Performance Evaluation on Hybrid Fiber Reinforced Concrete with Various Percentage of Mineral Admixture

Mohsin Nawaz[1], Satyendra Dubey[2], Y K Bajpai[3]
[1]*M.Tech-Structure, Civil Engineering Department, Gyan Ganga Institute of Technology and Science, Jabalpur*
[3]*Associate Professor, Civil Engineering Department, Gyan Ganga Institute of Technology and Science, Jabalpur*

***Abstract*- Concrete is a man-made construction materials which is most commonly used in construction work in the world. It is obtained by mixing of water, cement, fine aggregate, coarse aggregate and some minerals admixtures in necessary proportion are known as concrete. The hardened concrete can be worked as an artificial stone in which the voids of coarse are filled by the fine aggregates and cement. The hardening of concrete is caused by chemical reaction between cement, water, and reaction for a long time and hardening of concrete strong with the age. The properties of concrete depend on the quantity and proportion of the ingredients used in the mix and the control exercised in formwork and curing. The fly-ash contributing 5 - 10 percentage were used in concrete mixes by volume of cement and poly-propylene fiber, steel (crimped) fibers and hybrid fiber(poly-propylene and steel (crimped) fibers) of various proportions i.e. ranging from 4 ¬to 8 % as additives for each of the concrete mixes of M30 grade as per IS code method of mix design. Super plasticizer was also used in all mixes to make concrete better in workability.**

Index terms- Mechanical properties, strength evaluation, polypropylene and steel fiber. Hybrid fiber, fibrous concrete, mono fiber

1. INTRODUCTION

A Concrete with reinforcement fails suddenly when subject to earthquake and nuclear blast etc. This problem can be avoided if the critical sections are able to undergo large plastic deformation and be in a position to absorb large of strain energy.Section composed with high strength steel and higher steel ratios fail suddenly without yielding of tension steel, provision of compression reinforcement helps to some extent. The improvement in ductility of concrete allows economical use of high strength steel, higher cement ratio and avoids sudden failure and also the moment curvature characteristics of reinforced concrete section can be brought nearer to that of a steel section and the analysis of intermediate concrete structures get simplified. The concrete with improved ductility is more efficient building material.

2 LITERATURE REVIEW

Deepa A Sinha (2012) studied on Strength Characteristics of hybrid fiber reinforced concrete and concluded that the optimum dosage of fibers to get maximum strength for the M30 grade concrete is found and the properties of concrete i.e workability, compressive strength and flexural strength are found. H S Jadhav and M D Koli (2013) researched on flexural behavior of hybrid fiber reinforced concrete beams and investigated that in hybridization, the hybrid fibers of various proportions such as 0%, 0.25%, 0.5%, 0.75%, 1% and 1.25% by volume of concrete were used. A.P. Sathe and A.V. Patil (2013) studied on experimental investigation on polypropylene fiber reinforced concrete by replacing river sand to artificial sand with and without admixture and concluded that up to 0.5% adding of concrete with polypropylene fiber there is optimum percentage to increase in all mechanical properties. A Shivakumar (2011) studied on influence of hybrid fibers on the post crack performance of high strength concrete and concluded that the flexural properties of various fiber-reinforced concretes at low volume fractions of fibers up to 0.5%. Darole J S (2013) studied the Effect of hybrid fibers on mechanical properties of concrete and gave result the hybrid fiber (steel and polypropylene) with 0.5 %volume fraction by volume of concrete better than normal concrete.

Maniram Kumar (2014) researched on Strength Evaluation of Steel-Nylon Hybrid Fiber Reinforced Concrete and concluded that hybrid reinforced concrete is made by using steel and nylon 6 fibers. Four different mix combinations of steel- nylon 6 fibers were 100-00%, 75-25%, 50-50% and 25-75%.

3 OBJECTIVES

The main objective of the study is to investigate the change in characteristics strength properties of concrete mixed with different percentage of fly ash with fibers.

4 MATERIALS

In this study, materials used are ordinary Portland cement, fine aggregate, coarse aggregate, steel fibers and polypropylene fibers. Fly ash is also used as mineral admixture.

4.1 Cement

The Ordinary Portland cement of 43 grade confirming to IS 8112-1989 manufactured by Ultra tech Company was used in this experimental work. Cement with specific gravity 3.12 was used for the preparation of test specimens. There are different type of cement; out of that have used 43 grade ordinary Portland cement (OPC). Initial and Final setting time of cement respectively is 90 min and 360 min.

4.2 Fine and coarse aggregate

Broken stone from the local quarry of size 20 mm and 10 mm in the ratio of 60:40 respectively confirming to IS: 383-1970 has been used as coarse aggregate. The specific gravity of 10 mm and 20 mm coarse aggregate were taken as 2.72 and 2.74 respectively. Water absorption for 10 mm and 20 mm aggregate were 0.17 and 0.15 % respectively. Fineness modulus of 10 mm and 20 mm were 2.31 and 2.65 respectively. Locally available river sand of zone II conforming to IS 383-1970 with specific gravity 2.69, water absorption 1.82 % and fineness modulus 2.86.

4.3 Water

Clean and portable water from tape was used for mixing of concrete and curing the concrete as per IS: 456-2000 in the entire experimental program .fresh water are also accept for all purposes for this investigation. Water shall be free from objectionable quantities of oil, acid, alkali, salt, or other materials.

4.4 Fly Ash

We have used mineral admixture as fly-ash. It is ultra fine and replacement of cement 5%, and 10% by weight of cement. Fly ash is one of the most extensively used by-product materials in the construction field resembling Portland cement. It is an inorganic, non combustible, finely divided residue collected or precipitated from the exhaust gases of any industrial furnace.

4.5 Steel Fiber

Steel fibers with Hooked end & Flat crimped were used in the mixes. The steel fibers had a length of 50 mm and a diameter of 0.75mm (an aspect ratio of 100). The density of the fibers was 7.65 g/ cm3 and the young's modulus was 210 GPa.

4.6 Polypropylene Fiber

Fibrillated 20 mm cut length fibers were used. Polypropylene fiber had a length of 20 mm and a diameter of 1mm(an aspect ratio of 100) . The specific gravity of polypropylene fiber is 0.9.

5 Methodology

Following test were conducted on prepared samples and materials also as per relevant IS code of Practice:

[1] Slump Cone Test
[2] Compaction Factor Test
[3] Compressive Strength Test
[4] Flexural Strength Test

5.1 Compressive Strength Test

Compressive strength of concrete depends on many factors such as water-cement ratio, cement strength, quality of concrete material and quality control during production of concrete etc. Test for compressive strength is carried out either on cube or cylinder. Various standard codes recommend concrete cylinder or concrete cube as the standard specimen for the test.

5.2 Flexural Strength Test

The flexural strength of concrete prism was determined based on IS: 516 –1959. Beam specimens of size 100 mm x 100 mm x 500 mm were casted. The samples were de-molded after 24 h from casting

and kept in a water tank for7 days and 28 days curing. The specimens were placed in UTM and tested for flexural strength.

6 RESULTS AND DISCUSSION

The Compressive Strength and Flexural Strength of concrete are improved with the inclusion of reinforcements of fiber with fly-ash. The variation of strength of the concrete with partial replacement of fly ash with different % of fiber is given below.

These results indicate that the variation of compression strength of the concrete with 0% and 4% of fiber reinforcement with 5 % of fly ash replace with cement and strength is maximum in 4% of hybrid fiber reinforcement and slight decrease in 2% steel fiber reinforcement concrete. But 10% fly ash with 4% hybrid fiber gives us better results is 45.33 N/mm² with comparison of others. There is also differences in flexural strength of the concrete with 0% and 4% of fiber reinforcement with 5 % of fly ash replace with cement and there is better in 4% o hybrid fiber reinforcement and slight decrease in 4% polypropylene fiber reinforcement concrete.

7 CONCLUSIONS

The experiment shows that the effect of fiber can still be a promising work as there is always a need to overcome the problem of brittleness of concrete. The following conclusions could be drawn from the present investigation.

- The maximum compressive strength of specimen after 28 days is 45.44 N/mm² with 4% of hybrid fibers (polypropylene and steel) with 10% of fly ash with comparisons of normal concrete and other mix. It is 29.54 % increase overcome with normal concrete.
- The maximum flexural strength of M5 mix after 28 days is 7.13 N/mm² with 4% of hybrid fibers (polypropylene and steel) with 10% of fly ash with comparisons of normal concrete and other mix. It is 36.94 % increase overcome with normal concrete.

From the above points it can be concluded that fiber reinforcement is very effective for improving the strength characteristics, cracking and workability of the concrete. Therefore the performance of the concrete will be improved if proper design and construction methodology is adopted.

REFERENCES

[1] Deepa A Sinha(2012); Strength Characteristics of hybrid fiber reinforced concrete. IGRA ISSN : 2277-8160 Vol. 1, Issue 5.

[2] H S Jadhav and M D Koli (2013); FLEXURAL BEHAVIOR OF HYBRID FIBER

[3] REINFORCED CONCRETE BEAMS. IJSCER ISSN 2319-6009, Volume 02, No. 03.

[4] IS: 10262-2009, "Recommended guidelines for concrete mix design", BIS New Delhi.

[5] IS: 1199-1959, "Methods of Sampling and Analysis of Concrete", BIS New Delhi.

[6] IS: 2720 (Part 2)-1973, "Determination of Water Content", BIS New Delhi.

[7] IS: 2720 (Part 3/Sec 1)-1980, "Determination of Specific gravity", BIS New Delhi.

[8] IS: 383-1970, "Specification for coarse and fine aggregate from natural sources of concrete", BIS New Delhi.

[9] IS: 456-2000, "Practice for plain and reinforced concrete", BIS New Delhi.

[10] IS: 516-1959, "Methods of tests for strength of concrete", BIS New Delhi.

[11] IS: 8112-1989, "Specifications for 43-Grade Portland cement", BIS New Delhi.

[12] Maniram Kumar, Er. Ankush Khadwal(2014); Strength Evaluation of Steel-Nylon Hybrid Fiber Reinforced Concrete. IJERA ISSN: 2248-9622, Vol. 4, Issue 7(Version 6), July 2014, pp.32-36.

[13] AP Sathe and AV patil (2013); Experimental Investigation on Polypropylene Fiber Reinforced Concrete With Artificial. IJSR ISSN: 2319-7064 Volume 4 Issue 6.

[14] A.Sivakumar (2011); Influence of hybrid fibers on the post crack performance of high strength concrete: Part I experimental investigations. JCECT ISSN 2141-2634 Vol. 2(7), pp. 147-159.

[15] Er. Darole J. S., Prof. Kulkarni V.P., Prof. Shaikh A.P., Prof. Gite B.E.(2013); " Effect of Hybrid Fiber on Mechanical Properties of Concrete". IJERA ISSN: 2248-9622 Vol. 3, Issue 4, pp.1408-1411.

[16] M P Singh, S P Singh and A P Singh (2014); Experimental Study on the Strength Characteristics and Water Permeability of

Hybrid Steel Fiber Reinforced Concrete. ISRN Volume 2014 (2014), Article ID 518640, 10 pages.

[17] S. C. Patodi, C. V. Kulkarni (2012); Performance Evaluation Of Hybrid Fiber Reinforced Concrete Matrix. IJERA ISSN: 2248-9622 Vol. 2, Issue5, pp.1856-1863.