Flexural Behaviour of Ferro cement Slab with Partial Replacement of Granite Dust & Various Layer of Chicken Mesh under Monotonic Loading

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Abstract—Fluxural tests was conducted on ferrocement slab containing chicken mesh and granite dust. Granite fines are the by product of granite industries while cutting huge granite rates to the derived shapes. The granite powder from factory is carried by the water and stored tank. Then it is transported and disposed on the land. The major problem of disposing the fines in land to various environmental hazards site pollution in air and lend ferrocement is one of the structural material widely used dur to its advantage from its particular behaviour such as flexural strength.

The fundamental goal of the examination was to investigate the effects of partial substitution of fine aggregate in granite dust in cement mortor combining chicken mesh of different volume was investigated. Chicken mesh 3 layers ie 1 layer , 2 layer , 3 layer and level of granite powder substitation from 0%.5%, 10%, 15%,20% by weight fine aggregates by these percentage of replacement finding out the optimum value. Results show that that ferrocement slab with chicken mesh of 10% substitution of fine aggregate with granite dust display better performance in terms if load deflection behaviour and ultimate laod when related with other specimens.

***Index Terms*—Ferrocement, cement, Granite dust, flexural strength, Chicken Mesh, Rebars**

I. INTRODUCTION

Ferrocement has a high tensile strength and high modulus of rupture. Its tensile strength can be of the same order as its compressive strength. It has a high specific surface of reinforcement which is the same as or twice that of reinforced concrete. The greater surface area to volume ratio of reinforcement results in higher cracking strength for ferrocement. Ductility, which is an important characteristic of a structure to withstand an earthquake, increases with an increase in the volume fraction and specific surface of reinforcement, unlike reinforced cement concrete where lower ductility is observed with an increase in reinforcement ratio.

Ferrocement is widely used in marine, terrestrial and housing applications. Owing to its water tightness, thin walls, light weight and impact resistance it is used in the construction of boats, floatation buoys, docks and barges. It is also used in the construction of water tanks, sedimentation tanks, bus shelters, grain storage bins, silos, biogas digesters, etc. The housing applications of ferrocement include construction of water tanks, precast wall panels, roof panels, sandwich panels, hollow core slabs, sunscreens, repair and rehabilitation of existing housing elements.

II. REVIEW OF THE LITERATURE

2.1 MODULUS OF ELASTICITY OF FERRO CEMENT SLABS WITH VARYING LAYERS OF MESH SUBJECTED TO FLEXURE

SunilKumar M.V, N.Jayaramappa

Ferrocement is a wire mesh reinforcement embedded with mortar. This is durable and efficient material. Concrete is characterized by brittle failure, the nearly complete loss of loading capacity, once failure is initiated. This characteristic, which limits the application of the material, can be overcome by the inclusion of layers of steel meshes. Flexure test is performed using a manually operated hydraulic jack for the application of load, dial gauges are placed at the bottom of slab to record deflections and strain gauges are placed in the sides of the slabs to record strains. Using the experimental data, load – deflection curves and poisson's ratio of slabs are evaluated.

Two point loading flexure test is conducted to know the behaviour of slabs, to obtain load deflection variation and longitudinal & lateral strains. In comparing the variation of layers of mesh of the slabs,

the slab with 4 layers of mesh is having more deflection with higher load carrying capacity compared to the other two slabs. The deflection of slab with 4 layers of mesh is increased by 11.5% when compared with the slab of 2 layers of mesh.

2.2"AN EXPERIMENTAL STUDY ON USAGE OF QUARRY DUST AS PARTIAL REPLACEMENT FOR SAND IN CONCRETE AND MORTAR"

K.Subramanian et.al(2013):

"An Experimental Study on Usage of Quarry Dust As Partial Replacement For Sand In Concrete And Mortar" in their work the feasibility of the usage of different quarry dusts by studying the physical and chemical properties, workability of the quarrydust concrete, with different ratios of 100:0, 80:20.70:30,60:40&0:100 (quarry dust: sand) for M20 grade of concrete behaviour of quarry dust mortar and reinforced cement concrete beams, Sieve analysis was conducted for quarry dust and sand. Mix design has been developed using IS Mix Design for various proportion of four different quarry dust with river sand. Tests were conducted on cubes and cylinders to study the compressive and tensile strengths of concrete made of various proportion of quarry dust with river sand, optimum strength test values of various proportion of different quarry dust with river sand and the results were compared with natural sand.

% of Granite Waste	Weight of Cement (kg)	Weight of Fine aggregate (kg)	Weight of Granite Waste (kg)
0%	2.6	5.2	0
5%	2.6	4.94	0.26
10%	2.6	4.68	0.52
15%	2.6	4.42	0.78
20%	2.6	4.16	1.04

2.3 FLEXURAL BEHAVIOUR OF FERROCEMENT COMPOSITE SLAB

S.Dharanidharan

This Paper deals with an investigational program to understood the flexural behavior of a Ferro cement composite slabs under mid third loading. this study is an attempt to exploit the concept of steel – concrete composite to a comparable system in which steel sheeting is replaced by Ferro cement elements. These elements will act as permanent form work and also participating in the structural performance of the slab. The combination of Ferro cement slab with concrete slab when the two are so connected that they act as a single unit in resisting flexure is called as composite slab.

Increasing the number of steel mesh layers from 1 to 3 caused a substantial increase in flexural strength and energy absorption to failure. The preliminary investigation reported in this study indicates that Ferro cement cover can be successfully used for reinforced concrete slabs. Crack width of the tested reinforced concrete slabs was considerably narrowed by the use of Ferrocement. Specimens with Ferro cement cover showed higher stiffness and higher cracking moment than those with normal concrete cover. Deflection near service load was significantly reduced in the specimens with Ferro cement cover. A slight improvement in the bending capacity of the specimens with Ferro cement cover was observed. Full composite action can be achieved by shear connecter used to inter connect between the shear loading panel of Ferro cement slab, then it increases the shear behaviour.

III.EXPERIEMENTAL WORK AND INVESTIGATION

5.1 EXPERIMENTAL WORK

5.1.1 MIXDESIGN

Mix Design can be defined as the process of selecting ingredients of concrete and determine their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible. The object of any mixproportion method is to determine an economical combination of concrete constituents that can be used for a first trail batch to produce a concrete that is close to that which can achieve a good balance between the various desired properties of concrete at the lowest possible cost.

InthisstudymixdesignwasdoneasperIndianStandardguidelinesinIS:10262-2009.

Mix ratio= 1:2, Water/Cement Ratio=0.45 can be adopted.

QUANTITY OF MATERIALS AS PER MIX DESIGN

5.1.2 PREPARATION OF MOULD AND CASTING OF SPECIMEN

The Steel Cement cube mould was oiled before casting and mortar was prepared by exact amount of cement and sand by weighing. While casting a specimen a size of 70.6 x 70.6 x 70.6mm are used. The various percentage of marble waste such as

% Of Granit Dust	7days (N/mm^2)	14days (N/mm^2)	28days (N/mm^2)
0%	1.6	2.1	4.4
5%	1.8	2.2	4.9
10%	2	2.4	5.4
15%	1.4	1.6	3.6
20%	1.2	2	2.6

0%,5%,10%,15%,20% are partial replaced by fine aggregate used in ferrocement concrete.

At first cement, m-sand, granite waste mixed dry. After dry mixing add water and admixture in dry mix. Ferrocement mortar are placed in mould with proper manner. Specimens were demoulded after 24 hours and allow in curing tank for 28 days.

Fig. 1 Preparation of Mould and Casting of Specimen

COMPRESSIVE STRENGTH OF FERROCEMENT CUBE MOULD:

5.3.2 QUANTITY OF MATERIALS AS PER MIX DESIGN

The optimum of 10% granite waste used as partially replacement of fine aggregate in ferrocement concrete. So we calculate the quantity of material for casting of one slab using 10% of granite dust used

%Of Granite Dust used	Weight Of Cement (kg)	Weight Of Fine Aggregate (kg)	Weight Of Granite Dust (kg)
10%	11.5	23	2.3

PREPARATION OF MOULD AND CASTING OF SLAB

- While casting a slab has a dimension of 1000x400x40mm
- The optimization of 10% percentage granite dust partially replaced by fine aggregate used in ferrocement concrete.
- Cement mortar are placed in the ferrocement slabmould. Specimens were demoulded after 24 hours and allow in curing tank for 28 day.

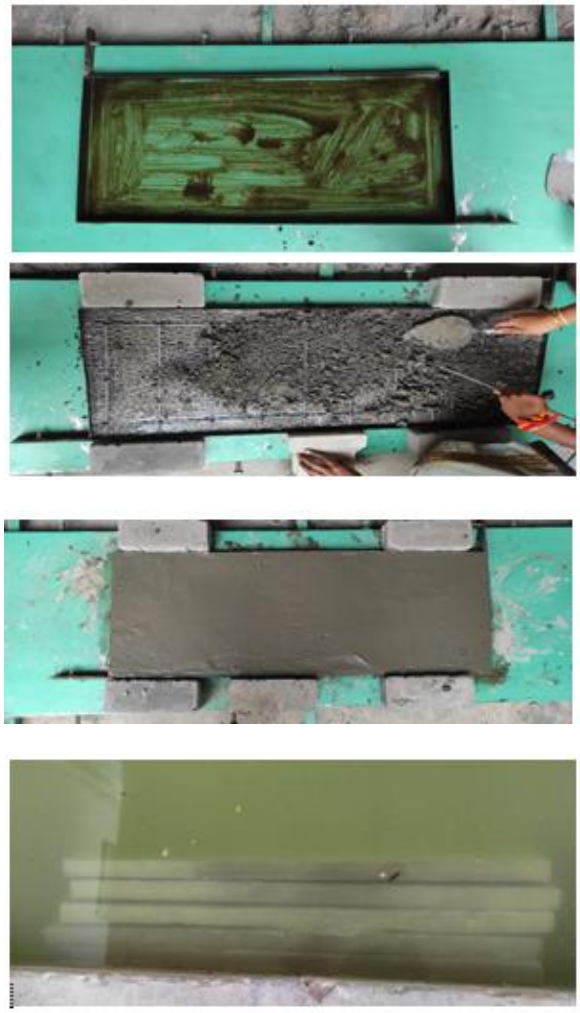


Fig. 2 Prepartion Of Mould Casting & Curing Of Slab

6.3 PROCEDURE FOR FLEXURAL TEST ON FERROCEMENT SLAB**:**

- Prepare the test specimen by filling the concrete into the mould in 3 layers of approximately equal thickness. Tamp each layer using the tamping bar as specified above. Tamping should be distributed uniformly over the entire crossection of the slab mould and throughout the depth of

each layer.

- Clean the bearing surfaces of the supporting and loading rollers , and remove any loose sand or other material from the surfaces of the specimen where they are to make contact with the rollers.
- Circular rollers manufactured out of steel having cross section with diameter 38 mm will be used for providing support and loading points to the specimens.
- The length of the rollers shall be at least 10 mm more than the width of the test specimen. A total of four rollers shall be used, three out of which shall be capable of rotating along their own axes.
- The distance between the outer rollers (i.e. span) shall be 3d and the distance between the inner rollers shall be d. The inner rollers shall be equally spaced between the outer rollers, such that the entire system is systematic.
- The specimen stored in water shall be tested immediately on removal from water; whilst they are still wet. The test specimen shall be placed in the machine correctly centered with the longitudinal axis of the specimen at right angles to the rollers. For moulded specimens, the mould filling direction shall be normal to the direction of loading.
- The load will applied on the slab, note down the displacement reading corresponding to the load. The same test procedure followed by the one, two, & three layer of mesh slab.
- Comparing the result and well known the fexural behavior of ferrocement slab under monotonic loading.

SLAB WITH SINGLE LAYER OF MESH

In this experimental setup the slab placed on the support. one end of the support is hinged and other end is roller support. The LVDT apparatus fixed at the centre of the slab and L/3 (L=Effective length of the slab) distance at both on two sides. The load will be applied at the center of the spread beam by use of 100 tones capacity of the actuator testing meachine. The rate of the loading fixed at 1KN/s. The slab will be fully observed and the first crack will be findout at the load of 6.3KN at midspan of the slab at the same time right side to near the loading point. The maximum load will be taken that 13.8KN at one layer of Chicken mesh slab.

Fig. 3 Experimental Setup For Flexural Test On Ferrocement Slab

Fig. 4 Flexural behaviour of Ferrocement Slab

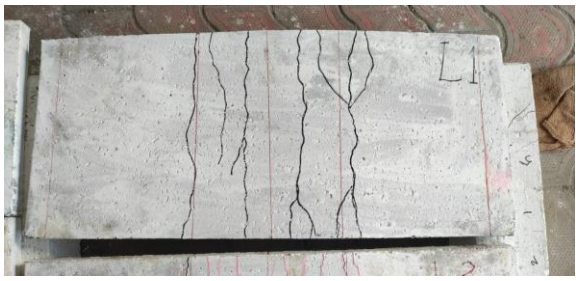


Fig .5 Crack pattern for Ferrocement slab with single layer of mesh

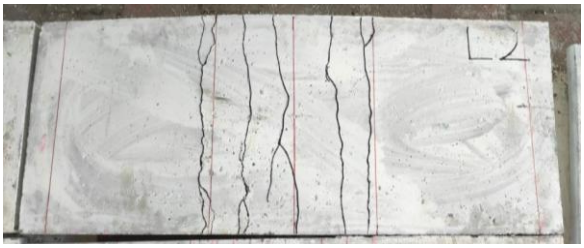
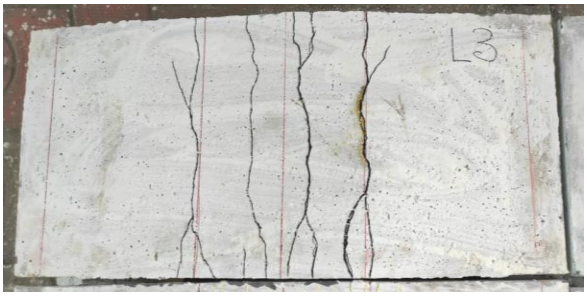
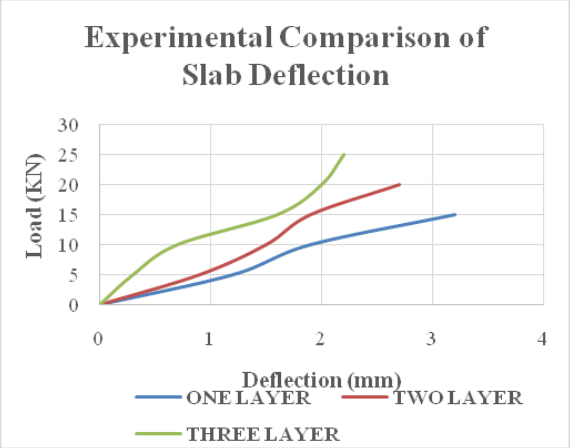


Fig. 6 Crack pattern for Ferrocement slab with two layer of mesh



One Layer Of FC Slab		Two Layer Of FC Slab		Three Layer Of FC Slab	
Load (KN)	Deflection (mm)	Load (KN)	Deflection (mm)	Load (KN)	Deflection (mm)
0	0	0	0	0	0
5	1.2	5	0.9	5	0.3
10	1.9	10	1.5	10	0.7
15	3.2	15	1.9	15	1.6
		20	2.7	20	2.0
				25	2.2

Fig. 7 Crack pattern for Ferrocement slab with three layer of mesh



CONCLUSION

This study usefull for the use of ferrocement slab with various layer of chicken mesh, steel bars, and optimization percentage of granite dust used. Flexural behavior of ferrocement slab test result concluded that,

1)In comparing the variation of layers of mesh of the slabs, the slab with 3 layers of mesh is having more deflection with higher load carrying capacity compared to the other two slabs .

2)The deflection of slab with 3 layers of mesh is increased by 24% ,15% respectively when compared with the slab of one layer and two layer of mesh.

3) In comparing the variation of layers of mesh of the slabs, load carrying capacity of slabs is increasing with increase in the number of layers of mesh.

4)The slab with 3 layers of mesh is having higher load carrying capacity when compared to the other two slabs.

5)The load carrying capacity of slab with 3 layers of mesh is increased by 11% ,7.5% when compared with the slab of one layer and two layers f 10% granite dust used in ferrocement slab is more efficiency compare than other percentage of granite dust used of mesh

6)The optimization of 10% marble waste used in ferrocement slab is more efficiency compare than other percentage of granite waste used.

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