International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 05 | May -2017 www.irjet.net p-ISSN: 2395-0072

STRENGTH BEHAVIOUR OF CONCRETE USING POLYMER MODIFIED AND STEEL FIBER REINFORCED CONCRETE

Sachin Kumar[1], Mr. Parmod Saharan[2], Dr. Arabinda Sharma[3]

[1]*M.tech student, Dept. of Civil Engineering, BRCM College of Engg. & Technology, Bahal, Haryana, India*

[2,3]*Assistant Professor, Dept. of Civil Engg., BRCM College of Engg. & Technology, Bahal, Haryana, India*

Abstract – *Concrete is being widely used in the construction work e.g. buildings, bridges, highways, tunnels etc. due to its high strength. A lot of research has been done or ongoing to improve the concrete strength with the advancement of technology. Relating to this a study has been carried out on the impact of concrete strength by using acrylic latex polymer modified concrete and steel fibre reinforced concrete (SFRC). It was observe in previous researches, in addition of SFRC increases the mechanical properties (compressive strength, tensile strength and flexural strength) of concrete. Now we will observe that the Involvement of acrylic latex polymer individual or combined with steel fibres effects on mechanical properties of concrete. For this, we have prepared a design mix of M25 grade as per IS 10262:2009.*

Keywords – Concrete, construction, polymer, steel fiber, design mix.

1. INTRODUCTION

Many new construction materials are being developed all over the world to improve the concrete properties with considerable effect. The economic progress of any construction project depends more on intelligent use of the materials and constant improvement of available materials. So that we can achieve the high performance of concrete for various construction work by applying the steel fibre's and polymers in concrete.

Concrete is the mixture of cement ,coarse aggregates, fine aggregates, and water. It is widely used in construction industry. Cement is used as a binding material in concrete. After addition of water in concrete, chemical reaction takes palace and concrete sets rapidly. Concrete plays a vital role in the development of any nation or any human civilization from ancient times. Concrete is usually characterized by its compressive strength. Concrete is widely used for making architectural structures foundations, brick/block walls, bridges/overpasses, motorways/roads, runways, structures, dams, pools/reservoirs, pipes, fences and poles and even boats.

SFRC is the developed by addition of steel Fiber with concrete at the time of mixing with definite proportions. There are many types of fibres such as steel fibre, glass fibre, rice husk etc. which are used in concrete. Steel fibres are mostly used now a day. These steel fibers are helpful to reduce the crack width in concrete member which results in reducing the permeability of concrete. Due to this concrete gains durability and strength for a very long time in compare to the concrete without steel fiber. Steel fiber also improves the toughness and load carrying capability in the concrete members.

Now a days many polymers are using in concrete to improve the various properties of concrete. Peoples are taking advantages polymers in form of Oils, tars, and gums etc. Polymer modified concrete are prepared by mixing of Portland cement concrete with a advanced polymers such as polyvinyl acetate, Styrene butadiene rubber, acrylic latex polymer and ethylene vinyl acetate. Out of these polymers acrylic polymer has a constant color which makes its very suitable construction materials in architecture. There are various research work are done and going on due to the massive impact of polymer on concrete.

Fiber reinforced polymer concrete (FRPC) consist of mixture of fibers and polymer in concrete. This type of concrete also gives the remarkable observation in concrete properties.

2. EXPERIMENTAL INVESTIGATION

We take a series of specimen of a specific size and shape for experiment. Cubes of size (150 mm × 150 mm), prisms of size (100 mm × 100 mm × 500 mm) and cylinders of size 150 mm dia. × 300 mm in height are taken for observing the compressive strength , flexural strength and tensile strength of concrete respectively. There are four types of concrete mixes of M25 concrete grade is prepared with or without using acrylic latex polymer and steel fibres. These are plain cement concrete(M25) , Plain cement concrete with acrylic latex polymer (M25+ AL), plain cement concrete with steel fibre (M25+SF), and plain cement concrete with combination of acrylic latex polymer and steel Fibre

(M25+AL+SF).

2.1. The characteristic of material used in mixes as discussed below

2.1.1. Cement – Ordinary Portland cement of 43 grade is used in all the specimen as binder of material. Quality is assured by checking the fineness, free from lumps and smoothness.

2.1.2. Properties of steel fibres are listed below.

Type	Diameter	Length	Aspect ratio
Crimped round	0.45 mm	36 mm	80

2.1.3. Properties of Acrylic latex polymer is listed below.

Polymer Type	Percent solid	ph	Colour
Acrylic polymer	46.5	7.5-9.5	White

3. CONCRETE MIX DESIGN

Mix Proportioning - A design mix of 1:1.21: 2.07 ratio is adopted with w/b ratio of 0.44 and 10% acrylic latex polymer by weight of the binder was added for M25+AL. For mix M25+SF a design mix of 1:1.21: 2.07 is adopted with w/c ratio of 0.44 and steel fiber quantity of 0.75 % by volume is incorporated.

For mix M25+AL+SF a design mix of 1:1.21: 2.07 with w/b ratio of 0.44, 10% acrylic latex polymer by weight of the binder and 0.75% steel fibre by volume is incorporated. Silica fume in 7 % quantity was added as a partial replacement of cement with super plasticizer (Glenium -51) in the ratio of 1 % of binder in all above mixes.

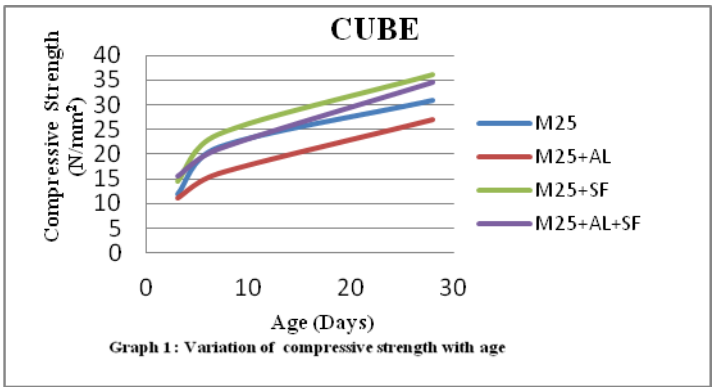
4. CASTING AND TESTING

A total of 36 specimens 9 for each different design mix of concrete were casted and their testing is done after 3 days, 7 days and 28 days.

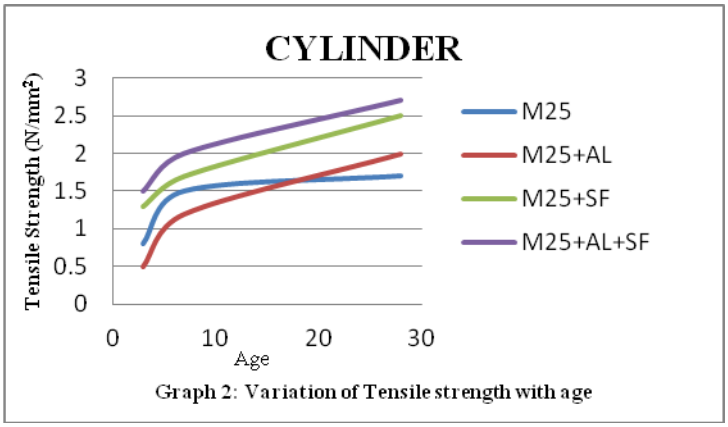
5. RESULTS

The average test readings of specimens after 3 days, 7days and 28 days are listed in following table.

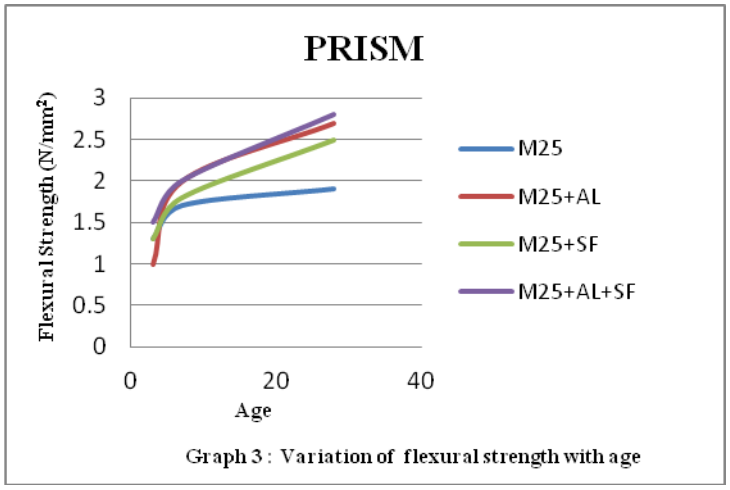
Properties	Age (days)	M25	M25+ AL	M25+ SF	M25+AL+ SF
Compressive	3	12	11	14.5	15.5
Strength(N/mm²)	7	21.5	16	24	21
	28	31	27	36	34.5
Tensile strength	3	0.8	0.5	1.3	1.5
(N/mm²)	7	1.5	1.2	1.7	2
	28	1.7	2	2.5	2.7
Flexural strength	3	1.3	1	1.3	1.5
(N/mm²)	7	1.7	2	1.8	2
	28	1.9	2.7	2.5	2.8



Graph 1: Variation of compressive strength with age



Graph 2: Variation of Tensile strength with age



Graph 3 : Variation of flexural strength with age

6. CONCLUSIONS

We see that the compressive strength of M25, M25+AL, M25+SF and M25+AL+SF are 31 N/mm², 27 N/mm², 36 N/mm² and 34.5 N/mm² respectively (Graph 1). There is a decrease in compressive strength in case of using acrylic latex, but use of steel fibre shows a great increase in compressive strength which is due to the compactness and bonding between concrete and steel fiber. Steel fibers are also capable of taking load.

While in case of cylinder testing acrylic latex polymer enhances the tensile property of concrete (Graph 2). From the above observation, involvement of acrylic latex with or without steel fibre significantly increases the value of tensile strength.

Using of acrylic latex, flexural behavior of prism shows an increase in the flexural strength of concrete (Graph 3). Combine use of steel fibre and acrylic latex also increases the flexural strength of concrete prism. This happens due the compactness of concrete due to the using acrylic latex polymer.

REFRENCES -

1. *Y.M. Ghugal, Polymer modified mortar: A material for strengthening of earthquake damaged structures, Proc. Tenth symposium on earthquake enginnering,Roorkee,1994,pp.16-18.*
2. *G.D.Awchat, N.M.Kanhe, Experimental Studies on polymer Modified Steel Fiber Reinforced Recycled Aggregate Concrete International Journal Application or Innovation in Engineering & Management (IJAIEM).*
3. *http://dda.org.in/cee/Technicalpaper/technical17.pdf*
4. *http://www.ijaiem.org/volume2issue12/IJAIEM-2013-12-04-005.pdf*
5. *V.M.Southarajan, Deependrasingh, Shreyansh Parakh,S.Thirumurugan and A.Shivkumar, Strain Hardening Properties Of Steel Fibres Reinforced Latex Concrete Composites, International Journal Of Engineering And Technology,5,2013,pp.1355-1367.*
6. *IS-10262: 2009, code for practice for design mix,*
7. *Shetty M.S., Concrete and Technology Theory and practice, sixth edition, pp. 428-435,2005*
8. *http://www.ijer.in/ijer/publication/v5si3/53.pdf*
9. *IS 383: 1970 Indian Standard specifications for coarse and fine aggregate from natural sources for concrete*
10. *Bing Chen et al "Mechanical properties of polymer-modified concretes containing expanded polystyrene beads". Construction and Building Materials, Vol. 21, pp. 7-11, 2007.*
11. *Shashikumara, S. R., Zai, S. A. K., Muthimani, R., Manirudrappa, N., "Residual Strength of SBR Latex Modified High Strength Concrete under Repeated Impact Loading," Concrete Repair, Rehabilitation and Retrofitting II, Taylor and Francis Group, London, pp.1209-1215, 2009.*
12. *Desai, S. B., "Use of Industrial Byproducts and Recycled Materials in Concrete Structures – An Engineer's Perspective," The Indian Concrete Journal, pp. 41-48, May 2010.*