Experimental Study on Strength Properties of Steel fibre Reinforced Concrete

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Abstract— The Infrastructure needs of our country is increasing day by day and concrete is a main constituent of construction material in a significant portion of this infrastructural system. It is necessary to enhance its characteristics by means of strength and durability. It is also responsible to compensate concrete in the form of using waste material and saves in cost by the use of admixtures such as fly ash, silica fume etc, as a partial replacement of cement. One of the many ways this could be achieved by developing new concrete composites with the fibres which are locally available that makes even non engineered construction can work well under severe loads like earthquake or sudden vibrations and natural disasters or attacks. Use of fibre to concrete has long been experienced since 1990. In the early 1900’s asbestos fibre were used in concrete and in 1950’s concept of composite materials came into being & fibre reinforced concrete was one of the focus of interest. To bring into focus the use of steel fibre in concrete an experimental programme was planned to study the material characteristics. In this paper M 35 grade of concrete mix design is carried out using fly ash. This present paper deals with the experimental study of steel fibre reinforced concrete. Steel fibre is added in 0.5, 1%, 1.5% dosages and followed by increments of flyash 10%, 20%. M 35 (1:1.44:2.69) grade of concrete is designed with water-cement ratio of 0.45. Physical properties of cement, fine aggregate, coarse aggregate, steel fibre is carried out. This study reports the feasibility of use of steel fibres and their effect due to variation in fibre content on structural properties such as cube compressive strength, split tensile strength. The workability tests on fresh concrete and strength tests on hardened concrete are also carried out. Compressive strength v/s mix designation, split tensile strength v/s mix designation are plotted graphically. The optimum dosage and mix designation for higher strength is found.

Key words: Wetland, Pollution, Biodiversity and Management

I. INTRODUCTION
Concrete is a versatile and composite construction material. Composed of cement (commonly ordinary Portland cement) and cementitious material such as fly ash, silica fume and slag cement, aggregate (generally coarse aggregate of gravels or crushed rocks such as limestone or granite plus a fine aggregate such as sand), water and chemical admixtures.

Concrete is an artificial building material whose production differs from application to application. Amongst general properties of concrete, we must understand that concrete should posses certain physical and chemical properties, tensile strength, low level of permeability to avoid moisture and retain chemical and volume stability.

Concrete has relatively high compressive strength, but significantly lower tensile strength and as such is usually reinforced with materials that are strong in tension (often steel). The elasticity of concrete is relatively constant at low stress levels but starts decreasing at higher stress levels as matrix cracking develops, concrete has a very low coefficient of thermal expansion and as unit matures concrete shrinks. All concrete structures cracks to some extent, due to shrinkage and tension. Concrete that is subjected to long duration forces is prone to creep.

II. FIBRE REINFORCED CONCRETE
Plain concrete posses a very low tensile strength, limited ductility and little resistance to cracking. Internal micro cracks are inherently present in concrete and its poor tensile strength is due to the propagation of such micro cracks, eventually leading to brittle fracture of concrete. It has been recognized that the addition of small closely spaced and uniformly dispersed fibres to the concrete would act as a crack arrester and would substantially improve its compressive and flexural strength properties. This type of concrete is known as fibre reinforced concrete. The waste produced from welding rods of same length is used as steel fibres. The welding rods which are thrown after welding is used as steel fibres in this project. They are not used further for welding and are not recycled, so we had chosen as fibre in present project work. The sizes Average (Aspect ratio) of steel fibres are of 93.75, 88.23, 103.44, 107.14 and 100.

III. OBJECTIVES OF PRESENT STUDY
1) To Study the compressive strength of cubes and split tensile strength of cylinders of steel fibre reinforced concrete for various proportions (M 0, M 1, M 2, M 3, M 4, M 5, M 6) with same water-cement ratio.
2) To Study the compressive strength of SFRC & comparing with normal conventional concrete (Designated as M 0).
3) To Study the tensile strength of SFRC.
4) To Study the optimum dosage of fibre used in SFRC.
5) To Study the workability requirement of SFRC.

IV. METHODOLOGY
Based on above objectives of present study, following methodology has been set for present project work
1) Mix design as per IS 10262:2009
2) IS 456:2000 Plain and Reinforced concrete code of practice.

<table>
<thead>
<tr>
<th>Mix type</th>
<th>Cubes</th>
<th>Cylinders</th>
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Table 1: Designation of mix type and total number of cubes and cylinders

Steel fibre is added in 0.5%, 1%, 1.5%, dosages with Fly ash increments of 10%, 20%.

VI. STEEL FIBRE REINFORCED CONCRETE

Fibre reinforced concrete (FRC) may be defined as a composite materials made with Portland cement, aggregate, and incorporating discrete discontinuous fibres. Now, why would we wish to add such fibres to concrete plain, unreinforced concrete is a brittle material, with a low tensile strength and a low strain capacity. The role of randomly distributes discontinuous fibres is to bridge across the cracks that develop provides some post-cracking “ductility”. If the fibres are sufficiently strong, sufficiently bonded to material, and permit the FRC to carry significant stresses over a relatively large strain capacity in the post cracking stage. The fibre reinforcement may be used in the form of three – dimensionally randomly distributed fibres throughout the structural member when the added advantages of the fibre to shear resistance and crack control can be further utilized. On the other hand, the fibre concrete may also be used as a tensile skin to cover the steel reinforcement when a more efficient two – dimensional orientation of the fibres could be obtained.

Graph 1: Graphical Representation of Compressive strength v/s Mix designation for 7 days of curing.
Graph 2: Graphical Representation of Compressive strength v/s Mix designation for 28 days of curing.

Graph 3: Graphical Representation of split tensile strength v/s Mix designation for 7 days of curing.

Graph 4: Graphical Representation of split tensile strength v/s Mix designation for 28 days of curing.

Graph 5: Graphical Representation of compressive strength v/s Mix designation for 7, 28 days of curing.

Graph 6: Graphical Representation of Split Tensile Strength v/s Mix designation 7, 28 days of curing.

Graph 7: Graphical Representation of Compressive Strength v/s Mix designation for 28 days of curing (Optimum dosage graph).

VIII. SUMMARY & CONCLUSIONS

The study on the effect of steel fibre with fly ash content can still be a promising works with replacement material which make concrete most economical. Always there is a need to overcome the problem of brittleness of concrete. Detailed Experimental study is been carried out on strength properties of steel fibre reinforced concrete, following conclusions could be drawn from present project work.

1) The Compressive strength of SFRC with various mix designation found comparatively higher as compared to normal conventional concrete. (Refer graph no 5).

2) The Split tensile strength of SFRC with various mix designation showed higher strength as compared to normal conventional concrete. (Refer graph no 6).

3) The Compressive strength of SFRC for mix designation M 5 (1.5% & 10%) showed higher strength compared to other mix designations & conventional concrete.

4) The optimum dose of 1.5% fibre & 10% fly ash showed better strength results compared to other dosages of fibre & fly ash (Refer Graph no 7).

5) Slump will lose as percentage of steel fibre is gradually increased & at lesser fly ash content.

6) Density of concrete increases as percentage of steel fibre increases.

7) Workability of concrete improves when mineral admixtures such as fly ash is added incrementally.

8) The Chemical admixture such as super plasticizer is necessary for higher grade to get required & workable mix.
REFERENCES


IX. PHOTO GALLERY

Fig. 2: Cutting of Welding Rods of 30mm Length

Fig. 3: Casted Cubes and Cylinders

Fig. 4: Performing Compression Test on Cubes

Fig. 5: Steel fibers after Compression Test

Fig. 6: Steel fibers penetrating out after Compression Test

Fig. 7: Steel fibers after Compression Test