AN EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF FINE AGGREGATE BY CRUMB RUBBER IN FERROCEMENT

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ABSTRACT:*India may be a vast country the economic prosperity of the country depends upon its products and economic transportation to the floating boats. this sort of boats is additionally play on important role within the defense of our country, India is that the second fast growing industry within the world. By using this waste tires as a crumb rubber in ferro cement by partial replacement of fine aggregate. The floating boats are required time consuming reason therefore we've to introduce our research which include that the thickness of the floating boat are reduce of with also cost of your time has less reduce. consistent with above information we've construct the some specimen (1:3) proportion in three different sizes and conduct compression and flexural test thereon specimen .The size of specimen are given 900×250×100mm,900×250××125mm, for flexural test and 150×150×150mmcube for compression test and also conduct various test son specimen like permeability, weight test. Finally the ferro-cement boats is 14meters long which is 300%cheaper than the ferroconcrete boats. This technology also can be easily exported to friendly foreign navies giving them the power to develop our country.*
KEYWORDS:1.ferro-cement, 2.crumbrubber,3.reinforcedsteelmesh.

1. INRODUCTION:

Reinforced concrete is that the most generally used construction material in present age. Ferro-cement are often considered because the origin and therefore the first application of ferro-concrete. Ferro-cement also called as Ferro-cement was invented by a Frenchman, Joseph Louis in 1848. Basically at that point Joseph wanted to make urns, cisterns and planters without the expense of kiln firing. Ferro-cement relates to sort of thin ferroconcrete consisting of huge amount of small diameter wire meshes distributed uniformly throughout the cross section and cement mortar. Ferro-cement may be a highly versatile sort of ferroconcrete possessing unique qualities of serviceability and strength which can't be matched with the other thin construction material. Though being the oldest and first of its kind use of Ferro-cement was limited and not widely accepted. one among the explanations it had been not adopted widely was that the assembly technology which was available at that point (19th century) wasn't efficient to supply small diameter wires and meshes. Their production was costlier as compared to large diameter iron rods and thus a setback was created. During war ferroconcrete was wont to manufacture boats thanks to shortage of materials, particularly steel. because the amount (volume) of steel required in Ferro-cement is more as compared to ferroconcrete and as a result its use was completely forgotten. During 1940's a known Italian architect Luigi Nervi revived the first concept of Ferrocement, he acknowledged components of Ferro-cement produced material which have approximately homogeneous mechanical properties and high resistance to impact. And with time the sturdiness and serviceability of Ferro-cement ascertained and eventually started achieving acceptance.

2. LITERATURE REVIEW:

2.1 Kumar A.(2005)," Ferro-cement box section-viable option for floor and roof of multi-storey building". A 5m x 9msize interior panel of a framed structure has been designed as panel-slab construction, flat Slab construction and using Ferro-cement box sections for 5kN/m2 superload . The self-weight, floor/ roof height and price of those options are compared. it's found that the flat slab option is comparable in weight to the panel slab option, about 58.2%less in floor heigh tand 17.7% costlier than the traditional panel and slab construction.

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2.2 Kohler, E.et.al(2007), "Precast Mortar Pavement sand Results of Accelerated Traffic Load Test" This paper summarizes experiences round the world with the utilization of precast slabs for pavement rehabilitation. The lifetime of this technique of precast slabs, when used as detailed for this test, is estimated to be between 142 and 242 million ESALs .These numbers result from estimated traffic applied.

2.3 Mahmood,M.et.al(2008),"Flexural Behavior of Flat and Folded Ferro-cement Panels".Thepaperdescribestheresultsoftestingfoldedandflat Ferro-cementpanelsreinforcedwithdifferentnumberofwiremeshlayers.Themainobjectiveoftheseexperimental testsistostudytheeffectofusingdifferentnumbersofwiremeshlayersontheflexuralstrengthoffoldedandflat Ferro-cementpanelsandtocompare the effect of varying the amount of wire mesh layers on the ductility and therefore the ultimate strength these sorts of Ferro-cement structure. Seven Ferro-cement elements were constructed and tested each having (600x380mm) horizontal projection and 20mm thick, consisting of 4 flat panels and three folded panels. The used number of wire mesh layers is one, two and three layers The experimental results show that flexural strength of the folded panels increased by 37% and 90% for panelshaving2and3wiremeshlayersrespectively,comparedwiththat having single layer, while for flat panel the rise in flexural strength compared is 4.5%, 65% and 68% for panel shaving 1,2 and3wire mesh layers respectively. The strength capacity of the folded panels, having the actual geometry utilized in this study, is within the order of three .5to5 times that of the corresponding flat panels having an equivalent number of wire mesh layers.

2.4 Anisha G Krishnan1, Allzi Abraham, (September 2016), The experimental study comprised of testing of three control beam specimens of dimension (200 X 300 x 1000) mm and three beam specimens with 25 mm thick ferro-cement formwork. The control beams were reinforced with two numbers of 10 mm diameter bars and two numbers of 6 mm diameter bars on top and bottom with 6 mm diameter two legged stirrups at 200 mm c/c. The formwork consisted of a skeletal reinforcement of 6 mm diameter bar which give shape and support for the mesh and one layer of chicken mesh having 0.88 mm diameter.

2.5 Dr. P. Srichandana and Kamanuru Naga Deepika, (July 2015)2 this investigation aims the study on behaviour of Ferro cement slab panels using self-compacting mortar (SCM) with varied W/C ratio, ash replacement and incorporating polypropylene fibers. Use of SCM rather than cement mortar in ferro-cement slabs plays an important role so as to eliminate the external vibration and to beat the difficulties and problems within the construction process.

2.6 K. Sasiekalaa and R. Malathy (November 2012)3 This paper focuses on materials, advantages, mechanical properties, practical design parameters, recommendation, research and development in ferro-cement

2.7 M. Amala, Dr. M. Neelamegam, (February 2012)5 The flexural properties of those Ferro-cement slabs are evaluated and compared under four point static loading system using specific test setups and comparative study of the test results confirm that Ferro-cement slabs made from copper slag are simpler in flexural strength and other mechanical properties. Impact strength of slab is tested and it's found that because the copper slag content is increased the K.E. is increased.

3 MATERIALS USED:

3.1 FERRO-CEMENT:

ferro-cement techniques through of recent origin are extensively utilized in many countries. Notablyin U.K, New Zealand and china, there's a growing awareness of the benefits of this system of construction everywhere the planet . it's documented that conventional ferroconcrete members are too heavy, brittle, can't be satisfactory repaired if damaged, develop cracks make it inefficient surely sorts of work. Ferro cement may be a relatively new material consisting of wire meshes and cement mortar. This material was developed by P.L Nervi, an Italian architect and engineer, in 1940. It contains closely spaced wire meshes which are impregnated with rich cement mortar mix. The wire mesh is typically of 0.5 to 1.0mm dia wire at 5mm to 10mm spacing and cement mortar is of cement sand ratio of 1:2 or 1:3 with water/cement ratio of 0.4 to 0.5.

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3.2 CEMENT: We used ordinary hydraulic cement of 53grades as per IS 1489:1991standards. Cement may be a key to infrastructure industry and is employed for various purposes and also made in much composition for a good sort of uses. Cement maybe named after the principal constituents, after the intended purpose, after the thing to which they're applied or after characteristic property. Ordinary hydraulic cement is suitable for general concrete construction when there's no. exposure to sulphates within the soil the quality required that it's made up of 95 to one hundred pc of hydraulic cement clinker and 0 to 5percentofminor additional constituents

3.3 FINE AGGREGATES: According to IS: 650-1991, the quality sand shall be obtained from pennar river, Nellore. the quality sand shall be of quartz, light grey or whitish variety and shall be free from silt. The sand grains shall be angular, the form of the grains approximating to the spherical form elongated and flattened grains being present only in very small or negligible quantities. the quality sand shall (100 percent) undergo 2-mm IS sieve and shall be (100 percent) retained on 90-micron IS Sieve with the subsequent particle size distribution. and therefore the sieves shall conform to IS 460 (Part: 1): 1985

Particle Size	**Grade**	**Percent**
Smaller than 2 mm and greater than 1 mm	I	33.33
Smaller than 1 mm and greater than 500 microns	II	33.33
Below 500 microns but greater than 90 microns	III	33.33

Table3.1 The physical properties of sand is given by

Colour	Grayish White
Specific gravity	2.60
Absorption in24 hours	0.80%
Shape of grains	Sub angular

Table 3.2.Properties of Fine aggregate

3.4 WASTE TYRE RUBBER:

Tire could also be divided in to 2 types- car and truck tires. Car tires are different from truck tires with reference to constituent materials. Usually three main categories of discarded tire rubber are considered like

- Chipped rubber
- Crumb rubber
- Ground rubber

Type of rubber	Crumb type
Size	4.75-0.425mm
Colour	black
Specific gravity	1.15

Chipped rubber is employed to exchange of gravel (coarse aggregate)..This rubber is obtained by cutting 300-430m long and 100-230mm width rubber sheets within the first stage and afterward second stage further cutting the sheets to vary its dimensions to 20-10mm size. Crumb rubber is employed to exchange of sand (fine aggregate).This rubber is obtained by separate mills where big size rubbers are converted into smaller sizes of size about 4.75-0.425mm. Ground rubber is employed to exchange the cement. during this type rubber particles of size about 0.075-0.475mm in dimension are used. These also are obtained by grinding in separate mills. it's a granular texture and ranges in size from very fine powder to sand-sized particles. it's made up of used tires, by crushing and grinding under normal temperature. it's widely used on road, tire making and rubber products. Rubber powder has higher purity and performance.Within the present study crumb rubber of size 4.75-0.425mm are used for the partial replacement of coarse aggregate. The pieces of tire rubber was allowed to undergo IS sieves. The particles which skilled 20mm sieve and retained on 10mm sieve are taken.

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Fig. 3.1 CrumbRubber

3.5 WATER:

Portable water was utilized within the experimental work for both preparing and curing. The pH value of water taken isn't but 6.

3.6 REINFORCED WIRE MESH :

Fine wire mesh reinforcement is that the essential element of ferro-cement, it controls the precise surface, which may be a crucial believe design. the quantity of layers of meshes, decide the thickness of the composite. Four basic kinds of meshes are in use.

a. Weld mesh
b. Fine wire mesh (woven square mesh/interlocked hexagonal wire mesh/Chicken wire mesh)
c. Expanded metal.
d. Crimped wire mesh

Here during this project we are using weld mesh of size 1mm dia with 10mm spacing. Welded wire mesh of rectangular pattern as shown in fig. 3.1 is formed by aligning wires perpendicularly and welding them at their intersections. Weld mesh is tied on skeletal steel framework and it provides a base for tying fine wire meshes there on. available in widths of 900, 1200 and 1500 mm and in lengths of 15 m or 30 m. lengths of 15 m or 30 m.

Fig. 3.2 Welded mesh

3.7 COUPLING AGENT OR BONDING AGENT:

Generally, coupling agents comprise bonding agents and surfactants (surface active agents), including compatibilizers and dispersing agents. Bonding agents act as bridges that link two different materials. Compatibilizers are used to provide compatibility between immiscible polymers through reduction of the interfacialtension. Coupling agents are classified into organic, inorganic and organic- inorganic groups. Organic agents include isocyanates, anhydrides, amides, imides, acrylates, chlorotriazines, epoxides, organic acids, monomers, polymers and copolymers. Only a few inorganic coupling agentssuchas silicates are used. Organic- inorganic agents include SILANES and TITANATES.

In this present study, SILANE coupling agent named as “3-Mercaptopropyldimethoxysilane” was used for the bond developing between rubber and concrete.

The surface treatment for rubber particles using silane involves

- Making an Ethyl alcohol aqueous solution at a selected concentration.
- Adding SILANE to the solution and stirring for 10min.
- Adding rubber particles to the solution made and stirring for 20min.
- Heating to 80^{o}c and refluxing for 30min while stirring then cooling to room temperature.
- Rinsing with alcohol by filtration and drying at 110^{o}c for 12hrs.

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4 TESTS:

4.1 COMPRESSIVE STRENGTH OF CONCRETE [IS 516-1956]:-

For cube test two types of specimens either cubes of 15cm X 15cm X 15cm or 10cm X 10cm x 10cm depending upon the size of aggregate are used. For most of the works cubical molds of size 15cm x 15cm x 15cm are commonly used. This concrete is poured in the mold and appropriately tempered so as not to have any voids. After 24 hours, molds are removed, and test specimens are put in water for curing. The top surface of these specimens should be made even and smooth. This is done by placing cement paste and spreading smoothly on the whole area of the specimen. These specimens are tested by compression testing machine after seven days curing or 28 days curing. Load should be applied gradually at the rate of 140 kg/cm2 per minute till the Specimens fails. Load at the failure divided by area of specimen gives the compressive strength of concrete.

4.2 FLEXURAL STRENGTH [IS 516-1956]:-

The test should be conducted on the specimen immediately after taken out of the curing condition so on prevent surface drying which decline flexural strength.Place the specimen on the loading points. The hand finished surface of the specimen shouldn't be in touch with loading points. this may ensure a suitable contact between the specimen and loading points.Center the loading system in reference to the applied force.Bring the block applying force in touch with the specimen surface at the loading points.Applying loads between 2 to six percent of the computed ultimate load.Employing 0.10 mm and 0.38 mm leaf-type feeler gages, specify whether any space between the specimen and therefore the load-applying or support blocks is bigger or but each of the gages over a length of 25 mm or more.Eliminate any gap greater than 0.10mm using leather shims (6.4mm thick and 25 to 50mm long) and it should extend the complete width of the specimen.Capping or grinding should be considered to get rid of gaps in more than 0.38mm.Load the specimen continuously without shock till the purpose of failure at a continuing rate (Indian standard specified loading rate of 400 Kg/min for 150mm specimen and 180kg/min for 100mm specimen, stress increase rate 0.060.04N/mm2.s consistent with British standard).

CONCLUSION:

As a cloth of construction, ferro-cement may be a homogeneous and ductile material with enormous capacity of energy absorption. it's an artificially formed timber and is a perfect material for earthquake prone area.Method of constructing structures by using ferro-cement cavity walls and hollow floors within built framework is that the best system with stiffened shear walls and floors automatically formed in it. this technique are often utilized in sort of precast or cast-in-situ method of construction.For retrofitting structures damaged thanks to shock loading ferro-cement is that the only reliable alternative. Thus ferro-cement as a cloth and construction method are ideal for building structures in earthquake areas. here is the results of compressive test is crumb rubber increase while compressive strength of mortar decreases. Same as in flexural strength also. crumb rubber increases while flexural strength of mortar decreases.

REFFERENCES:

1. State Historical Commission. "S.S. Selma Ship Texas Historical Marker". "WWII Builders of Concrete Ships and Barges". Archived from the original on 2018-09-24. Retrieved 2019-07-08.
2. A Brief History of Concrete Ships Jump up to:[a b c d] Eberhardt, Robert. "Concrete Shipbuilding in San Diego, 1918–1920," Journal of San Diego History, 41:2, Spring 1995.[1]"Working Lives--Pat Durkin."
3. Jump up to:[a b] Svenska, På. "The History about the Ferro-Concrete Ships." Archived 2007-03-07 at the Wayback Machine
4. National Register of Historic Vessels, Name: Violette, Certificate Number 716."Archived copy". Archived from the original on 2008-04-20. Retrieved 2008-04-21.
5. Fougner, Nicolay Knudtzon. Seagoing and Other Concrete Ships. H. Frowde and Hodder & Stoughton, 1922..
6. "SHIPBUILDERS" - Various Issues 1919 and 1920. Lloyds Register 1916 onwards The Belgian Shiplover No. 74 Reports of the United States Shipping Board, 1919 – 1932.

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