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RESEARCH ARTICLE

EXPERIMENTAL INVESTIGATION OF FERROCEMENT PANEL UNDER FLEXURE BY PARTIAL REPLACEMENT OF COAL FLY ASH

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ABSTRACT

The aim of this paper is to study the flexural behaviour of Ferro-cement panels and the comparative study of panels via using welded square mesh and chicken (or) hexagonal wire mesh and also using partial replacement of coal fly ash addition of 5%, 10%&15%. The test results of single and double layer panels of 30 mm thickness. In this study, all the specimens were divided into four groups to investigate the strength and behavior of ferrocement flat panels subjected to two-point loading. Forty eight Ferro-cement panels with dimensions of 500mm x 150mm x 30mm were constructed and tested.

Key words: Ferro-Cement Panels, Welded Wire Mesh, Chicken (or) Hexagonal Wire Mesh, Coal Fly Ash And Ultimate Flexural Strength.

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INTRODUCTION

A working definition of Ferro-cement is ''a thin shell of highly reinforced Portland cement mortar''. A large number of civil infrastructures around the world are in a state of serious deterioration today due to carbonation, chloride attack, etc. Moreover many civil structures are no longer considered safe due to increase load specifications in the design codes or due to overloading or due to under design of existing structures or due to lack of quality control. In order to maintain efficient serviceability, older structures must be repaired or strengthened so that they meet the same requirements demand of the structures built today and in future. Ferrocement over the years have gained respect in terms of its superior performance and versatility. Ferrocement is a form of reinforced concrete using closely spaced multiple layers of mesh and/or small diameter rods completely infiltrated with mortar. In 1940 Pier Luigi Nervy, used ferrocement first for the construction of aircraft hangars, boats and buildings and a variety of other structures. It is a very durable, cheap and versatile material.

EXPERIMENTAL INVESTIGATION

Materials

The cement used in the tests was fresh Ordinary Portland Cement (Grade 53) locally available.

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Locally available clean and good graded fine aggregate (River Sand) was used, after passing through I.S sieve 2.36 mm. Square welded wire meshes were used with 20 x 20 mm opening used in the specimens having diameter 1.0 mm. The chicken (or) hexagonal wire mesh was also used, it having wire diameter 0.5 mm. The opening of chicken (or) hexagonal wire mesh was 25 mm and diameter of mesh 0.5mm. Ordinary drinking water was used for mixing and curing of the water was clean and free from acids, alkalis and organic impurities. Fly ash is useful in many applications because it is a pozzolan, meaning it is a siliceous or alumino-siliceous material that, when in a finely divided form and in the presence of water, will combine with calcium hydroxide (from lime, Portland cement, or kiln dust) to form cementitious compounds.Moulds were made from wooden panel. The moulds were fabricated in college workshop. The size of moulds is 500X150X30 mm. The moulds were oiled before casting of panels.

Mixing proportions

The mix proportion was 1:2 (Cement: Sand) with water to cement ratio of 0.40. Nine cubes (70 mm x 70 mm x 70 mm) were tested for specimens to obtain the average compressive strength (fcu). The specimens were cured by immersing in water for about 28 days. The average compressive strength of tested cube was 40 Mpa.

Casting of Panels

Different panels of thickness 20mm having number of mesh 1 & 2 have been casted. For Square and expanded type mesh

total 24 panels have been casted. For every single thickness of panel there consist of 1 to 4 layers of mesh. For every mesh layer three specimens are casted. Moulds were made from plywood of 20mm thickness.

Fig. 1. Typical cross section of ferrocement structure

The moulds were fabricated in college workshop. The size of moulds is 500X150X30 mm inner dimensions. The moulds were oiled before casting of panels.

Instrumentation and set up

The specimens were white colour in order to observe the cracks easily and they were placed on a simply supported base and each support was 50 mm apart from the edge of the specimen. The load was distributed on a two line load at one-third of clear span of the specimen

Test Program

To study the strength and structural behaviour and ultimate strength of ferrocement slab panels, a number of experiments have been carried out. This includes the properties of the materials used, casting of ferro-cement slab panels, and preparation of samples, testing procedure, description of the testing instrument and the geometry of the specimens. The experimental program includes preparing and testing of ferrocement slab panels under two-point loading. The primary variables were the thickness of panels, number of layers of meshes and different type of meshes (Square Welded and hexagonal wire mesh). The specimens were white colour in order to observe the cracks easily and they were placed on a simply supported base and each support was 50 mm apart from the edge of the specimen. The load was distributed on a two line load at one-third of clear span of the specimen.

Fig. 2. Flexural test setup

TESTING RESULT

Coal fly ash added (%) Vs load & flexural strength: This topic covers the results of the various experimental studies. The results that are presented include coal fly ash percentages and the various testing results for the cement & coal fly ash combinations. The test results of the age of (28 days) from the day of casting. Panels were placed in sunlight for 4 hours for drying before testing. The graph shows the coal fly ash added (%) Vs load & flexural strength curve,

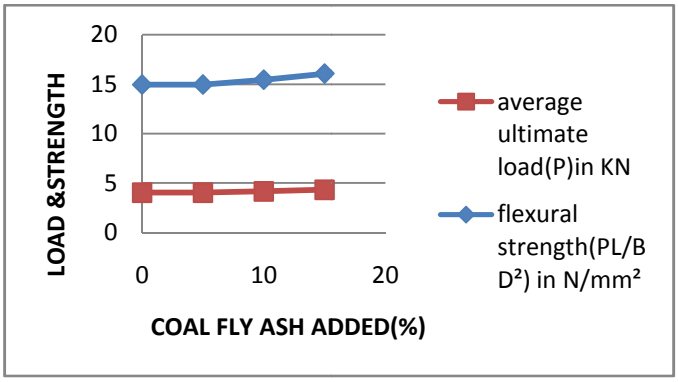

Fig. 3. coal fly ash added (%) V_s load & flexural strength 30 mm thick 1 layer welded wire mesh

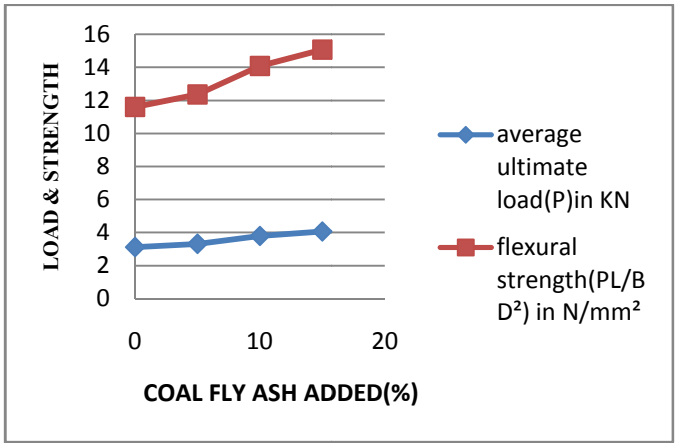

Fig. 4. coal fly ash added (%) V_s load & flexural strength 30 mm thick 1 layer hexagonal wire mesh

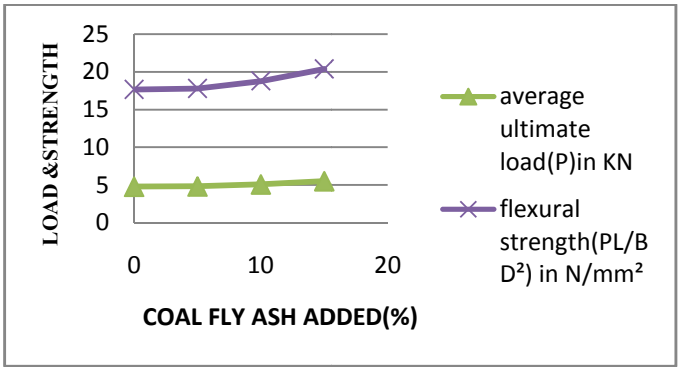

Fig. 5. coal fly ash added (%) V_s load & flexural strength 30 mm thick 2 layer welded wire mesh

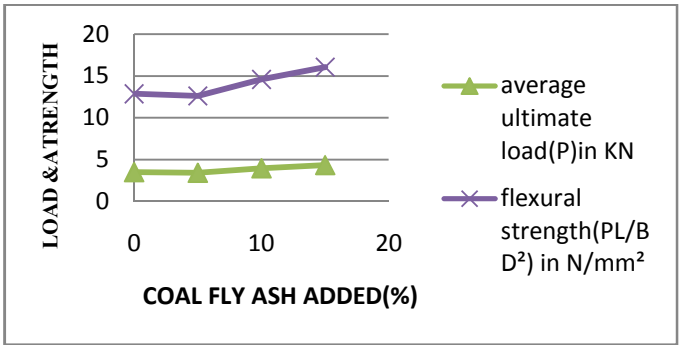

Fig. 6. coal fly ash added (%) V_s load & flexural strength 30 mm thick 2 layer hexagonal wire mesh

Fig .7. Flexure testing machine

Conclusion

The use of coal fly ash slightly improves the properties of ferrocement panels, coal fly ash can be used as replacement in ferrocement up to certain limits. It was observed that by the partial replacement of coal fly ash for ferrocement panels, the density has no significant changes, but the flexural strength values have been increased with the partial replacement of coal fly ash. Partial replacement of coal fly ash gave probable increase in strength values comparing to partial replacement of conventional ferrocement panels. The strength of these replacement which has increased the ferrocement panel strength parameter and resulted to the usage in the roof panels, boats, fishing vessels, water tanks, sedimentation tanks, swimming pool linings, septic tanks, grains storage bins, silos, canal linings ,pipes etc. Based on the summary of results discussed above, it was concluded that coal fly ash was an effective stabilizer than conventional ferrocement for improving the strength properties of ferrocement panels. By using the coal fly ash, the construction methodology will be simple and can be maintained for longer time. It has the main advantage such as it will be economical for any type of construction and it mainly provides an eco-friendly environment by avoiding different type of pollution effects and from harmful hazards.

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