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Study on Strength Characteristics of Steel Fiber and Fly Ash based SCC

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ABSTRACT— *Self-compacting concrete which has excellent deformability in the fresh state and high resistance to segregation it can flow under its own weight and does not need any vibration. In recent years, Self-Compacting Concrete (SCC) has gained a vital use for placement in congested reinforced concrete structures with difficult casting condition. For such application, the fresh concrete must possess more fluidity and high cohesiveness. The uses of fine materials in self-compacting concrete are needed such as fly ash can ensure the required concrete properties. It had an excellent strength property not only that, it reduces the requirements of cement. And addition of fiber to self-compacting concrete (SCC) especially steel fibre improves its structural properties. Current study has been made on fly ash, with various percentage of mixes were prepared with fly ash ranging from 5% to 15% and steel fibre added for each percentage of fly ash as 1%, 1.5% and 2% in self-compacting concrete to improve the strength properties for M60 grade of concrete.*

Keywords— Self Compacting Concrete, Steel Fiber, Fly Ash, Strength

1, INTRODUCTION

The main aim of environmental protection agencies and the government is to seek ways to reduce the problems of health hazards posed by industrial by products and way of disposal. Every year huge quantities of industrial by-products are being produced by various industries. Some industrial by products like fly-ash, ground granulated blast furnace slag, copper slag and silica fume have been successfully used in the construction industry for the production of high strength value added concrete. Even though the construction industry is already facing a scarcity of source materials such as cement are highly energy intensive, the utilization of industrial wastes will go a long way in promoting sustainable development of construction industry. In recent years, self-compacting concrete (SCC) is an innovative concrete has gain a huge use for placement in congested reinforced concrete structures with difficult casting condition. It fills it's from works own, does not need any vibration. For such application, the fresh concrete must possess more fluidity and high cohesiveness. The use of fine materials such as fly ash is needed for SCC and also it reduces the usage of cement particles. Fly ash had an excellent strength property and also reduces the requirements of cement. And addition of steel fibre improves the mechanical properties of self-compacting concrete can ensure the required concrete properties. The

addition of fiber especially steel fiber in SCC improve its structural properties, especially the flexural and tensile strength makes advantages of its high performance in fresh state. The main focus of this investigation is to find out the strength properties of self-compacting concrete using steel fiber and fly ash. Here we partially replaced fly ash of cement as 5%, 10%, and 15%. And for the each percentage of fly ash, steel fiber had been added for 1%, 1.5% and 2%.

2, EXPERIMENTAL WORK

2.1 Ordinary Portland cement (OPC)

Most of the investigation on SCC is being made using ordinary Portland cement. Though all cement conforming to various IS codes are suitable, selection of cement should be based on their compressive strength, fineness and compatibility with other ingredient. Here OPC 43 grade is used.

2.2 Aggregates

The aggregates are normally divided into two categories, namely fine and coarse. Fine aggregate normally consists of natural, crushed, or manufactured sand. Coarse aggregates can be made of natural gravel or crushed stone. In the present study the sand confirm to zone II as per Indian standards. The crushed aggregate used were 12.5mm.A maximum size of 10mm to 14 mm is usually selected as coarse aggregates up to 20 mm may be used in SCC.

2.3 Fly ash

Fly ash a by-product of the combustion of pulverizes coal in thermal power plants. Fly ash is used in developing SCC to make up the demand for higher powder content. Fly ash is ranging in diameter from less than1µm up to 150µm. they are use full in enhancing the deformability and stability of the fresh SCC. Class F- normally produced from bituminous coal has been used.

2.4 Steel fiber

The inclusion of fibre especially steel fibers in SCC significantly enhances the flexural strength, ductility and toughness. Because of its non-flexibility it gives more strength. The most important thing describing a fiber is its aspect ratio. Aspect ratio is the length of fibre divided by an equivalent diameter of fibre, where equivalent is the diameter of the circle with an area equal to the cross sectional area of fibre. Steel fiber having aspect ratio 50 with geometry of cylindrical hooked ends used.

2.5 Viscosity modifying agent

Viscosity modifying agent is mostly used in the he self-compacting concrete; it was used for the workability and stability of the concrete. The viscosity modifying agent mostly was in liquid from, powder type or combination of two.

2.6 Super plasticiser

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Super plasticizers, also known as high range water reducers, are chemicals used as admixtures in SCC. It used to improve the workability of concrete. It may be in liquid or powder from.

3, TESTING DETAILS

3.1 Fresh test

In the present study, the slump flow, V-funnel, L-box, and U-box tests are used for evaluating the workability, flow ability and passing ability of the concrete.

3.2. Compressive strength studies

The compressive loading tests on concretes were carried out on a compression testing machine of capacity 2000 kN. For the compressive strength test, a loading rate of 2.5 kN/s was applied. The specimen used was 100 mm cube. The test was performed at 7, 14 and 28 days. The specimens were tested after taking the cubes from curing tank in dry condition.

3.3 Split tensile strength studies

The tensile loading tests on concrete were carried out on compression testing machine of capacity 2000 KN to find the tensile strength of the concrete. The specimen used was 100mm x200mm cylinder. The test was performed at 7, 14 and 28 days. Three specimens were casted for each percentage and found the average. The specimens were tested after taking the cylinder from curing tank in dry condition.

3.4 flexural strength studies

The flexural loading test on concrete was carried out on beam testing machine to find out the flexural strength. The specimen was casted 100mm x 100mm x 300mm prism. The test was performed at 7, 14 and 28 days. Three specimens were casted for each percentage and found the average. The specimens were tested after taking the prism from curing tank in dry condition.

4, MIX PROPORTION

This section explains the process and experimental works carried out to achieve aim of the study. The observation in this investigation will be concentrated on determining the optimum percentage addition of class-f fly ash and fibre in the concrete. The mix was prepared for three percentage of variation. For 5% of fly ash 0%, 1%, 1.5% and 2% of steel fibre had been added. As same as for 10% and 15% of fly ash same proportion of steel fibre added for each percentage. Casted specimens de moulded and kept for curing 7, 21 and 28 days. After curing, the compressive strength, split tensile strength, and flexural strength of the concrete specimens was tested at the age of 7, 21 and 28 days.

5, RESULTS AND DISCUSSION

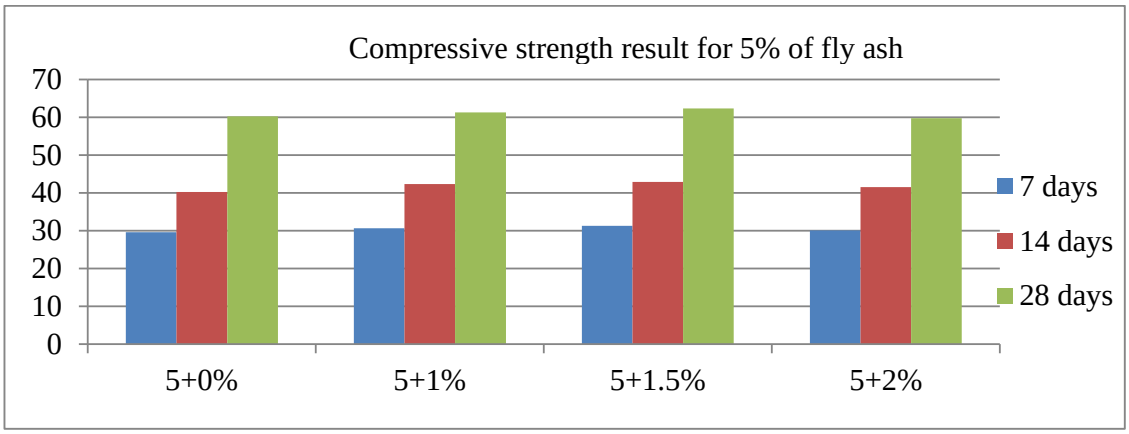

Figure 1 5% of Fly ash with 0, 1, 1.5 and 2% of steel fibre

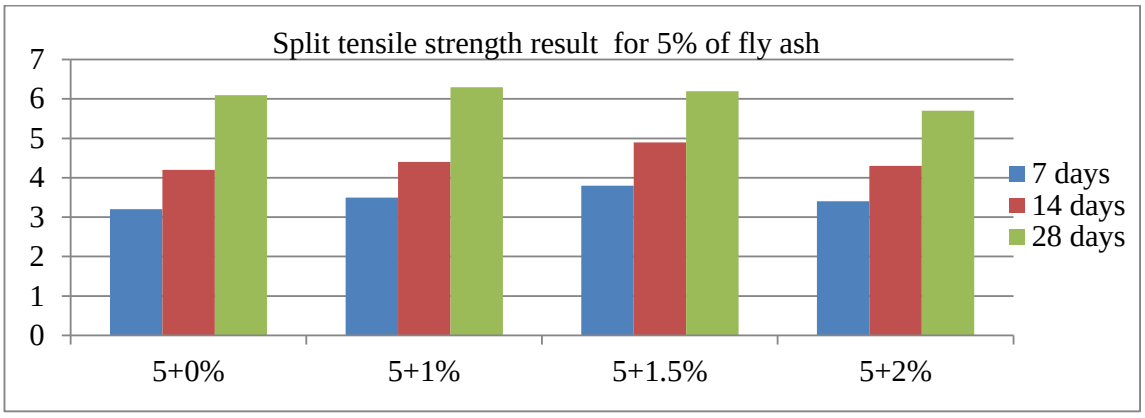

Figure 2 5% of Fly ash with 0, 1, 1.5 and 2 % Steel Fiber

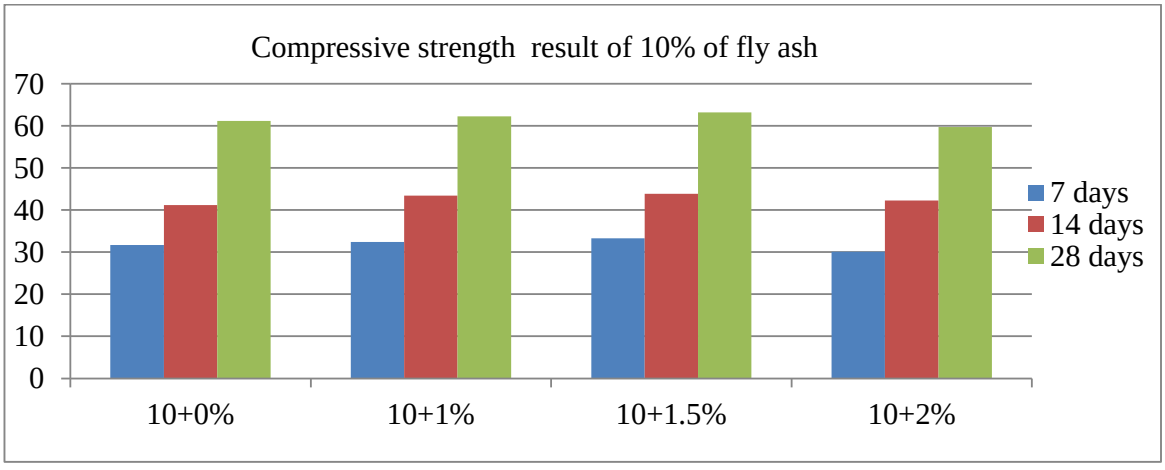

Figure 3 10% of Fly Ash with 0, 1, 1.5 and 2 % Steel Fiber

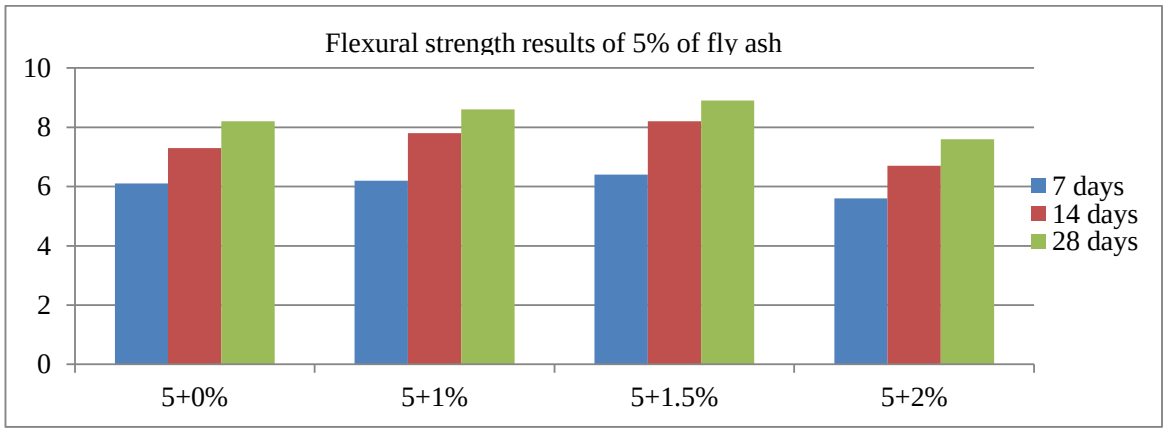

Figure 4 5% of Fly Ash with 0, 1, 1.5 and 2% of Steel Fiber

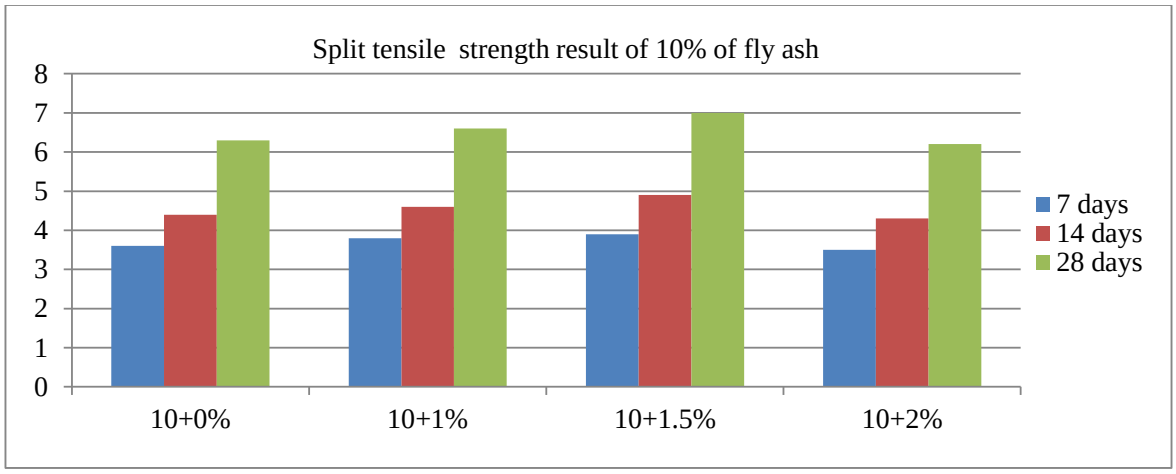

Figure 5 10% of Fly Ash with 0, 1, 1.5 and 2% of Steel Fiber

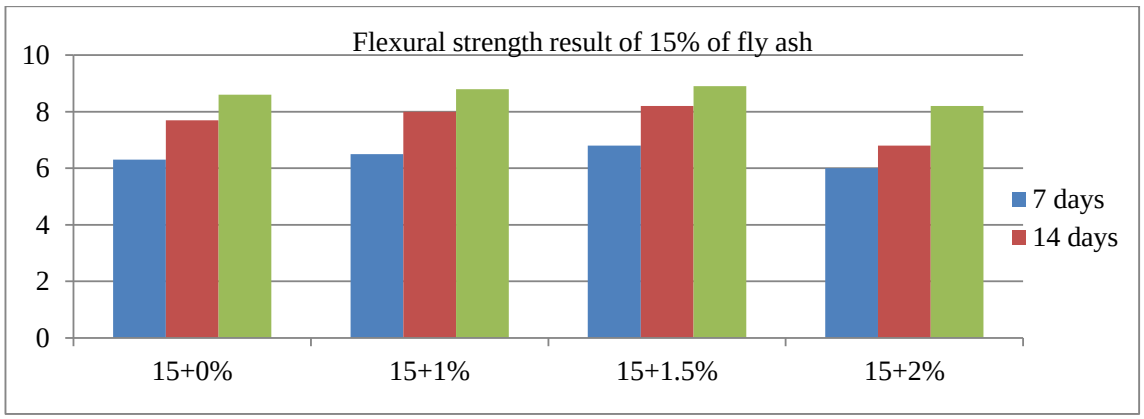

Figure 6 10% of Fly ash with 0, 1, 1.5 and 2% of Steel Fiber

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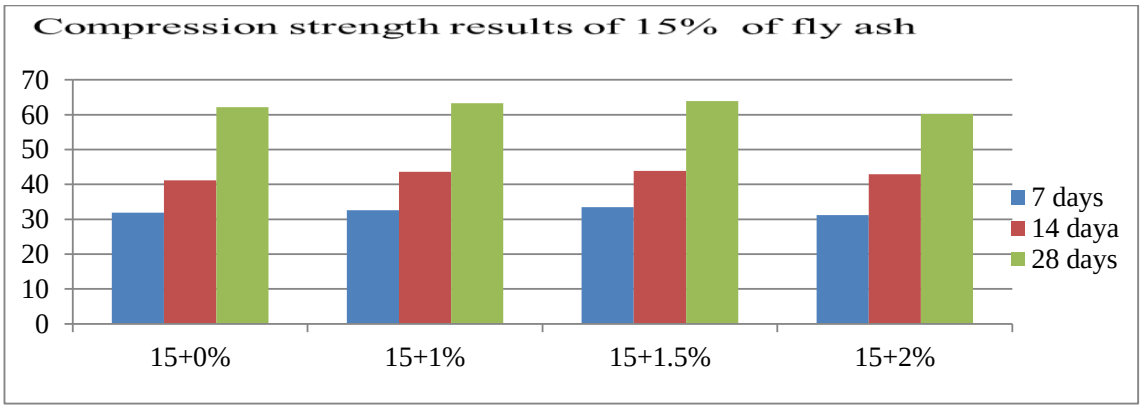

Figure 7 15 % of Fly Ash with 0, 1, 1.5 and 2% of Steel Fiber

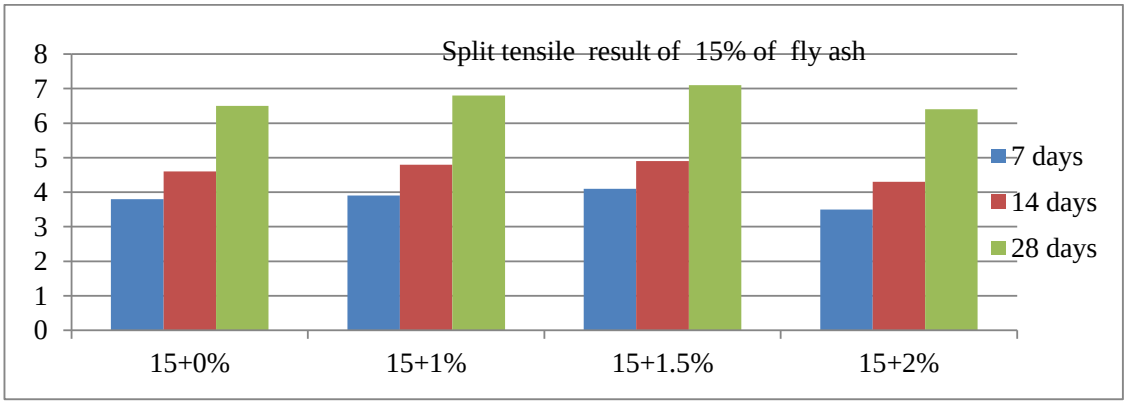

Figure 8 15% of Fly Ash with 0, 1, 1.5 and 2% of Steel Fiber

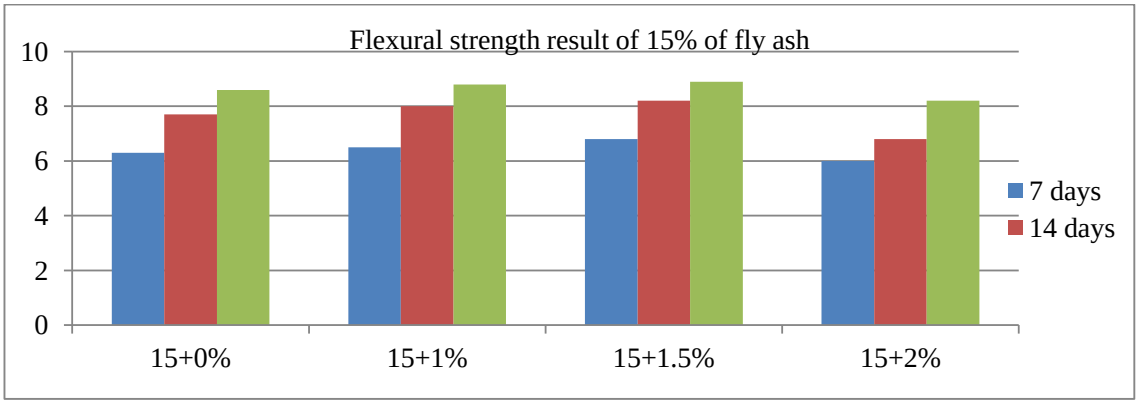

Figure 9 15% of Fly ash with 0, 1, 1.5 and 2% of Steel Fiber

VI. CONCLUSION

This paper had present experimental results of an investigation on the feasible use of fly ash with addition of steel fibre in SCC. Based on the results of this present study, the following conclusion can be drawn:

1. In preliminary fresh test addition of steel fibre with fly ash gives good results, increasing of steel fibre at 2%, It reduces the requirements of scc like flow ability and workability. The steel fibre had been blocked in instruments of 5+2%, 10+2%, and 15+2%. It created a difficult in usage so 1.5% of steel fibre chose as an optimum.
2. The compressive strength split tensile and flexural strength shows increased with the fly ash content still addition of 1.5% of steel fibre. 2% of steel fibre shows decreased in strength of 5, 10 and 15% of fly ash. Finally Concluded that addition of 15 % of fly ash and 1.5% of steel fibre gives an increased strength of all tests.
3. The overall assessment of both the fresh and hardened properties indicates that it is feasible to produce SCC with fly ash and steel fibre still 1.5% of steel fibre.

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