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A Study on Flexural Behaviour of Steel Fiber Reinforced Concrete with Addition of Mineral Admixture

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ABSTRACT
Fibre Reinforced Concrete (FRC) is very useful in extreme climate where shrinkage of concrete causes cracks. The Fibre Reinforced Fly ash concrete (FRFAC) has been successfully used to minimize cavitations / damages in hydraulics structures. This experimental investigation is to study the effects of replacement of cement (by weight) with three percentage of fly ash and the effects of addition of steel fiber composite. A control mixture of proportions was designed. Cement was replaced with three percentages (10%, 20% & 30%) of Class C fly ash. Three percentages of steel fibers (0.30%, 0.45% & 0.60%) having 20 mm length were used.
This study reports the feasibility of use of steel fibres and their effect due to variation in fibre length, fibre content on structural properties such as cube compressive strength, cylinder compressive strength, split tensile strength, modulus of rupture and modulus of elasticity of this composite. Tests will be conduct on beams with optimum fibre parameters, and the results compared with those of identical Reinforced Concrete beam.

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I. INTRODUCTION

1.1 GENERAL

- Fibre Reinforced Concrete (FRC) is very useful in extreme climate where shrinkage of concrete causes cracks
- The Fibre Reinforced Fly ash concrete (FRFAC) has been successfully used to minimize cavitations / damages in hydraulics structures

1.2 INTRODUCTION

Concrete is very strong in compression but weak in tension. As a Concrete is a relatively brittle material, when subjected to normal stresses and impact loads. The tensile strength of concrete is less due to widening of micro-cracks existing in concrete subjected to tensile stress. Due to presence of fiber, the micro-cracks are arrested. The introduction of fibers is generally taken as a solution to develop concrete in view of enhancing its flexural and tensile strength.

Fly ash is the fine powder major waste material produced from many thermal power plants. The disposal of fly ash is the one of the major issue for environmentalists as dumping of fly ash as a waste material may cause severe environmental problem. Therefore, the utilization of fly ash as an low cost mineral admixture in concrete instead of dumping it as a waste material can have great beneficial effects. It can be used particularly in mass concrete applications where main emphasis is to control the thermal expansion due to heat of hydration of cement paste and it also helps in reducing thermal and shrinkage cracking of concrete at early ages. The replacement of cement with fly ash in concrete also helps to conserve energy. The introduction of the paper should explain the nature of the problem, previous work, purpose, and 2 the contribution of the paper. The contents of each section may be provided to understand easily about the paper. The extensive investigation has been carried out on mixing of different types of fibers to the conventional concrete. The addition of steel fibers of suitable size, shape and aspect ratio to a properly designed concrete mix improves its resistance to tensile stress and modifies the brittle behaviour considerably and reduces shrinkage and temperature cracks. Fiber Reinforced Concrete (FRC) is very useful in extreme climates where shrinkage of concrete causes cracks. It is increasingly being used for precast elements, airport runways and tunnel lining. While addition of fly ash in FRC improves its compressive strength and reduces permeability at same workability.

The fibers and fly ash are added for improving its performance against creep, wear, fracture and decrease in the permeability. The Fiber Reinforced Fly Ash Concrete (FRFAC) has been successfully used to minimize cavitation / erosion damages in hydraulic structures such as sluiceways; navigation docks and bridge piers where high velocity flows are encountered. It is also rapidly gaining acceptance as suitable material for repairing, rehabilitation and renovation of concrete structures. Topçu and Canbaz [1], demonstrated through

experiments that the addition of fibers provide better performance for concrete, while fly ash in the mixture may adjust the workability and strength losses caused by fibers, and improve strength gain. The results are based on experimental investigations in which concrete was produced with three different replacement ratios of fly ash and three different types of steel and polypropylene fibers.

II. LITERATURE REVIEW

2.1 REVIEW OF LITERATURE

An Investigation of Steel Fiber Reinforced Concrete with Fly Ash
Khadake S.N. 1, Konapure C.G.2 (2012)

This paper deals with Investigation for M-25 grade of concrete having mix proportion 1:1.50:3.17 with water cement ratio 0.465 to study the compressive strength, and Flexural strength of steel fiber reinforced concrete (SFRC) containing fibers of an interval of 0.5% from 0.0% to 1.5% volume fraction of hook end Steel fibers of 71 aspect ratio were used. The percentage of Fly Ash by weight is to be increased by 10% from 00% to 30%.

After curing these specimen were tested as per relevant codes of practice Bureau of Indian Standard. A result data obtained has been analyzed and compared with a control specimen. A relationship between Compressive strength vs. days, and flexural strength vs. days represented graphically. Result data clearly shows percentage increase in7, 28 & 45 days Compressive strength for M-25 Grade of Concrete.

Effect of Fly Ash and Steel Fibre on Portland Pozzolana Cement Concrete
Muntadher Ali Challoob1,2, Vikas Srivastava3 (2013)

This paper presents the result of an experimental investigation carried out to evaluate the mechanical properties of concrete with steel fibre and steel fibre fly ash in which portland pozzolana cement was partially replaced with fly ash by weight. The experimental investigation carried out on steel fibres concrete up to a total fibre volume fraction of 0.5%, 1% and 1.5% and fly ash in which portland pozzolana cement (PPC) was partially replaced with 30% fly ash. The mechanical properties, compressive strength and splitting tensile strength were studied for concrete prepared. Compressive strength and splitting tensile strength were determined at 7, 28 and, 56 days. The laboratory results showed that addition of steel fibres reinforced fly ash into PPC concrete decreases the strength properties. While the results showed that steel fibres addition into PPC concrete improve the strength properties

Strength study of high volume fly ash concrete with fibres
JO JACOB RAJU and JINO JOHN (2016)

High Volume Fly Ash concrete system addresses all the major sustainability issues. It is recommended over the ordinary concrete as it considerably saves cement and also prevents environmental pollution. The use of fibres improves specific material properties of the concrete, impact resistance, flexural strength, toughness, fatigue resistance, and ductility. In this paper an attempt is made to study the mechanical properties of High Volume Fly-Ash Concrete with addition of fibres at 0.1, 0.2, and 0.3% of cement and with 60% fly ash replacement with cement. It is found that fibre additions have increased its strength characteristics considerably over the ordinary cement concrete. A mathematical model was developed using SPSS 20 for the strength parameters of HVFAC with fibres. The major parameter that affected strength was total binders and water-binder ratio.

III. METHODOLOGY

A systematic line-up of the contents makes it possible to compare the different methods step by step. It should be kept in mind, though, that not all of the investigated documents are first-hand material. Comparisons are made between the assumptions made for each method in total as well as between the different design situations each method considers. With crack-width reduction being one of the main benefits from fibre reinforcement, and since the size of those benefits (that can be utilized in design) is governed by the assumptions on which the stress-strain diagram is based, these are especially examined and compared with the ones for the stress-crack-width based method. Furthermore, since the final fibre capacities are determined by the characteristic values of the residual strengths, also the procedures of how to determine these values are given extra attention.

The following tasks are to be carried out in order to achieve the research objectives:

1. Collecting the required information and documents related to the fly ash and steel fibre.
2. Undertaking a comprehensive Documented Case Study on relevant subjects focused on the usage of fly ash and steel fibre in construction field.
3. Developing an adequate experimental program to study the use of steel fibre in concrete mixtures.
4. Analyzing the experimental output test results to draw conclusions.

5. In this experimentation, an attempt would be made to find out the properties of concrete produced by replacing the cement with fly ash in 10%, 20% & 30%, percentages of steel fibers (0.30%, 0.45% & 0.60%).
6. The experimental investigation would include casting and testing of cubes specimens to study the compressive and flexure strength of concrete cubes and beams. The Grade of concrete will be M 20

IV. CONCLUSION

4.1 CONCLUSION

The fly ash can serve as a good substitute for cement in reasonable proportions by volume and whatever deficiencies that may result can be easily overcome by use of steel fibres. Properties of the resulting composites show better performance than plain concrete both in terms of mechanical and structural strengths.

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