ISSN NO. 2456-3129

International Journal of Engineering, Pure and Applied Sciences,
Vol. 3, No. 1, March-2018

Experimental Investigation on the Behaviour of Strength and Durability of Concrete Using the Combination of Steel Fiber, Glass Fiber and Flyash

Sourabhlalotra[1] , Tapeshwar Kalra[2]

Research Scholar[1] , Surya Educational Charitable Trust,Bapror ,Rajpura(Punjab)
Assistant Professor ,Surya Educational Charitable Trust,Bapror ,Rajpura(Punjab)
Email: sourabhlalotra@gmail.com[1] ,kalratapeshwar333@gmail.com[2]

Abstract- Concrete is the most widely utilized "man-made" material globally for construction in many developing countries in all types of civil engineering works. Also, concrete is an environmental - friendly material and in areas of growing environment – related awareness that is of prime importance. The potential for using fly ash as a supplementary cementitious material in concrete has been known almost since the start of the last century. Historically, fly ash has been used in concrete at levels ranging from 15% to 25% by mass of the cementitious material component. The actual amount used varies widely depending on the application, the properties of the fly ash, specification limits, and the geographic location and climate. There has been lot of research took place over using fly ash and steel and glass fibers as additive in cement, admixture in concrete and cement replacement material in concrete**.** Many of investigations were attempted by the researchers to improve the quality, strength and durability against adverse exposures, since decades. Portland cement concrete is considered to be a relatively brittle material. When subjected to tensile strength, unreinforced concrete will crackand fail. Since the mid 1800's steel reinforcing has been used to overcome this problem. As a composite system, the reinforcing steel is assumed to carry all tensile loads. When fibers are added to the concrete mix, it too can add to the tensile loading capacity of the composite system. In fact, research has shown that the ultimate strength of concrete can be increased by adding fly ash steel and glass fiber reinforcing. In this research paper, an attempt is made to use combination of fly ash, steel and glass fibers in concrete with varying percentages of fibers and flyash from 0%, 05%,10%,20%,30% percentages of total fiber content for M 20 grade structural concrete with locally available aggregates (i.e. fine & coarse aggregates) and Ordinary Portland cement (OPC). The details of investigation along with the analysis and discussion of the test results are reported here in.

Keywords: Flyash, durability, strength, steel fiber, glass fiber.

1. INTRODUCTION

Menakanda in 2008, found that fly ash aggregate produced by normal curing showed comparable result with the concrete produced by normal curing. In the investigation where the properties of fly ash aggregate which are produced by cold bounded technique and that are compared with natural gravels. As the concrete which is made out of these techniques is good idea to replace it with other materials. The effect of using fly ash in industrial buildings are somehow very representative job as it will have a tremendous change in the universe. Fly ash can be used in different ways, as a partial replacement of cement in construction industry. Concrete as a material literally forms the basic our modern life: infrastructure like bridges dams buildings. Concrete is the basic of much of civilization's infrastructure and of its physical development. The performance of concrete is relate to workmanship, mix proportion, material characteristic's and adequacy of curing, quality concrete involves a variety of material and a numbers of different processes.

The strength and durability of concrete can b changed by making appropriate changes in its ingredents like cementanious materials aggregate and water and by adding some special ingridents. Hence concrete is well suited for a wide range of application. However concrete has some deficences as low tensilstrength , low posting cracking capacity, britellness and low ductile. Limiting fatigue life not capable of accommodating last deformation low impact strength.
The presence of micro cracks at the mortar aggregates interface is responsible for the inhearnt weakness of plane of concrete. The weakness can be removed by inclusion of fiber in the mix. Different type of fiber, such has those used in traditionl composite material has been interdused into the concrete mixture to increase its toughness or ability to resist crack growth. The fiber help to transfer load at the internal micro cracks such a concrete is called fiber reinforced concrete. Thus fiber reinforced concrete is a composite material essentially consisting of conventional concrete or mortar reinforced by fine fiber.

IJEPAS

International Journal of Engineering, Pure and Applied Sciences,
Vol. 3, No. 1, March-2018

2. LITERATURE REVIEW

Yasir Khan, M Anwar Ansari, Md. Saroj, ShahnewajHaider, Sachin Kulkarni, Gunderao .V. Nandithe study of Experimental investigation on strength and durability properties of steel and glass fibre reinforced concrete composite. In present project work M 35 grade (1: 1.7: 2.4) concrete with constant w/c ratio of 0.45 is designed mixed, cubes and cylinders are casted. The strength and durability properties are carried out for various mix designations and compared with normal conventional concrete. The physical tests on materials are carried out on cement, fine aggregate, coarse aggregate. Specific gravity, water absorption, fineness modulus, normal consistency setting time tests are carried out. Cube compressive strength and split tensile strength for 7 and 28 days are obtained. The various mix designation set for fibre reinforced concrete are tested for 7 and 28 days and compared with normal conventional concrete.

Water absorption, porosity, fire resistance tests are also carried out to check durability properties. Average compressive strength v/s various mix designations for cubes and cylinders are plotted graphically. The optimum dosage of fibre (steel and glass) reinforced concrete for various mix designation is plotted graphically. Water absorption, porosity and fire resistance are also shown graphically.

Adanagouda, Dr.H.M. Somasekharaiah, Shashi kumar.Bin this study the Cement is the most popular material used in construction, recent trend is in concrete cement is replaced by admixtures such as GGBS, fly ash, slag, silica fume and metakaolin to improve the characteristics of high performance of concrete in order to reduce the creep and shrinkage and to improve tensile strength, fibers are added. The scope of present investigation deals with the strength properties of high performance concrete, on the effect of partial replacement of cement by fly ash with different percentages viz 0%, 10% and 20% was used in the concrete mix containing composite fibers (steel and polypropylene) of different percentages viz 0%, 0.50%, 0.75% and 1% steel fibers and 0.25% polypropylene fiber constant for all fly ash concrete mixes on the properties of high performance concrete. An aggregate binder ratio of 2.5 and different water binder ratio viz 0.30, 0.35 and 0.40 with super plasticizer of 0.6% by weight of binder was used in this investigation. Each series consists prisms, cylinders and cubes as per IS standard. The tests are conducted to find out the flexural strength, split tensile strength and compressive strength at the age of 7 days and 28 days.

V.R.Rathi ,A.V.Ghogare ,S.R.NawaleI in this study, the result of glass fiber reinforced moderate deep beam with and without stirrups have been presented. Six tee beams of constant overall span and depth 150mm, 200mm, 250mm, 300mm with span to depth (L/D) ratios of 4,3,2.4, &2 and glass fibers of 12mm cut length and diameter 0.0125mm added at volume fraction of 0%, 0.25%, 0.50%, 0.75% & 1 %.The beams wear tested under two point loads at mid span. The results showed that the addition of glass fiber significantly improved the compressive strength, split tensile strength, flexural strength, shear stress and ductility of reinforced moderate deep beam without stirrups.

KomalChawlaand Bharti Tekwanitheexperimental investigation conducts on the use of glass fibers with structural concrete. Cem-fill anti crack, high dispersion, alkali resistance glass fiber of diameter 14 micron, having an aspect ratio 857 was employed in percentages , varying from 0.33 to1 percentage by weight in concrete and the properties of this Fiber Reinforced Concrete (FRC) like compressive strength, flexure strength, toughness, modulus of elasticity were studied.

Milind V. Mohodinthis studyit has been found that different type of fibers added in specific percentage to concrete improves the mechanical properties, durability and serviceability of the structure. It is now established that one of the important properties of Steel Fiber Reinforced Concrete (SFRC) is its superior resistance to cracking and crack propagation. In this paper effect of fibers on the strength of concrete for M 30 grade have been studied by varying the percentage of fibers in concrete. Fiber content were varied by 0.25%, 0.50%, 0.75%, 1%, 1.5% and 2% by volume of cement. Cubes of size 150mmX150mmX150mm to check the compressive strength and beams of size 500mmX100mmX100mm for checking flexural strength were casted. All the specimens were cured for the period of 3, 7 and 28 days before crushing. The results of fiber reinforced concrete for 3days, 7days and 28days curing with varied percentage of fiber were studied and it has been found that there is significant strength improvement in steel fiber reinforced concrete. The optimum fiber content while studying the compressive strength of cube is found to be 1% and 0.75% for flexural strength of the beam. Also, it has been observed that with the increase in fiber content up to the optimum value increases the strength of concrete. Slump cone test was adopted to measure the workability of concrete. The Slump cone test results revealed that workability gets reduced with the increase in fiber content.

3. MATERIALS

Ordinary Portland Cement (OPC) 43 grade confirning 8112: 9189 was used . The finess of cement was 2.69.

IJEPAS
International Journal of Engineering, Pure and Applied Sciences,
Vol. 3, No. 1, March-2018

Fine Aggregate Locally available sand passed through4.75mm IS sieve issued various properties of fine aggregates are shown in table as given below:

Table 1

Properties	Value Obtained
Fineness Modulus	2.66
Specific Gravity	2.69
Water Absorption	1.45%

Coarse Aggregatesin this study Coarse aggregate maximum size 20mm was used.Crushedaggregateavailablefromlocalsourceshasbeenused.Thecoarseaggregateswithamaximumsizeof20mm havingthespecificgravity valueof2.958 andfinenessmodulusof7.136areusedas coarseaggregate.Thelooseandcompactedbulkdensityvaluesofcoarseaggregatesare1467and1629 kg/m3 respectively,thewaterabsorptionof1.26%.

FLY ASH Fly ash is a by-product produced from the combustion of coal in an electrical generation station. Fly ash is a natural pozzolan, which means that it is a "siliceous or siliceous-and-aluminous material" that chemically reacts with calcium hydroxide or free lime (CH) that has evolved during reaction of cement and water to form composites having cementitous properties.

Table 2

Property	value
Fineness of test fly ash	80%
Specific property of test fly ash	1.25
Specific gravity	1.24

STEEL FIBER In present work weigh batching hand mixing Steel Fibre Reinforced Concrete is used to study cube compression test, flexural test on beams and onplain.Steel fibres are formed from low carbon content iron .The inclusion of fiberespecially steel fibersinconcrete significantly enhances the flexural strength,ductilityandtoughness.Because of its non-flexibility it gives more strength.The typical diameter of fibres lies in the range of 0.25-0.75 mm.l Length of these fibres is 30 mm and the diameter of steel fibre used is 0.6. Density of steel fibre is 7900 kg/cum.

GLASS FIBER.In general, fibers are the principal load-carrying members, while the surrounding matrix keeps them in the desired locations and orientation, acting as a load transfer medium between the fibers and protecting them from environmental damage. The fibers provide reinforcement for the matrix and other useful functions in fiber-reinforced composite materials.The glass fibres used are modulus of elasticity 86 GPa, Filament diameter 12 microns, specific gravity 2.68, length 12 mm. The number of fibres per kg is 212 millon fibres. Durability was poor with the original type of glass fibers since the alkalinity of cement reacts with its silica. In the 1970s alkali-resistant glass fibers were commercialized. Alkali resistance is achieved by adding zirconia to the glass. The higher the zirconia content the better the resistance to alkali attack.The best fibers have zirconia contents of 19% or higher.

4. OBJECTIVE

To analysis the behaviour of the properties of concrete strength and durability of concrete using the combination of fly ash, steel fiber and glass fiber on different percentage of fibers and fly ash.

4. EXPERIMENTAL INVESTIGATION

The experimental program is planned to quantify the compressive strength, Flexural strength, Split tensile Strength and Workability using fly ash steel fiber and glass fiber at various Percentage level will be used in the investigation to observe the effect of different combination of ash and fibers level in contributing the compressive, flexural and split tensile strength at various stages of curing, concerete cubes of size 150mm X 150mm X 150mm were casted. 90 cubes were casted for determination of compressive strength. After 24 hours, the specimen were demoulded and subjected to water curing. The compressive test were carried out by Compression Testing machine (CTM). Splitting Tensile test and flexural tensile test were carried out by Universal testing machine (UTM). Before testing the cubes were air dried for two hours. Crushing loads were noted and average compressive strength of 6 specimen is determined at 7,14 and 28 days. For splitting tensile strength cylindrical mould of size 150mm X 300mm and for flexural test concrete beam of size 700mm X 150mm X 150mm was used throughout the investigation.

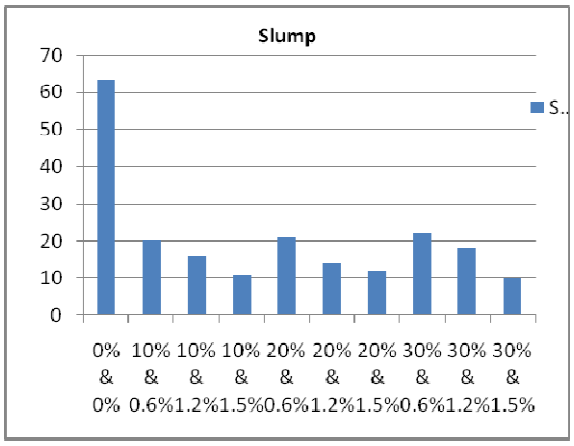
Workability of each batch of concrete mix was determined by carrying out slump test. The test was carried out as per specifications confirming IS: 1199- 1959. Slump measure was recorded in terms of mm.

5. RESULTS AND DISSCUSSION

Workability Testcan measure the behavior of the inverted cone, which is under the action of gravitational force.

IJEPAS

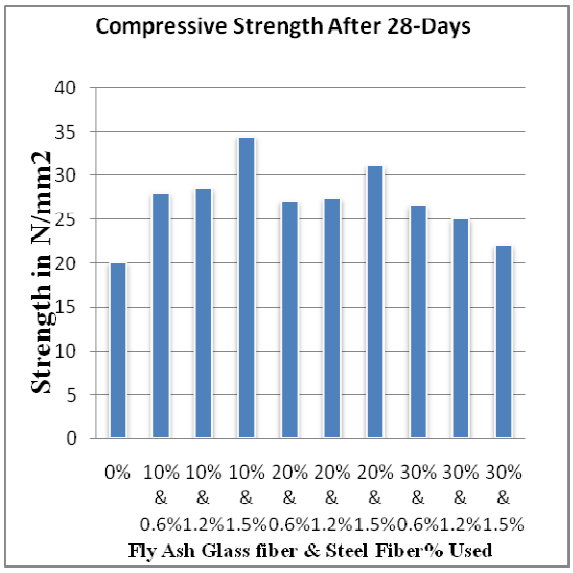
International Journal of Engineering, Pure and Applied Sciences,
Vol. 3, No. 1, March-2018



6. TESTS ON HARDENED CONCRETE

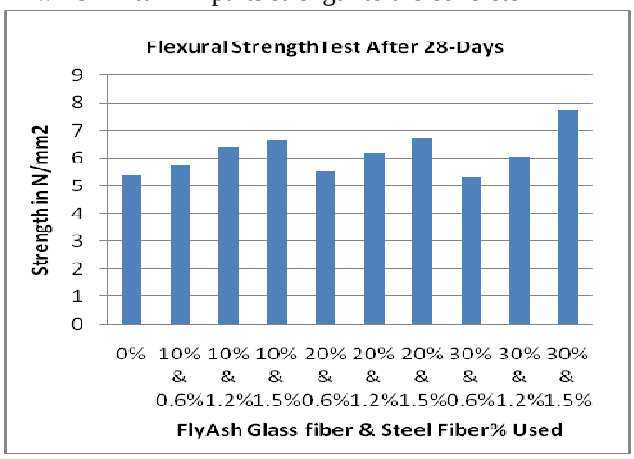
The test were done according to the codes of Bureau of Indian Standards. The tests for compressive strength on cubes were measured at 14 and 28 days of curing as per IS 516- 1959, test for flexural strength on beams was measured at 28 days of curing as per IS: 516:1959; and tests for split tensile strength on cylinder was measured at 28 days of curing.

6.1.1 Compressive Strength Test:

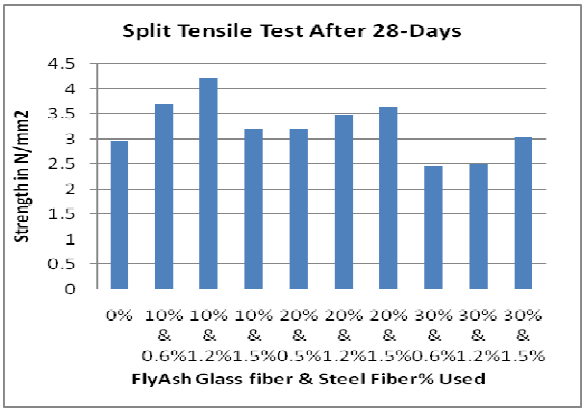


7. CONCLUSION

- The compressive strength of concrete reaches highest, when the cement has been replaced by 10% of flyash and with addition of 1.5% of steel fibre.This is due to the fact that the fly ash acts as pozolonic material and it combines with free lime to form CSH ,which imparts strength to the concrete. Also by adding steel fibers,the bond between different constituents become very strong which in turn imparts strength to the concrete



- The split tensile strength is maximum when



cement is replaced by 10% fly ash and addition of 1.2% of glass and steel fiber.

- The value of flexural strength increases mainly due to addition of steel fibers and it was recorded highest when cement was replaced by 10% of fly ash and with addition of 1.5% of steel and glass fiber.
- It goes on increasing continuously when there is increase in the amount of fly ash.This is due to the fact that fly ash being spherical, small, fine particles that required very low content of water to mix with free lime. But by adding Glass and steel fiber, the workability goes on decreasing and it reaches minimum for 1.5% glass and steel fiber.
- Slump will lose at the higher percentage of Steel and Glass Fibre. Density of concrete increases as percentage of fibre dosages of Steel and Glass fiber.

REFERENCES

[1]. Yasir Khan, M Anwar Ansari, Md. Saroj, ShahnewajHaider, Sachin Kulkarni, Gunderao .V. Nandi 'Experimental Investigation on Strength and Durability properties of Steel and Glass fibre reinforced concrete composite' International Journal of Advanced Research in Science, Engineering and Technology Vol. 3, June 2016 ISSN: 2350-0328

International Journal of Engineering, Pure and Applied Sciences,
Vol. 3, No. 1, March-2018

[2]. Adanagouda, Dr.H.M.Somasekharaiah, Shashi kumar.B'Experimental Investigation on Strength Characteristics of Fly Ash Based High Performance Concrete with Steel Fiber and Polypropylene Fiber' International Journal of Innovative Research in Science, Engineering and Technology) Vol. 4, Issue 9, September 2015 ISSN:2319-8753.

[3]. Sharma, Amit, and Ashish Kumar Sharma. "Mathematical Modeling of Vibration on Parallelogram Plate with Non Homogeneity Effect." *Romanian Journal of Acoustics and Vibration* 13, no. 1 (2016): 53.

[4]. Sharma, Subodh Kumar, and Ashish Kumar Sharma. "1651. Rayleigh-Ritz method for analyzing free vibration of orthotropic rectangular plate with 2D thickness and temperature variation." *Journal of Vibroengineering* 17, no. 4 (2015).

[5]. V.R.Rathi , A.V.Ghogare ,S.R.Nawale 'Experimental Study on Glass Fiber Reinforced Concrete Moderate Deep Beam' International Journal of Innovative Research in Science, Engineering and TechnologyVol. 3, Issue 3, March 2014ISSN: 2319-8753

[6]. Milind V. Mohod'Performance of Steel Fiber Reinforced Concrete'International Journal of Engineering and Science Vol. 1, Issue 12 (December 2012) ISSN: 2278-4721,