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Review on Mechanical and Durability Properties of Hybrid Fibre Reinforced Concrete

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Abstract: *This study presents the experimental study on effect of glass fibers, steel fibers and hybrid fibers (combination of steel and glass) in the durability and mechanical properties of concrete in comparison with the conventional concrete. The steel fibers, glass fibers and their combination are added to the normal conventional concrete to impart good strength properties such as compressive strength, flexural strength and split tensile strength to the concrete. It also enhances the chemical resistance, permeability, impact strength and other properties of concrete. The aim of the work is to study the properties of steel fibers, glass fibres and hybrid fibre for the durability properties of concrete for different proportions.*

Keywords: Durability Properties, Chemical Resistance, Impact Strength

I. INTRODUCTION

Concrete is a composite material composed of fine and coarse aggregate bounded together with the cement paste (water and cement) that hardens over time. It has high compressive strength, stiffness and durability under normal conditions, but it is weak in tension and it is a brittle material. To overcome this demerits it is reinforced with different materials like steel, wire, cable, fiber etc. So to overcome the demerit and enhance the properties of the normal concrete fiber reinforced concrete is used. Here in general fiber acts as the load carrying member that transfer load between the fibers and protecting it from external damaging and by using the fibres the concrete can be cast in thinner sections. The fibers can be divided into two groups:

- Fibers that have a moduli value lesser than the cement matrix. Examples are: Nylon, cellulose and polypropylene.
- Fibers that have a greater moduli value than cement. Examples are the glass, steel, asbestos fibers etc.

1.1 Glass Fibers

A fiber glass is a form of fiber-reinforced plastic where glass fiber is the reinforced plastic. This is the reason perhaps why fiber glass is also known as glass reinforced plastic or glass fibre reinforced plastic.
The glass fiber is usually flattened into a sheet, randomly arranged or woven into a fabric. According to the use of the fiberglass, the glass fibers can be made of different types of glass. Fiberglass is lightweight, strong and less brittle. The best part of fiberglass is its ability to get moulded into various complex shapes. This pretty much explains why fiberglass is widely used in bathtubs, boats, aircraft, roofing, and other applications

1.2 Steel Fibers

The fibers are made from hard-drawn low carbon high tensile steel wire and are continuously deformed conforming to the provisions of ASTM 820. Fiber concrete works because unlike mesh reinforcing, the steel fibers reinforce in three dimensions throughout the entire concrete matrix.

II. LITERATURE REVIEW

S. Threndral and Hemapriya, 2018

They have done an investigation on "The rapid chloride penetration test on hybrid fibre reinforced concrete in comparison to normal concrete" and concluded that the steel fibre and hybrid fibre reinforced concrete shows good resistance to

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permeability compared to conventional concrete and less cracks are formed in the specimen which indicates improved ductility with the addition of fibres.

M.P Singh et al., 2014

They have done an experimental study on strength properties and water permeability of hybrid steel fibre reinforced concrete and have concluded that the steel fibre reinforced concrete shows decrease in permeability and that there is a maximum decrease in water permeability with 12.5mm long steel fibres at a volume faction of 1.0% and the strength properties are also increased with addition of steel fibres.

Dhirendra Singhal et al., 2011

They studied the Permeability of steel fibre reinforced concrete with the influence of fibre parameters and explained that the permeability of concrete decreases significantly with the inclusion of steel fibres in concrete, and that there is also decrease in the permeability in further addition of steel fibres by weight factions.

E. Arunakanthi, et al., 2016

They have experimentally studied the properties of fiber reinforced concrete and said that in compressive strength, flexural strength and split tensile strength, the addition of Steel fiber the strength is increasing linearly, but in glass fiber up to 1% it is increasing and from 2% it is decreasing.

Vamsi Krishna and Srinivasarao, 2016

Studied on durability of steel fiber reinforced concrete. The grade of concrete adopted is M30. Fiber dosage of 0.5%, 1% and 1.5% by volume of concrete were used for their study. Hooked steel fibers were randomly dispersed in concrete. The cube specimens were immersed in 3% Sulfuric acid for a curing period of 28 days and 56days. Steel fibers were found to be effective to acid resistance. Percentage loss of weight was increased with increasing in fiber dosage subjected to acid curing. Compressive strength decreased with increase in fiber dosage respectively subjected to acid curing compare to normal concrete. Fiber dosage of 0.5% shows better results.

Nithin Dsouza et al., 2018

They investigated on strength and durability aspects of steel fiber reinforced concrete. For their study M25 grade concrete with hookend type steel fibers dosages of 0.5%, 1% and 1.5% by weight of concrete having an aspect ratio of 60 were used. The specimens are tested for 7 and 28 days age. It is observed that, when compared to conventional concrete the steel fiber reinforced concrete was more resistant to acid attack and sulphate attack, leading to less loss of weight and compressive strength for concrete with addition of steel fibers. Among the different percentage of steel fiber reinforced concrete, the 1.5% steel fiber reinforced by weight of its concrete is more resistant to the acid attack and sulphate attack.

Chandra Khoe, et al., 2011

"Oxygen permeability of fiber-reinforced polymers", the use of fiber reinforcement in concrete reduces the corrosion rate in concrete. Since oxygen molecules are smaller than water and chloride molecule they diffuse faster. So here the oxygen permeability test is done as a comparison with normal fiber reinforced concrete and epoxy coated fiber reinforced concrete and the results shoes that the oxygen permeability of normal fiber reinforced concrete is poorer than epoxy coated fiber reinforced concrete.

P. Saravana, et al., 2010

"Study on strength and chloride ion penetration resistance of fiber reinforced concrete", the experiment is conducted as comparison of strength and permeability of steel and polypropylene fiber reinforced concrete. The results shows that mechanical properties increase with percentage of increase in Steel fibres compared to Polypropylene fibre whereas the the passage of chloride ion is reduced in Polypropylene fiber compared to Steel fibers.

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Chandramouli.k, et al., 2010

"Chloride ion penetration resistance studies on concrete modified with alkali resistance glass fibers", here the influence of fiber content on the durability performance of glass fiber reinforced concrete specimen having different percentage of glass fiber with varying grades of concrete are investigated. The durability properties of modified concrete and normal concrete specimen are compared. The results shows that the addition of glass fibers improves the durability property of the concrete appreciably.

Kesava Raju Vegesana, et al., 2020

They Researched Compressive behavior of Steel Fiber Reinforced concrete exposed to Chemical attack and found that the steel fiber reinforced concrete is subjected to chemical attack with both chloride and sulphate. After that process the compressive strength of the specimen is tested and compared with normal concrete. The results reveals that the steel fiber reinforced performs better than conventional concrete for all the attacks.

Suseendran et al., 2018

They have studied strength and chloride ion penetration resistance of fibre reinforced concrete and said that the mechanical properties increase with percentage of increase in Steel fibres compared to Polypropylene fibre and the passage of chloride ion is reduced in Polypropylene fibre compared to Steel fibres

V.Marcos-Meson, et al., 2019

They studied Durability of steel fiber reinforced concrete exposed to acid attack and said that the steel fiber reinforced concrete is subjected to chemical attack and the durability of the concrete is tested. The result shows that the steel fiber reinforced concrete acts same as normal concrete upon acid attack when the concrete is not cracked but whereas when it is cracked it leads to larger deterioration of its mechanical properties.

III. CONCLUSION

- There is a significance increase in the mechanical properties such as the compressive, flexural, split tensile strength of the concrete with the addition of fibres to the concrete.
- With the inclusion of fibre to the concrete have good durability properties when compared to the conventional concrete
- The steel fibre concrete shows good strength properties compared to other types of fibres that are added to the concrete, whereas the glass fibre and other fibre has good chemical resistance and sulphate attack than steel fibre concrete, so combination of both the fibre as hybrid fibre produce the good results.

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