AN EXPERIMENTAL INVESTIGATION ON RETROFITTING USING FERROCEMENT ALONG WITH FIBERS

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ABSTRACT: Rehabilitation and strengthening of old structures using advanced materials is a contemporary research in the field of Structural Engineering. During past two decades, much research has been carried out on shear and flexural strengthening of reinforced concrete structures using different types of fiber reinforced polymers and adhesives. Strengthening of old structures is necessary to obtain an expected life span. Life span of Reinforced Concrete (RC) structures may be reduced due to many reasons, such as deterioration of concrete and development of surface cracks due to ingress of chemical agents, improper design and unexpected external lateral loads such as wind or seismic forces acting on a structure, which are also the reasons for failure of structural members. The superior properties of polymer composite materials like high corrosion resistance, high strength, high stiffness, excellent fatigue performance and good resistance to chemical attack etc., has motivated the researchers and practicing engineers to use the polymer composites in the field of rehabilitation of structures. This paper reviews fourteen articles on rehabilitation of. The paper reviews the different properties of banana fiber and sisal fiber composites and adhesives, influence of dimensions of beams and loading rate causing failure. The paper proposes an enhanced retrofitting technique for flexural members and to develop a new mathematical model.

KEYWORD: flexural strengthening, Ferro cement, epoxy resin

1.INTRODUCTION

Ferrocement is a building material composition composed of cement, sand, water, aggregates and metallic mesh. The metallic mesh can be replaced by chicken mesh or

wooden or bamboo mesh. It is strong, economic, fireproof, earthquake resistant, and increases flexural strength.

Ferrocement has a broad range of applications which include construction, sculpture, repair of existing artefacts and boat-building. It is also used in the construction of roof channels, doors, water tanks, toilet pans, slabs and biogas plants.

Ferro-cement can't strictly be classified as a sustainable material, but it is highly efficient and cost-effective. And hence we have used ferrocement with sisal fiber and banana fiber. These fiber has been used to increase the flexural strength of the structure.

The chemical composition of banana fiber is cellulose, hemicellulose,lignin, pectin and wax and it is highly strong fiber. The elongation will be smaller. The weight of banana fiber will be very light. By adding banana fiber the strength will be increased. Sisal fiber is durable material with low maintenance it can be easily recycle it exhibits good sound and impact absorbing properties it has a very good fire resisting properties

Sisal fiber is one of the most widely cultivated natural fiber. And it is easy to cultivate. The plant is known formally as agave sisal.

And the other material used with Ferro cement is chicken mesh. It is used as reinforcement in the sheet to increase the strength of the sheet. And it also gain the strength of buildings, beams and where it is used.

2. Materials used

The banana fiber consists of cellulose-31-35%, hemicellulose-14-17% lignin-15-16%. We studied the properties of banana fibre, pineapple leaf fibre, coir, wheat straw, barley straw and rice straw and resulted that pineapple and banana fibers have higher cellulose content 70-82% and 60-65%. The banana fibre showed the diameter of 80-250 μm with the elongation percentage of 1.0-3.5.Sisal Fiber is exceptionally durable with a low maintenance with minimal wear and tear.It is Recyclable. Sisal fibers are obtained from the outer leaf skin, removing the inner pulp. It is available as plaid, herringbone and Sisal fibers are Anti-static, does not attract or trap dust particles and does not absorb moisture or water easily. The fine texture takes dyes easily and offers the largest range of dyed colours of all natural

fibers. It exhibits good sound and impact absorbing properties. Its leaves can be treated with natural borax for fire resistance properties

Thin concrete sheet = 8mm (thickness)

Concrete of grade M25

2 % of fiber and mesh will be added in between concrete layer

Epoxy will be added to paste both mesh and concrete

The applications of ECC include short columns, highway pavements, bridge decks and permanent formwork, etc. The 1 km. (0.62 mile) long Mihara Bridge in Hokkaido, Japan was opened to traffic in 2005; and the steel-reinforced road bed contains 800 m3 (28251 ft3) of ECC material; the tensile ductility and tight crack control behavior of ECC led to a 40% reduction in material used during construction (Technology Network, 2009). Similarly, a 225 mm (9 in.) thick ECC bridge deck on interstate 94 in Michigan was completed in 2005 and 30 m3 (1059 ft3) of material used was delivered on-site in standard mixing trucks (Lepech and Li, 2009). The 95 m (312 ft.) Gloria Roppongi high-rise apartment building in Tokyo containing a total Wof 54 ECC coupling beams (2 per storey) was intended do mitigate earthquake damage; similar structures include the 41-storey Nabeaure Okohama Tower (4 coupling beams per floor) (MRS Bulletin, 2006). A sixty year old dam which was severely damaged showing evidence of cracks, spalling and some water leakage in Mitaka Dam near Hiroshima was repaired using ECC with 20 mm (0.78 in.) thick layer in 2003 (Technology Network, 2009). Also in 2003, an earth retaining wall in Gifu, Japan was repaired using ECC

I. Constituents of Ferro cement

Ferrocement is a composite thin element which is constructed of building materials—chicken mesh, cement, fine aggregate (sand) and water. (Naaman, 2000; ACI Committee 549R-97; and Nassif and Najm, 2004) and each of these materials are separately described in this section below.

II. Chicken Mesh

Ferro cement uses layers of continuous/ small diameter steel wire/ weld mesh netting (metallic or non-metallic) as reinforcement with high volume fraction of reinforcement (2 to 8%) and the specific surface of reinforcement is considerably higher for fibrocement than for RCC. Also, the reinforcing chicken mesh has openings large enough for adequate bonding; the closer distribution and uniform dispersion of reinforcement, transform the otherwise brittle mortar into a high performance material distinctly different from reinforced concrete. Skeletal steel rods/wires/strands are used as spacer material and to form the skeleton of the shape of the structure to be built, around which the mesh layers are later attached

III. Cement

Portland cement is generally used in fibrocement. But the type of cement should be selected according to the need or environment in which the structure is built, for example ASTM cement Type I-V mentions the strength characteristics of cement and its specific use / application (OPC 43). Mineral admixtures, such as flash, silica fumes, or blast furnace slag, may be used to maintain a high volume fraction of fine filler material as well as to enhance the properties at wet and hardened state.

IV. Aggregate

Only fine aggregate is used in fibrocement. Coarse aggregate is not used in fibrocement. Normally, the aggregate consists of well graded fine aggregate (sand) that passes a 3 mm sieve.

Sieve and since salt-free source is recommended, sand should preferably be selected from riverbeds and be free from organic or other deleterious matter (Sakthivel & Jagannathan, 2011). Good amount of consistency and compatibility 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

V. Water

In fibrocement, the water used for mixing cement mortar should be fresh, clean and fit for construction purposes; the water of pH equal or greater than 7 and free from organic matter— silt, oil, sugar, chloride and acidic material

3. Ferro cement Construction Process

Construction sequencing/ process is important for fibrocement construction. Since the fibrocement elements are very thin in the order of 10-25 mm (0.39-1 in.), considerable care is to be taken to maintain minimum cover of 3 mm (1/8 in.). The details on storage of materials, details of the workers, tying of reinforcement, preparation and application of mortar and curing are detailed in this section below.

4. Properties of Ferro cement

The unique properties of fibrocement are described in detail in this section. Also, the research scope on fibrocement is identified and given in this section by the present authors.

5. Methodology

Initially the cement 0PC 43 is taken into mixture with M25 grade. The aggregate chosen is of 6mm (chips) the fiber added is about 2% of the total weight. 260g of cement, sand 390g, aggregate 780g .Being the proportion of aggregate was small there is no need of mix design .the water cement ratio was taken as 0.5. The content of fiber added in the mix is 28.8g

6. RESULT

Compressive strength of the specimen

Without ferrocement sheet	22.40 N/mm²
With ferrocement sheet	28.60 N/mm²

Flexural strength of the specimen

Without Ferrocement sheet	3.83 N/mm²
With ferrocement	6.75 N/mm²

Tensile strength of the specimen

Without Ferrocement sheet	5.15 N/mm²
With ferrocement	8.45N/mm²

7. CONCLUSION

we conclude that the usage of ferrocement along with fibers are economical and naturally available, the mesh used is capable of increase in strength and flexibility and have the property of bonding. The past decades used various materials which is a composite of glass carbon materials are used are readily available and cost efficient.

8. REFERENCE

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