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"BEHAVIOUR OF CONCRETE IN THE REPLACEMENT OF CEMENT AND SAND RESPECTIVELY IN THE DIFFERENT PROPORTION OF POLYMER AND STEEL FIBERS"

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Abstract - *In the current research work, polymer and steel fibers have been used in the mix for some improvement in the properties of grade M-25 concrete. The purpose of current research is to study the effect of polymers and steel fibers in comparison to normal concrete. In present work, Portland Pozzolana cement of has been used to make the concrete mixture. In some concrete specimens, the ratios of polymers with cement are made created by using in 2.5%, 5.0%, 10%. In addition, in other concrete samples, the ratio of steel fibers with the polymer has been prepared mixture by taking 0.5% and 1.0%. The ratio of water/cement to in making these specimens made by has been taken 0.43. Compressive strength and flexural strength have been tested in the concrete specimen, respectively, in 7, 14 and 28 days. Finally, based on the results, conclusions have been drawn.*

Keywords: Cement; Sand; Polymer; Steel fiber; Compressive strength; Flexural strength.

1. INTRODUCTION -

In recent time, it has been found that normal concrete gets cracked due to the presence of water flood and natural calamity like the earthquake. Consequently, the concrete structures become weak. That is why the quality of concrete needs to be improved.

Generally, maintaining concrete strength and flexural strength in building construction is very important. In order to maintain the toughness and durability in concrete over time, research has been done to improve the properties of concrete from time to time. We have used polymer and steel fiber to improve the properties of flexural strength along with compressive strength, durability, and crack control in concrete in the current research. On one hand, in form of bond in polymer cement, on the other hand, steel fiber is helpful in maintaining the durability. In current work, the ratio of polymers to 2.5%, 5.0%, 10% and steel fiber ratio have been taken 0.5% and 1.0%. We have done made replacement with cement and sand to respectively polymer and steel fiber. And to see their effects, we have shown workability along with Compressive Strength and Flexural Strength on these concrete specimens, their results are shown in the next results chapter.

1.1 Polymer Modified Concrete –

In the Concrete based on polymer composite material resulting from the polymerization of the monomer mixture is used. The polymer as a replacement for cement and polymer concrete used for because of water moist curing, high strength, and excellent bond to concrete properties. A polymer concrete property is depending on water/cement content, water moist curing, and concrete characteristic conditions etc. The most commonly used polymers concrete is methyl methacrylate, polyester, polyurethane, Latex polymer and Acrylic polymer. Generally, cement and polymer are used in concrete during mixing period. Similar to the normal concrete and polymer concrete used to further improve the toughness properties and durability. Uses of material like polyethylene, poly (tetra-fluoro-ethylene), polypropylene, polyisobutylene, acrylic polymer have been reported in the literature review part.

1.2 Fibers –

Reinforcement increases the behavior of concrete. Steel fibers contain low carbon and uses of such fibers help in the modification of properties both in plastic as well as in the hardened stage of concrete binder material. As per past literature review generally, steel fiber helps in controlling flexure cracks, erosion, and durability. Steel fiber reduces concrete workability slump comparing to the other

fibers. As well as improved in concrete strength and properties of the concrete mix. If the steel fibers are strong then increase the resistance of cracking and decrease the crack width.

2. Experimental Methodology –

The above-formed concrete is generally referred as M-25 grade concrete and was made according to Indian Standard code IS: 10262-2009. In addition, some specimens were prepared from the different acrylic polymer varying replacement level namely 0%, 2.5%, 5%, 10% by mass of total cement content. And another concrete specimen prepared from the different steel fiber varying replacements level namely 0.5% and 1.0% by mass of total sand content.

Table -1: Mix design ingredients used per m^3 of concrete

Materials	Proportions
Water (L)	191.58
Cement (kg)	445.53
Fine Aggregate (kg)	662.64
Coarse Aggregate (kg)	1114.88
Calculated Proportions	1 : 1.48: 2.5

2.1 Material Properties –

To know the properties of the material, the Pycnometer and fineness test has been done in the fine and coarse aggregate material. Portland Pozzolana cement (PPC), acrylic polymer, and steel fiber are used in the present work.

Steel fiber aspect ratio (L/d) is 40/0.5 and 60/0.5, and S.F. ratio of 0.5%, 1.0 and Polymer ratio of 2.5%, 5.0%, and 10% % has been used.

Table -2 Properties of sand and coarse aggregate

Physical properties of material	Coarse Aggregate	Fine Aggregate
Specific gravity	2.68	2.64
Fineness modulus	6.57	2.67
Bulk density (kg/m^3)	1520	1680

2.2 Process and Mixing –

The concrete specimen size of 150 mm x 150 mm x 150 mm and beam size is 100 mm x 100 mm x 500 mm is prepared for different proportion of concrete material. The effect of the composition of the finished cube surface and the effect of the concrete specimen's strength created by the different mix ratio is to see. **A**re shown in Figures 1, 2, and 3.

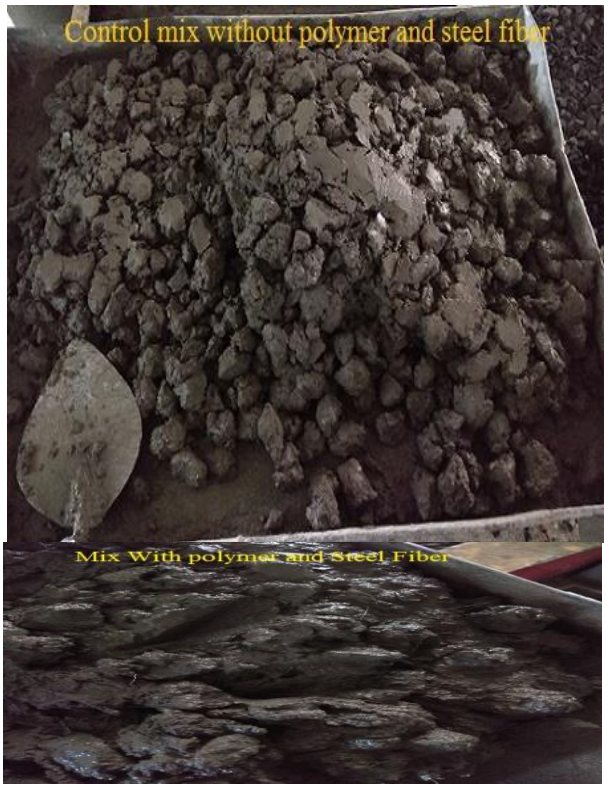
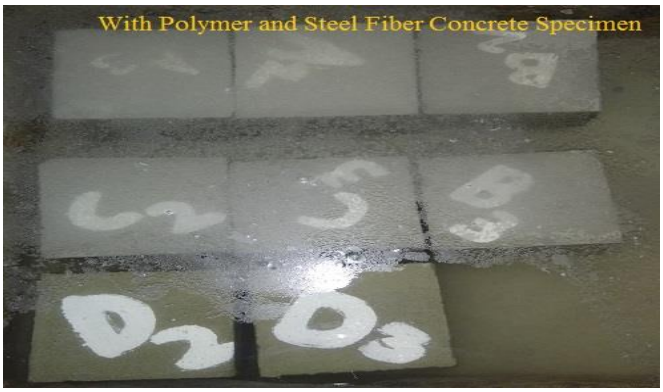
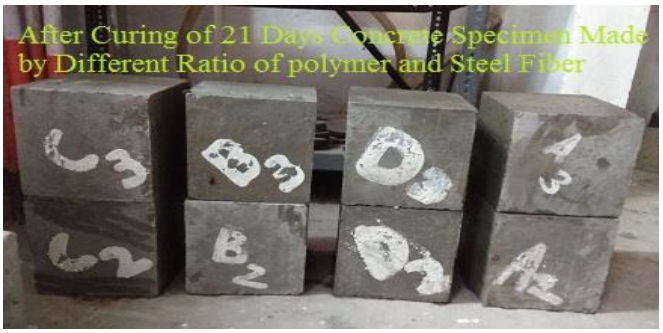
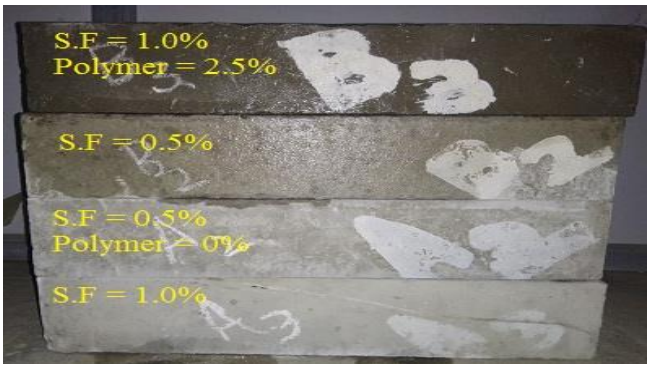


Fig. 1 Mixing process of concrete specimen.

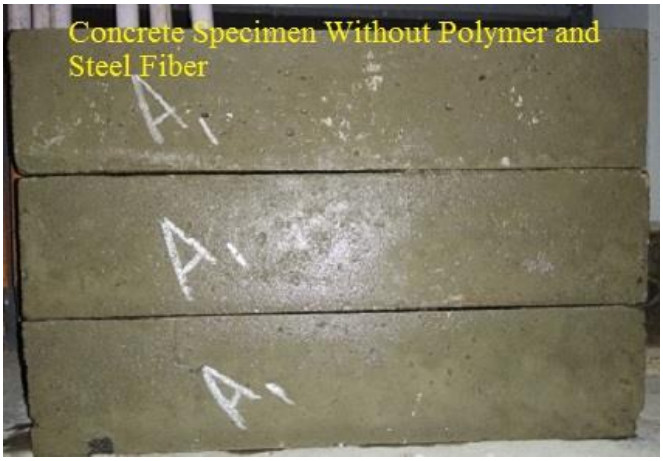
Cube specimen –







Beam Specimen –



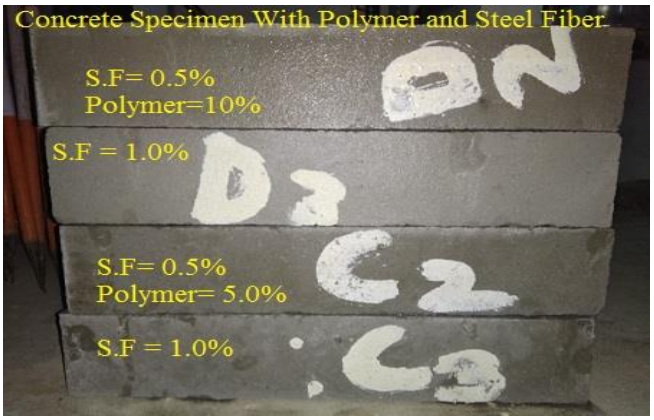


Fig. 2 Cube and Beam Specimens

Fig. 3 Steel fiber and Acrylic polymer

3. RESULTS AND DISCUSSION

3.1 Compressive strength test:

After 6, 13, and 20 days of water curing treatment, the compressive strength of these concrete specimen has been fixed at age 7 days, 14 days and 28 days. Results are shown in tables 3.

Table 3 Compressive strength of different mix concrete specimen

Cement / polymer ratio	Steel fiber ratio	Compressive strength (N/mm²)		
		7 days	14 days	28 days
0 %	0 %	7.5	14.0	24.5
	0.5 %	9.0	15.5	25.5
	1.0 %	10.5	17	27.0
2.5 %	0 %	8.5	15.5	27.5
	0.5 %	9.5	16.5	28.5
	1.0 %	10.0	18.0	30.0
5.0 %	0 %	9.0	16.0	29.0
	0.5 %	10.5	17.5	31.5
	1.0 %	**11.5**	**19.0**	**33.0**
10 %	0 %	6.0	11.5	18.5
	0.5 %	7.5	12.0	19.0
	1.0 %	8.0	13.5	20.5

3.2 Flexural strength test –

In these beam specimens, after treatment in the water for 6, 13, and 20 days the flexural strength in concrete specimen has been determined, results are shown in tables 4.

Table 4 Flexural strength of different mix concrete specimen

Cement / polymer ratio	Steel fiber ratio	Compressive strength (N/mm²)		
		7 days	14 days	28 days
0 %	0 %	1.060	1.560	3.340
	0.5 %	1.430	1.840	4.540
	1.0 %	1.710	2.120	5.140
2.5 %	0 %	1.340	1.710	4.350
	0.5 %	1.890	2.080	5.320
	1.0 %	2.060	2.540	5.760
5.0 %	0 %	1.730	1.970	3.340
	0.5 %	1.980	2.280	4.420
	1.0 %	**2.420**	**2.890**	**6.540**
10 %	0 %	0.780	1.040	3.150
	0.5 %	0.930	1.350	4.280
	1.0 %	1.010	1.890	4.400

4. CONCLUSIONS –

The compressive strength of concrete specimen made in addition to 5.0% polymer and 1.0% steel fiber increased as a compared to conventional mix and all other mix ratios. However, higher varying replacement level of Polymer (i.e. 10% mixes) results in decreases than that all polymer mix ratio. Also, it is observed that the flexural strength maximum is 6.54 N/mm2 at the mixture of polymer ratio and polymer-steel fiber mix ratio of 5% and 1.0%. The flexural strength decreases with increased more than that 10% ratio of polymer mix into the concrete specimen.

REFERENCES

[1] Doo-yeol yoo, Min-Jeo kim. “Development of cost effective ultra-high performance fiber reinforced concrete using hybrid steel fiber”. Construction and building materials journal (2017), pp. 383-394.

[2] Mohd Zamin Jumaat, Kim Hung. “Behavior of shear and mechanical properties of steel fiber cement based and geo-polymer oil palm light weight concrete”, Construction and building materials journal, 148 (2017), pp. 369-375.

[3] Josef Novak, Alena. “Fire response of hybrid fiber reinforced concrete to high temperature” Procedia Engineering, Elsevier journal 172 (2017) pp. 784-790.

[4] Messaoud Saidani, Michael. "Behavior of different types of fiber reinforced concrete without Admixture", Engineering Structures Elsevier journal, 113 (2016) pp. 328-334.

[5] Malgorzata Pajak. "Investigation on concrete reinforced with two types hooked end fiber under flexure", Procedia Engineering Elsevier journal 193 (2017) pp. 128-135.

[6] V.S. Aarthi, Kurunji, R.Poorani, "An experimental investigation on use of copper slag and fiber in concrete" International Journal for Scientific Research & Development, Vol. 5, Issue 02, (2017) ISSN: 2321-0613.

[7] Moh. Salman Quraishi. "Effect of M40 concrete with partial substitute of opc with micro silica and replacement of fine aggregate with 50% manufactured sand along with addition of steel fiber", International Research Journal of Engineering and Technology, ISSN: 2395-0056, Vol. 04 Issue: 07, July -2017.

[8] Shafeeq–Ahamed. "Investigation on steel fiber reinforced concrete with partial replacement of natural sand by M-sand", International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395-0056, Vol. 04 Issue: 07, July -2017.

[9] M.L. Nehdi. "Novel steel fiber reinforced preplaced aggregate concrete with superior mechanical performance" Cement and Concrete Composites journal (2017).

[10] S.K. Hirde & Omprakash S. Dudhal, "Review on Polymer Modified Concrete and its Application to Concrete Structures", IJER journal, vol. 5, pp. 766-769, Feb -2016.

[11] "Behaviour of Polymer Strengthened Plain Concrete" by M. Iqbal et.al. (2014)

[12] Kapil Soni & Y.P. Joshi, "Performance Analysis of Styrene Butadiene Rubber-Latex on Cement Concrete Mixes" (2014)

[13] Vikas S Kerur & Umesh P Patil, "Effect of Styrene Butadiene Rubber Latex Polymer On The Compressive And Tensile Strength of Concrete Containing one or Two Admixtures", International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395-0056 Vol. 02 Issue: 04, July-2015.

[14] Raman Bedi et.al., "Mechanical Properties of Polymer Concrete", Hindawi journal of composites, vol. 2013, article 948745, pp. 12.

[15] R. Deeb, A. Ghanbari, B.L. Karihaloo, "Development of self-compacting high and ultra high performance concretes with and without steel fibers", Cement and concrete composites 34 (2012), pp. 185-190.

[16] Ohama, Y., "Polymer-Modified Mortars & Concretes", Concrete Admixtures Handbook. Properties, Science, and Technology. Park Ridge: Noyes Publication (1984).

[17] IS: 10262-2009. Specifications for concrete mix design, Bureau of Indian Standards, New Delhi, 2000.

[18] IS: 456-2000. Indian standard code-guidelines for concrete mix design, Bureau of Indian Standards.

[19] IS: 516-1959. Method of testing guidelines for compressive strength of concrete, Bureau of Indian Standards, New Delhi, 1959.

[20] IS: 8112-1989. Specifications for 43-Grade Portland cement, Bureau of Indian Standards, and New Delhi, India.

[21] Rossignolo, J. A., Agnesini, M. V. C., "Mechanical Properties of Polymer- Modified Lightweight Aggregate Concrete". Cement and Concrete Research. 32: 329-334 (2002).