Flexural Behaviour of Ferrocement Slab With Partial Replacement of Marble Waste & Various Layer of Welded Square Mesh Under Monotonic Loading

Augustin[1], Asst.Prof.M.Raffik Bash[2]
[1]PG Student, Government college of engineering,Tamil Nadu, India
[2]Assistant Profosser, Department of Civil Engineering, Government college of engineering,Tamil Nadu, India

Abstract- *Ferrocement Technology has been established as environmentally friendly low cost technology. Ferrocement is a type of thin wall reinforced concrete construction where hydraulic cement is reinforced with layer of continuous and relatively small diameter mesh. In this phase, to study the usage of marble waste and findout the optimum percentage of marble dust used in the ferrocement concrete slab were carried out. This study analysis the behaviour of ferrocement concrete slab reinforced with various layer of welded Square mesh and Steel bars with optimum percentage of marble dust used. The flexural test were conducted in laboratory. It can be used to analysed the various layer welded square meshes of slab for under Monotonic loading. This test result will be used to investigate the flexural behavior of ferrocement slab.*

Keywords- Ferrocement Slab, Welded Square meshes, Monotonic load, Marble Dust, Flexural behaviour

I. INTRODUCTION

In the past few decades, various new construction materials and techniques have evolved in the construction industry. In this context, it becomes necessary to throw light upon ferrocement which is almost as old as reinforced concrete, an effective and durable construction material. Though the concept of ferrocement is not new, its real development and utilization has been significant only in recent years. It is increasingly being put to numerous applications including construction of new structures and rehabilitation of existing structure. 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.

PROPERTIES OF MARBLE DUST:

In India, about 6 million tons of wastes from marble industries are being released from marble cutting, polishing, processing and grinding. In Tamil Nadu state, Salem is an area that concentrates a large quantity of marble process industries, which are responsible by the disposing of hundreds of tons of wastes in the environment per year. This scene is even more aggravated by the increasing production in the last decade, getting attention from all society with the destination of disposal wastes. Marble dust comes from crushed marble, which is formed by the crystallization of limestone or dolostone. The crystals appear as a calcite material through different atmospheric and temperature changes. The pressure present in the formation of marble destroys any other objects in the rock creating a dense, smooth rock.

FERROCEMENT:

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" .The mesh may be made of metallic and suitable materials. In the words of Nervi who first used the term ferrocement its notable characteristics is "Greater elasticity and resistance to cracking given to the cement mortar by the extreme subdivision and distribution of the reinforcement"

II. METHODOLOGY

MIX DESIGN

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 mix proportion 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.

In this study mix design was done as per Indian Standard guidelines in IS:10262-2009.
Mix ratio= 1:2 , Water/Cement Ratio=0.45 can be adopted.

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

At first cement, sand, marble 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.

III. EXPERIMENTAL INVESTIGATION

In order to know the mechanical behaviour of ferrocement concrete specimens were casted and tested. The 7 days & 28 days water cured ferrocement mortor cube specimens were tested for mechanical properties such as compressive strength.Mechanical behaviour of ferrocement specimens were studied with the help of conducting compression test.

TEST ON FERROCEMENT CUBE MOULD

The test is carried out for the Ferrocement cube mould to check whether the optimization of marble waste was used in ferrocement concrete. The trial mix for Ferrocement cube mould with the dimension of 70.6x70.6x70.6mm is casted and allow for curing. The test is carried out for 7 ,14 and 28 days of casting.

Test Setup For Specimen as shown in Fig

COMPRESSIVE STRENGTH OF FERROCEMENT CUBE MOULD:

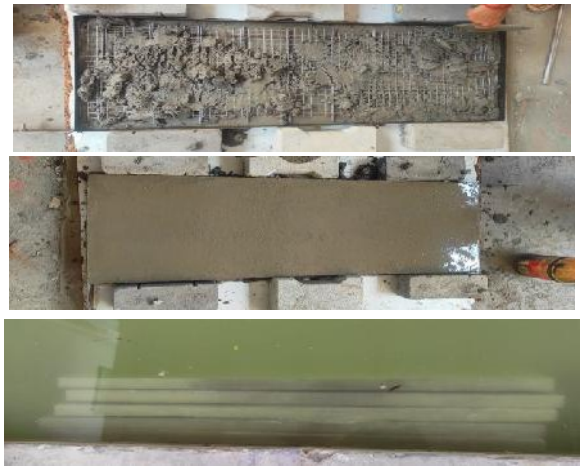
% of Marble waste	7 days (N/)	14 days (N/)	28 days (N/)
0%	2	2.4	5.4
5%	1.4	1.6	5.2
10%	2.2	2.6	5.6
15%	1.8	2.2	4.6
20%	1.6	2	2.6

PREPARATION OF MOULD AND CASTING OF SLAB

The optimum of 10% marble 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 marble waste used.

PREPARATION OF MOULD AND CASTING OF SLAB

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



Preparation of Mould and Casting of Slab as Shown in fig

FLEXURAL BEHAVIOUR OF FERROCEMENT SLAB

Test procedure

- 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 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.

Comparison of Load Vs Deflection curve With Various Layer Welded Square Mesh as shown in Fig

COMPARISON OF FERROCEMENT SLAB DEFLECTION WITH VARIOUS LAYER OF WELDED SQUARE MESH

One Layer Of FC Slab		Two Layer Of FC Slab		Three Layer Of FC Slab	
Load	Deflection	Load	Deflection	Load	Deflection
0	0	0	0	0	0
5	0.9	5	0.8	5	0.2
10	1.5	10	1.2	10	0.8
15	2.8	15	2.4	15	1.5
20	3.7	20	3.3	20	2
25	4.5	25	4	25	2.6
		30	4.7	30	3.5
				35	4.2
				40	5.5

IV. CONCLUSION

This study usefull for the use of ferrocememnt slab with various layer of welded square mesh, steel bars, and optimization percentage of marble waste used. Flexural behavior of ferrocememnt 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 11.5% ,9.8% 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.

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