GI mesh due to incomplete coverage of materials by mortar
3. Ferro-cement is labour intensive. So it might not be economical to use ferrocements in places where the labour costs are high
4. As Ferro-cement components are usually thin structures, Buckling is another factor that needs to be taken into consideration during.

VIII. CONCLUSION

This brought out that fibrocement is an innovative material and the ready availability of Material and easy construction methods it suitable for housing, water and food storage Structures. Ferrocement is found to be suitable material for repairing the defective RCC structural elements to increase their performance. The performance of fibrocement is depend On properties of reinforcing mesh, there is need to specify optimum range of properties of Mesh. Considering the unique features, fibrocement is important alternative for RCC and Repair material in future.

IX. ACKNOWLEDGEMENT

The Authors greatly appreciate the help of Prof. Sachem Kumbhar Sir Department of CIVIL., VOGCE and all the staff and students of Department of Civil. We also thanks Mr. Santosh khsirsagar for his Information.

X. REFERENCES

[1]. ACI Committee 549 report, Guide for the Design, Construction and Repair of Ferrocement, ACI 549.1R-93, 1993

[2]. Nassif, H. H. and Najd, H., 2003. Experimental and analytical investigation of fibrocement-concrete composite beams, Cement & Concrete Composites, 26:787-796

[3]. Bureau of Indian standard "IS 456: 2000 plain and reinforced concrete-code of practice (fourth revision)" ICS 91.100.30, 2000

[4]. Ghavami k. "Ultimate Load Behavior of Bamboo-Reinforced light weight Concrete Beams." Cement and Concrete Composites. Vol.17, pp281-288, 1995.

[5]. Joel Bernstein, "Ferrocement: Application in Developing Countries, National Academy of Science, Washington D.C. Feb 1973, and pp 40-45.

[6]. ACI Committee 549, "Guide for the Design, Construction and Repair of Ferrocement", ACI 549.1R-93, American Concrete Institute, 1999pp 27.

[7]. S. K. Patra, "Ferrocement=A Review", IJERT Vol. 2 Issue 10, October=2013, pp 562-565