Review on Ferrocement

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Abstract- A review of behavior and strength of reinforced concrete (RC) structures strengthened with ferrocement jackets is presented. The effect of different number of layers, angle of ferrocement jacket with different grades of concrete is also discussed. The best solution for the number of layers and of the angle of ferrocement jacket is also cited with the grades of concrete, wherever available. Various critical issues, related with ferrocement jacket, based on literature review are presented.

Keywords – Ferrocement, RCC structures, Number of layers, Grade of concrete

I. INTRODUCTION

Ferrocement is commonly used as repairing & strengthening material, apart with this character ferrocement 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 ferrocement under normal conditions [1]. Ferrocement jackets reinforced with expanded steel meshes can be used effectively to strengthen shear deficient concrete columns. The shear strength of ferrocement jacket can be estimated by the following simple equations given below [2]:

$$v_{sf} = 2\eta v_f t_f a_f f_{yf}$$

where,

v_f = volume fraction of ferrocement reinforcement

t_f = thickness of ferrocement jacket,

a_f = t distancebetween load point and edge of the jacket (a gap distance less than shear span),

η = global efficiency factor for ferrocement reinforcement (0.65 for long diagonal direction of expanded mesh),

f_{yf} = the yield strength of ferrocement reinforcement.

Ferromesh plays very important role in enhancing the strength capacity and in failure mode for preventing the sudden and brittle failure. It also increases the ductility [3].A procedure to analyze ferrocement slabs has been presented by Ihsan Qasim Mohamad And he also found that Geometric nonlinear concept playsan important role in predicting the analytical results and gives more accurate results[4].The confinement can be improved with the help of ferrocement shell, which is helpful in increasing the ultimate strength is linearly vary with the specific surface area. Mathematically it is expressed as follows[5].,

$$P = f_c'[1.0 + 0.35Ct)(0.912 + 0.35S_f)\ A_g + f_y A_s$$

Where,
P = Ultimate load carrying capacity of FCRC prism section
f_c' = Strength of unconfined concrete

Ci = Confinement index

S_f = Spacing of ferrocement mesh

A_g =Gross cross sectional area

f_y =Yield strength of longitudinal tie/mesh steel

A_s =Area of longitudinal steel

Expanded steel mesh also achieved good ductility and modulus of rupture [MOR]. MOR is directly proportional to volume fraction and more volume fraction reduces crack spacing and width[6]. Double layer WWM gives nearly double strength than the single layer of WWM. There is increase in strength with change in orientation of mesh from 90º to 45º[7].Ferrocement jacket improves the axial load capacity & axial stiffness about 33% & 26% respectively. The column repaired with ferrocement improves the ductility characteristics[8].

High-performance ferrocement laminate (HPFL) is new material composed of grid rebar and ordinary cement mortar, which contained polyethylene fiber, expansion agent, water reducer, fly ash, etc. HPFL can raise the bearing capacity of the concrete members significantly[9]. The durability of ferrocement structures can be enhanced with the help of suitable surface coating & surface coating will offer the best protection for the mortar and the mesh[10].

Ferrocement is one of the most commonly used material due to its easy availability, durability, economy, and the ability to mould in any require shape easily. When it is oriented with 45 degree, it gives higher percentage of energy absorption compared to 0 & 60 degree [11]. The most common type of reinforcement used for ferrocement is Woven wire grids with a hexagonal weave. The advantages of such reinforcement include its relatively low cost and ease of use. The size of the openings in the grid are varied from 10 to 25 mm and depend on the grid's characteristics[12]..The shear strength, lateral stiffness and the lateral load capacity of the masonry is significantly increased when retrofitted with ferromesh[13]. Light weight ferrocement beam have good moment of resistance capacity. The numbers of layers of wire mesh are help full in sustaining greater number of repetition, strain carrying capacity, increasing the margin between first crack and ultimate flexural strength [14]..The 45° orientation emerges as the weakest configuration because of the lowest volume fraction of wire mesh in the direction of loading at this orientation [7].

The LWF beams exhibit better performance in achieving the improvements on pre-cracking stiffness, load carrying capacity, energy absorption capacity, ductility index and a higher ultimate flexural load-to-weight ratio compared with RC beams [15]. Post fire flexural strength and toughness of ferrocement jacket is good in comparison with plain mortar. An increase in wire mesh content significantly improved the mechanical properties of ferrocement under normal conditions; however after fire exposure the amount of wire mesh was no longer significant, regardless of heating duration[16]. The ferrocement was invented by Joseph Louis Lambot in 1848, but it was used for construction elements in the beginning of the 19th century by Pier Luigi Nervi , a famous Italian designer who wanted to have a homogeneous and efficient material for his complex architectural shapes. The disadvantage of ferro concrete construction is the labor intensive nature of it, which makes it expensive for industrial application[17]. The shear strength of the ferrocement plate depends upon the volume fraction of wire mesh. Hexagonal mesh improves the shear capacity over than that of diamond and square meshes because of it having a higher straight length [18].

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