ISSN 2229-5518

Enhancement the Strength of Conventional Concrete by using Fly ash and Nylon Fiber

1 Saxena Jaya, 2 Saxena Anil Kumar, 3 Arora T.R.
1P.G. Student, 2Associate Professor, 3Professor & Head
1,2,3Lakshmi Narayan College of Technology, Department of Civil, Bhopal
Corresponding author: jayajhuma@gmail.com

Abstract: Fiber can be defined as a small piece of reinforcing material possessing certain dimensional characteristics. The most important parameter describing a fibre is its Aspect ratio "Aspect Ratio" is the length of fibre divided by an equivalent diameter of the fibre. The properties of fibre reinforced concrete are very much affected by the type of fibre. Fibres are secondary reinforced material and acts as crack arrester. Prevention of propagation of cracks originating from internal flaws can result in improvements in static and dynamic properties of matrix.

In the present study an attempt have been made to enhance the strength of concrete by adding fly ash in varying percentage 10%,20% and 30% and nylon fiber with 0.20%,.25% and 0.30%.

These two additive materials has increased the compressive strength and flexural strength of conventional concrete.

Keywords: Fiber Reinforced Concrete, Nylon Fiber, Conventional concrete.

1. Introduction

Fibre reinforced concrete (FRC) is a composite material consisting of cement, sand, coarse aggregate, water and fibres. In this composite material, short discrete fibres are randomly distributed throughout the concrete mass. The behavioural efficiency of this composite material is far superior to that of plain concrete and many other construction materials of equal cost. Due to this benefit, the use of FRC has steadily increased during the last two decades and its current field of application includes: airport and highway pavements, earthquake-resistant and explosive-resistant structures, mine and tunnel linings, bridge deck overlays, hydraulic structures, rock-slope stabilization, etc.

Extensive research work on FRC has established that addition of various types of fibres such as metallic and non-metallic fibre like (steel), glass, synthetic, and carbon, in plain concrete improves strength, toughness, ductility, post-cracking resistance, etc. These dramix hooked end steel fibres and polypropylene fibres can effectively be used for making high-strength HFRC after exploring their suitability.

Fibre reinforced cement and concrete materials (FRC) have been developed progressively since the early work by Romualdi and Batson in the 1960s. By the 1990s, a wide range of fibre composites and FRC products were commercially available and novel manufacturing techniques were developed for use with high fibre content In this investigation, therefore, an attempt has been made to study the feasibility of using of fibres for making HFRC. Cementitious materials are generally quite brittle, with relatively low strength and strain capacity under tension. Hence a hand-laid steel bar reinforcement is usually necessary to increase tensile strength. For low reinforcement levels, the partial or even complete replacement of this conventional reinforcement by fibers is an advantageous alternative. For special applications, highly ductile fiber reinforced cementitious materials like ultra-high performance concrete or engineered cementitious compo- sites have been developed. Fibers may also be applied to control the detrimental effects of shrinkage. A significant reduction in crack width and crack spacing is possible, especially at early ages. They possess a high tensile strength and a high elastic modulus these are available at relatively low costs. The high modulus, which is much higher than the one of concrete or cement paste prevents the fiber from stretching or cross contraction upon load, which hence leads to a good fibre–matrix bond and smaller crack widths. A variety of tests have been performed to determine the actual characteristics and advantages of tuberous materials. The addition of steel fibres help in converting the brittle characteristics to ductile ones. To faster the compressive strength without sacrificing the ductility, a strategy adopted is to add discrete steel fibres as reinforcement in concrete. It is obvious that the behaviour of HFRC depends on the orientations, distributions, aspect ratios, geometrical shapes and mechanical properties of fibres in concrete mixtures. The orientations and distributions of fibre affect the properties of FRC such as toughness, strength, ductility and crack width.

2. General properties of Nylon Fiber

Nylon is smooth, light weight and high strength.

a) **Strength:** Nylon has good tenacity and the strength is not lost with age. It is one of the lightest textile fibres is at the same time also one of the strongest. Nylon has excellent abrasion resistance.

b) **Elasticity:** Nylon has good elasticity which makes it much suitable for the apparel purposes. Nylon like other fibres has its own limit of elasticity.

3.3.6 Nylon Fibre

Nylon is a generic name that identifies a family of polymers. Nylon fibre's properties are imparted by the base polymer type, addition of different levels of additive, manufacturing conditions and fibre dimensions. Nylon is heat stable, hydrophilic, relatively inert and resistant to a wide variety of materials. Nylon is particularly effective in imparting impact resistance and flexural toughness and sustaining and increasing the load carrying capacity of concrete following first crack.

c) Benefits of Nylon Fibers :-

- Improve mix cohesion over long distances
- Improve freeze-thaw resistance
- Improve resistance to explosive spalling in case of a severe fire
- Improve impact resistance
- Increase resistance to plastic shrinkage during curing

3. General properties of Fly Ash :-

Fly ash is a rich cementitious industrial waste which has the great potential to substitute Portland cement, a major producer of CO2 and thereby decreasing greenhouse gas emissions. The production of fly ash in India is likely to be more than 175 million tons by the year 2012.Though due to lot of efforts by State and Central Government the utilization of fly ash has gone beyond 50%, still a lot has to be done for full utilization of this precious wealth from the waste. The eastern state of Orissa in India has a large coal deposit thus facilitating thermal power plants and producing more and more fly ash day by day.

Coal-based thermal power installations in India contribute about 65% of the total installed capacity for electricity generation. In terms of energy supply the contribution is even higher, as these plants meet base load requirements. The ash content of coal used by thermal power plants varies between 25 and 45%. However, coal with an ash content of around 40% is predominantly used in India for thermal power generation.

i) **Fineness:** The fineness of fly ash is important because it affects the rate of pozzolanic activity and the workability of the concrete. Specifications require a minimum of 66 percent passing the 0.044 mm (No. 325) sieve.

ii) **Specific gravity:** Although specific gravity does not directly affect concrete quality, it has value in identifying changes in other fly ash characteristics. It should be checked regularly as a quality control measure, and correlated to other characteristics of fly ash that may be fluctuating.

iii) **Chemical composition:** The reactive aluminosilicate and calcium aluminosilicate components of fly ash are routinely represented in their oxide nomenclatures such as silicon dioxide, aluminum oxide and calcium oxide. The variability of the chemical composition is checked regularly as a quality control measure. The aluminosilicate components react with calcium hydroxide to produce additional cementitious materials. Fly ashes tend to contribute to concrete strength at a faster rate when these components are present in finer fractions of the fly ash.

Sulphur trioxide content is limited to five percent, as greater amounts have been shown to increase mortar bar expansion. Available alkalis in most ashes are less than the specification limit of 1.5 percent. Contents greater than this may contribute to alkali-aggregate expansion problems.

4 Materials Used:-

The main objective of test programme is to study strength characteristics of concrete with adding different percentage of fly ash and polypropylene fibre. The main parameters that were studied include compressive strength, Split tensile test and flexural test. The materials used for casting concrete samples, along with the tested results are described as under.

i) Cement:-

Cement is a fine, grey powder. It is mixed with water and materials such as sand, gravel, crushed stone to make concrete. The cement and water form a paste that and binds the other materials together as the concrete hardens. The ordinary cement contains two basic ingredients namely argillaceous and calcareous. In argillaceous materials clay predominates and in calcareous materials calcium carbonate predominates. In the present work Ultra-Tech 43 grade(OPC) Cement was used for casting cubes for all concrete mixes.

The cement was Uniform colour i.e. grey with a light greenish shade and was free from any hard lumps. Ordinary Portland cement **Ultra-Tech 43 grade(OPC**) was used. Tests were carried out on various physical properties of cement and the results are shown in Table.

ii) Coarse Aggregate:-

Crushed granite stones obtained from local queries were used as coarse aggregate. The maximum size of coarse aggregate used was 20 mm. The properties of coarse aggregate were determined by conducting tests.The broken stone is generally used as coarse aggregate. The aggregates were washed to remove dust and dirt and were dried to surface dry condition. The aggregates are tested as per IS 383: 1970.

iii) Fine Aggregates:-

Natural river sand was used as fine aggregate. The properties of sand were determined. The results are shown in Table.3.The results obtained from sieve analysis. The results indicate that the sand conforms to Zone II.

iv) Water:-

Portable water available in the college campus free from salts was used for casting and curing of concrete as per **IS: 456 – 2000** recommendations.

v) Fly Ash :-

Fly ash used in conventional concrete by **10%, 20% & 30% replaced by cement** sample.

vi) Nylon fiber:- Nylon fiber used in conventional concrete by 0.20%, 0.25% and 0.30%**.**

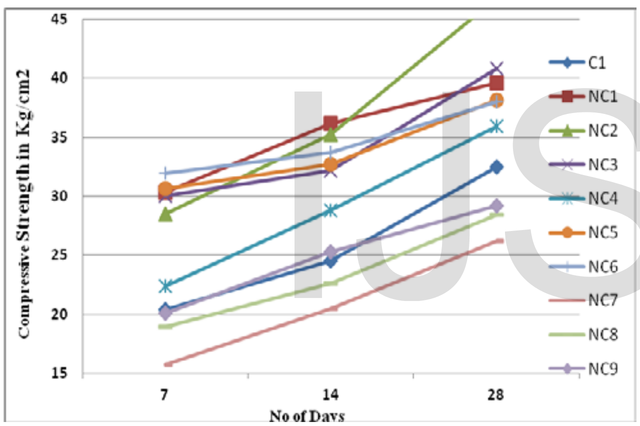
5) Test Results and Analysis :-

Grade of Concrete – M25

Sr. No.	Concrete Proportion	Symbol	7 Days Strength kg/cm^2	14 Days Strength kg/cm2	28 Days Strength kg/cm^2
1	100% Cement Concrete	**C1**	**20.4**	**24.55**	**32.47**
2	90% cement+10 % Fly ash + 0.20% Nylon fiber	**NC1**	**30.37**	**36.15**	**39.6**
3	90% cement+10 % Fly ash + 0.25% Nylon fiber	**NC2**	**28.49**	**35.25**	**46.9**
4	90% cement+10 % Fly ash + 0.30% Nylon fiber	**NC3**	**30.03**	**32.15**	**40.8**
5	80% cement+ 20% Fly ash + 0.20% Nylon fiber	**NC4**	**22.34**	**28.83**	**35.94**
6	80% cement+ 20% Fly ash + 0.25% Nylon fiber	**NC5**	**30.62**	**32.71**	**38.12**

ISSN 2229-5518

7	80% cement+ 20% Fly ash + 0.30% Nylon fiber	**NC6**	**31.95**	**33.69**	**37.96**
8	70% cement+ 30% Fly ash + 0.20% Nylon fiber	**NC7**	**15.73**	**20.43**	**26.23**
9	70% cement+ 30% Fly ash + 0.25% Nylon fiber	**NC8**	**18.94**	**22.61**	**28.45**
10	70% cement+ 30% Fly ash + 0.30% Nylon fiber	**NC9**	**20.09**	**25.3**	**29.19**



6. Conclusions

The test carried out at 7 days, 14 days and 28 days, the comparison is made between the conventional concrete with different proportion and with different proportion nylon fibre and fly ash..

- **a.** The compressive strength of nylon fibre mixed with conventional concrete is increased.
- **b.** When we used the nylon fibre in conventional concrete in various proportion 0.2% ,0.25% and 0.3% of volume of concrete the result obtained by the compressive strength is increased.
- **c.** In conventional concrete , cement replaced by 10%, 20% and 30% with fly ash. The comparative study of all mixed the result obtained . In conventional concrete 10% fly ash , 90% cement , and 0.2%, 0.25% and 0.3% nylon fibre getting the good strength of concrete.

Refrences :-

1. ACI committee, "State - of - the art report in fibre reinforced concrete'' ACI 554 IR – 82 Detroit Mechigan 1982.
2. ASTM C1018 – 89, Standard Test Method for Flexural Toughness and First Crack Strength of Fibre Reinforced Concrete (Using Beam with Third – Point Loading) 1991 Book of ASTM Standards, Part 04.02, American Society for Testing and Materials, Philadelphia, pp.507 – 513.
3. Arnon Bentur & Sidney Mindess, '' Fibre reinforced cementitious composites'' Elsevier applied science London and Newyork 1990.
4. Colin D. Johnston, "Fiber reinforced cements and concretes" Advances in concrete technology volume 3 – Gordon and Breach Science publishes – 2001.
5. Perumalsamy N. Balaguru, Sarendra P. Shah, ''Fiber reinforced cement composites'', Mc Graw Hill International Editions 1992.
6. C.D. Johnston, "Definition and measurement of flexural toughness parameters for fiber reinforced concrete" Cem. Concr. Agg. 1982
7. Gram, H.E, Durability of natural fibre in concrete. Swedish Cement and Concrete Int, 1983. 2004, pp. 4177-4188.
8. Mohr, B.J., Nanko, H. and Kurtis, K.E. Durability of pulp fibre-cement composite to wet/dry cycling, Cement and Concrete Composite, June 2003a

9. Mohr, B.J., Nanko, H., Kurtis, K.E. Durability of pulp fibre-cement composite to wet/dry cycling, Cement and Concrete Composite, December, 2003b.
10. Ramakrishna, G., and Sundara, T., (2005). Study into the durability of natural Cement and concrete composite fibres and the effect of corroded fibres on the strength of mortar, 27, (5), 2005, pp. 575-582.

.