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Hybrid Fiber Reinforced Concrete with the Addition of Styrene Butadiene Rubber (SBR) Polymer

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Abstract: ***Fibre Reinforced concrete is a well-known composite material used in civil engineering and other applications. Conventional concrete has poor tensile strength so its capacity to absorb Energy is limited. The weakness in tension zone can be overcomem by strengthening their matrix with reinforcing fibrous materials. Presence of fibres in concrete mix improves tensile strength, flexural strength and structural quality of the material as well. At the same time it is well known that the concrete is porous and the porosity is due to water-voids, air voids or due to inherent porosity of gel structures itself and the strength of the concrete is naturally reduced. It is investigated and conceived by many research workers that dropping of porosity results in improvement in the strength of concrete. The addition of monomer (Styrene Butadiene) and consequent polymerization is the modern practice adopted to decrease the present porosity of the concrete and to improve the strength.***
The present study is done on the mechanical behaviour of hybrid fibre reinforced polymer concrete. Experimentation includes compression strength test for M30 grade concrete mix, where concrete was reinforced with 2% fibres with combinations of Crimped fibres + Hooked End steel fibres, To this combination SBR polymer was added in 0, 5, 10, 15, 20 and 25 percentages by the volume of water and strengths were found out. The results indicated that as the polymer content increased to up to 15% showed that strength and workability also increased and decreases beyond.
Keywords: Hybrid fibre Reinforced polymer concrete, Styrene Butadiene Rubber, flexural strength, split tensile strength, fibres

I. INTRODUCTION

Fiber reinforced concrete can be well-defined as a composite material comprising of mixture of concrete or cement mortar with discontinuous, discrete, uniformly dispersed appropriate fibers. Fiber addition to concrete makes its components ductile and tough. Incorporation of fibers into cement matrix not only boosts the tensile and flexure strength of concrete but also minimizes the crack propagation. Researchers have shown that the impact resistances and toughness characteristics of concrete can be enhanced by adding fiber to concrete.

A. Various Types Of Steel Fibers Are

a) Straight Slit Steel fiber



b) Hooked End Steel fiber

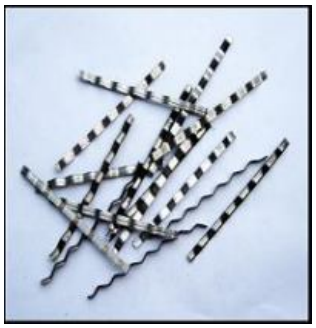


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c) Paddled Steel fiber



d) Crimped Steel fiber



B. Hybrid Fiber Reinforced Concrete (HFRC)

When two or more types of fibers are combined reasonably to yield a compound which gets the benefits of each individual fiber and shows a synergistic response is called hybrid fiber reinforced concrete.

1) *Application of Hybrid Fiber Reinforced Concrete:* Hybrid fiber reinforced concrete related composites, particularly the one having a great fracture stiffness and are useful in slabs and thin pre-cast products like tiles, curtain walls, roof sheets, permanent forms, cladding panels, I and L shaped beams, etc. To get high strength, good workability, increased durability and adequate ductility, fibre reinforced concrete needs to be designed for the areas of new application. Applying and developing the idea of hybridization, superior properties of concrete should be developed. At lower fiber content ductility and strength of concrete can be enhanced, rather than reinforcing fiber with single type of fiber. fibers can be used in combination. Problems dealing with workability needs to be eliminated by limiting the high aspect ratio fiber content without negotiating the properties such as ductility and strength in concrete. Durability related problems can be balanced by adding one fiber to the other type of fiber.

C. Styrene Butadiene Rubber (SBR) Emulsion

Styrene Butadiene is a monomer which is capable of combining chemically with similar or different molecules to form a higher molecular weight compound. Styrene butadiene rubber (SBR), is formed from a copolymer of styrene and butadiene. SBR is a mixture of about 75% butadiene and 25% styrene.

1) *Objectives:* Experimental investigation is carried out to understand strength characteristics. If both fibers and polymer are used together in concrete, it may yield a highly effective construction material in terms of strength and durability. Hence this study is to determine the Compressive strength of Hybrid Fiber Reinforced Polymer Concrete.

Design of concrete mix is done in accordance with Indian code of practice IS: 10262-2009.

II. METHODOLOGY

Following table shows design mix proportion for M30 grade concrete

Cement	Fine aggregate (M sand)	Coarse aggregates	Water
375 Kg/m^3	762 Kg/m^3	1165 Kg/m^3	150 Kg/m^3
Ratio			
1	2	3.1	0.4

In the present work the following materials have been used to cast the specimens.

1) Ordinary Portland Cement (53 Grade) confirming to IS: 12269-1987
2) M sand
3) Coarse aggregate with maximum particle size 20mm, confirming to IS: 383-1970
4) Potable water for mixing and curing of concrete
5) The fibers used are Crimped Steel Fibers of effective length 50mm and equivalent diameter 1mm having the aspect ratio of 50.
6) Styrene Butadiene Rubber (SBR) was used as a polymer
7) Chemical Admixture: Super Plasticizer Conplast-SP430.

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III.RESULTS AND DISCUSSION

A. Workability Test Results

Workability of concrete is tested by conducting slump test. The results of workability tests on different combination of hybrid fiber reinforced concrete with different percentages of polymer are presented in table 1 and their variations are plotted in the figure 1.

Table 1: Workability test results of Crimped + Hooked End

Percentage of polymer added	Slump (mm)
	Crimped + Hooked End
0	75
5	77
10	79
15	80
20	79
25	78

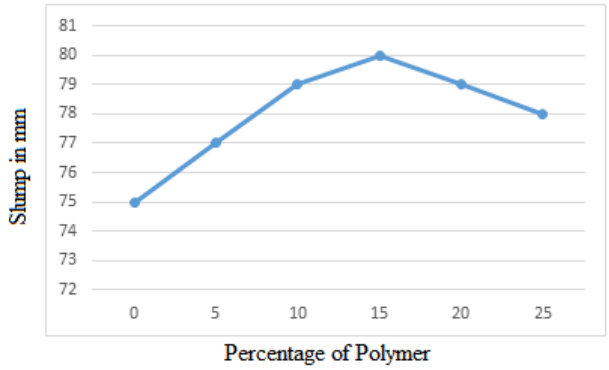


Figure 1: Variation of Slump of fiber reinforced concrete with varying percentage of polymer

From table 1, it is seen that workability of hybrid fiber reinforced concrete of Crimped + Hooked End fiber reinforced concrete had increased with increase in polymer quantity up to 15%, after which it has declined as measured from slump. Therefore at polymer content of 15% maximum workability is achieved.

B. Compressive Strength Test Results

The test results obtained for compressive strength of hybrid fiber reinforced concrete are presented in table 2 to 4 and their variations are plotted in figure 2 to 4 for 7, 14 and 28 days.

Table 2: Compressive strength test results of (Crimped fiber + Hooked End Fiber) Reinforced Concrete for 7 days

Percentage of polymer added	Load (kN)			Average load (kN)	7 days compressive strength (MPa)
	Trial 1	Trial 2	Trial 3		
0	573.1	560	551.3	561.47	24.95
5	612.4	641.9	621.1	625.13	27.78
10	654.9	678.9	690.1	674.63	29.98
15	718.9	720.4	708.11	715.80	31.81
20	689.6	702.42	691.1	694.37	30.86
25	652.9	661.7	675	663.20	29.48

(Quantity of Fibers: Crimped Fibers = 37.8 g, Hooked End Fibers = 37.8 g)

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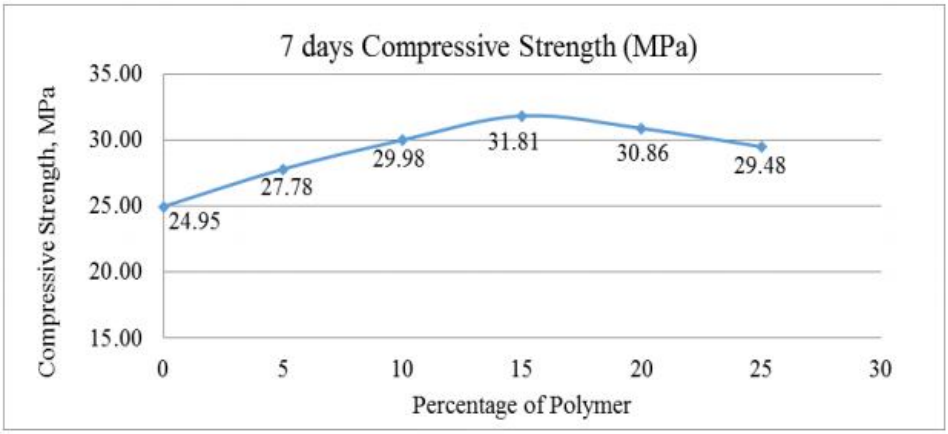


Figure 2: Variation of Compressive strength of (Crimped fiber + Hooked End Fiber) reinforced concrete for 7 days with varying percentage of polymer

The compressive strength of HFRC for (Crimped fiber + Hooked End Fiber) combination enhances with increase in polymer quantity up to 15% and decreases beyond that.
From table 2, it is observed that maximum strength of HFRC is 31.18 MPa. Change in strength with respect to polymer quantity is graphically denoted in the figure 2

Table 3: Compressive strength test results of (Crimped fiber + Hooked End) Fiber Reinforced Concrete for 14 days

Percentage of polymer added	Load (kN)			Average load (kN)	14 days compressive strength (MPa)
	Trial 1	Trial 2	Trial 3		
0	677.0	664.0	656.2	665.73	29.59
5	337.31	493.06	587.67	472.68	32.26
10	617.43	641.08	660.66	639.72	32.76
15	681.59	698.75	711.24	697.19	34.32
20	718.25	725.01	730.36	724.54	34.63
25	732.86	735.06	737.38	735.1	34.55

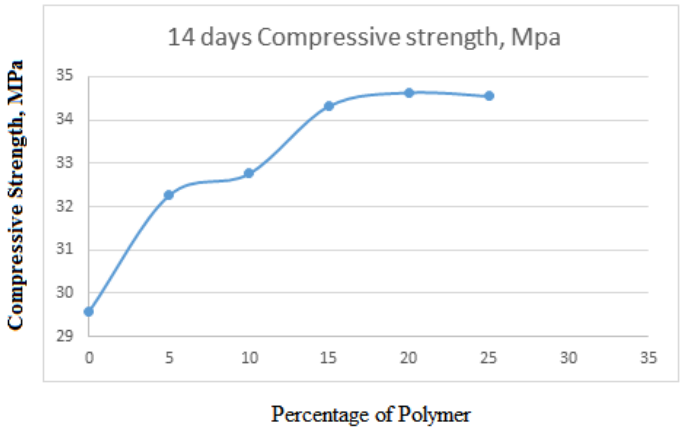


Figure 3: Variation of Compressive strength of (Crimped fiber + Hooked End Fiber) reinforced concrete for 14 days with varying percentage of polymer

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The compressive strength of HFRC for (Crimped fiber + Hooked End Fiber) combination enhances with increase in polymer quantity up to 15% and beyond that .

From table 3, it is observed that maximum strength of HFRC is 34.63MPa. Change in strength with respect to polymer quantity is graphically denoted in the figure 3

Table 4: Compressive strength test results of (Crimped fiber + Hooked End Fiber) Reinforced Concrete for 28 days

Percentage of polymer added	Load (kN)			Average load (kN)	28 days compressive strength (MPa)
	Trial 1	Trial 2	Trial 3		
0	884.9	872.2	866.1	874.40	38.86
5	926.3	913.4	942.9	927.53	41.22
10	988.6	991.1	1013	997.57	44.34
15	1109.4	1118.7	1048.5	1092.20	48.54
20	1007.1	1013.3	1017.7	1012.70	45.01
25	997.4	981.4	972.8	983.87	43.73

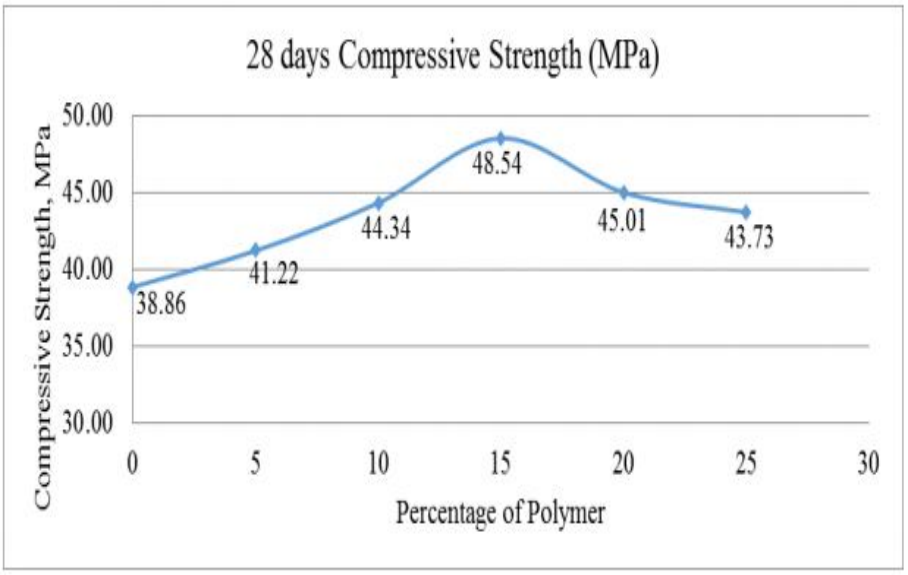


Figure 4: Variation of Compressive strength of (Crimped fiber + Hooked End Fiber) reinforced concrete for 28 days with varying percentage of polymer

The compressive strength of HFRC for (Crimped fiber + Hooked End Fiber) combination enhances with increase in polymer quantity up to 15% and decreases beyond that. From table 4, it is observed that maximum strength of HFRC is 48.54 MPa. Change in strength with respect to polymer quantity is graphically denoted in the figure 4.

IV. CONCLUSIONS

The following conclusions can be drawn.

A. The workability of hybrid fiber reinforced concrete of unique combination such as Crimped + Hooked End had enhanced with increase in polymer quantity up to 15%, after which it has declined as measured from slump. Therefore at 15% of polymer content maximum workability is achieved for Crimped + Hooked End fiber combination.

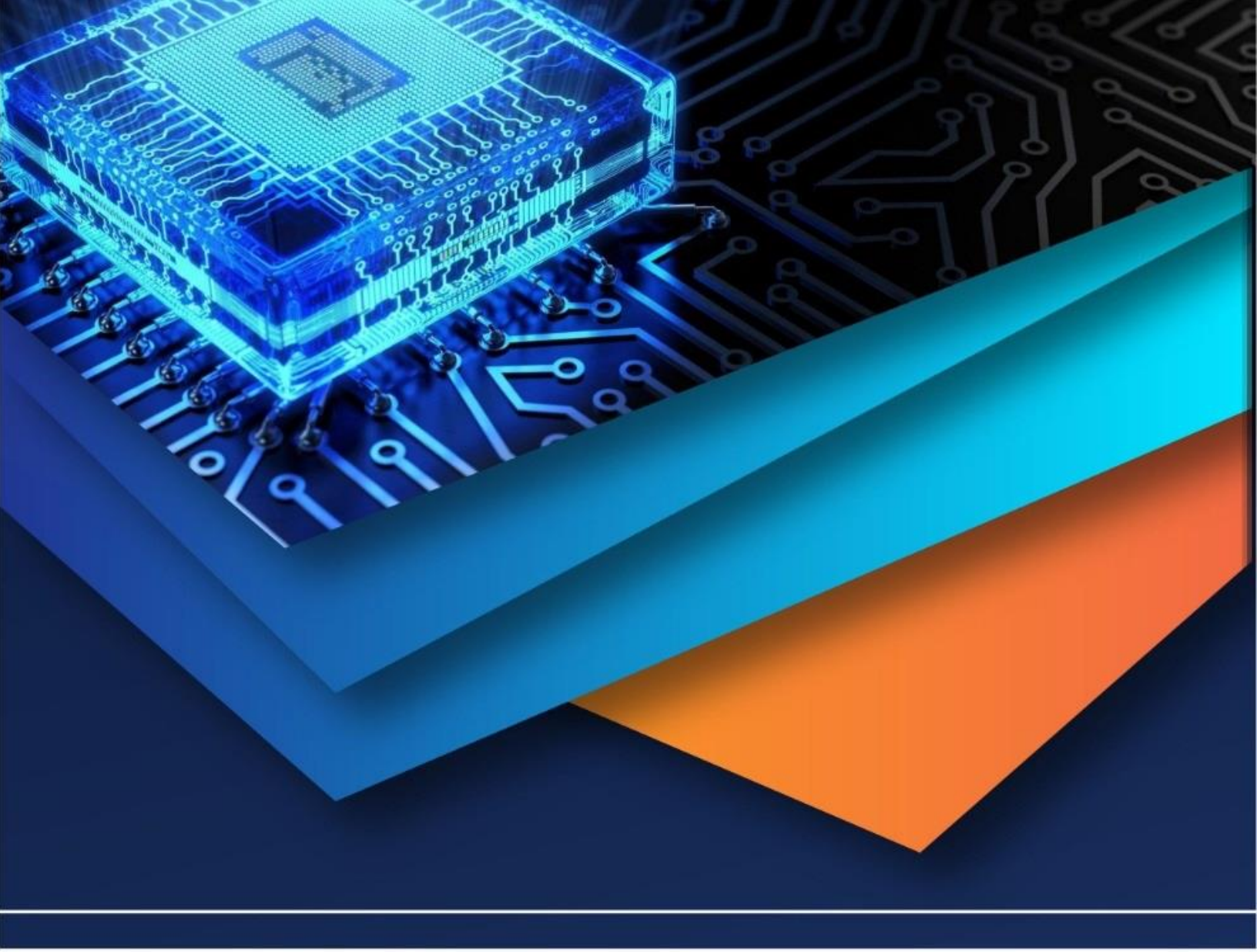
B. The compressive strength of HFRC increases with increase in the amount of polymer quantity up to 15% and further decreases beyond that. The compressive strength of Crimped + Hooked End fiber combination was found to be 31.81 Mpa ,34.63 Mpa and 48.54 Mpa for 7,14 and 28 days respectively.

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REFERENCES

[1] Mohammad Ismail, Bala Muhammad, JamaluddinMohdYatim, AinulHaezahNoruzman and Yong Woo Soon. "Behaviour of Concrete with Polymer Additive at Fresh and Hardened States", Procedia Engineering 14 (2011), pp. 2230 - 2237.
[2] Abdulrahman Mohammed, MoncefNehdi and AihamAdawi. "Recycling WasteLatex Paint in Concrete with Added Value", ACI Materials Journal, Volume 105, No. 4, July – August 2008, pp. 367 – 374.
[3] Dr.Mahdi Saleh Essa and Nada Flah Hassan. "Effects of Adding Styrene Butadiene Rubber Admixture (SBR) on Concrete Properties and Bond Between Old and New Concrete", Journal of kerbala University, Volume 6, No. 2, Scientific 2008.
[4] R. Radhakrishnan, Syam Prakash. V and C.K. Prasad VarmaThampan. "Performance of Styrene Butadiene Rubber as a Concrete Repair Material on Tropical Climate", International Journal of Advancement in Research & Technology, ISSN 2278-7763, Volume 1, Issue 6, November 2012, pp. 1 – 5.
[5] D.B. Mohite and S.B. Shinde. "Experimental Investigation on Effect of Different Shaped Steel Fibers on Compressive Strength of High Strength Concrete", IOSR Journal of Mechanical and Civil Engg, Volume 6, Issue 4 (2013), pp. 24 – 26.
[6] M. Tamil Selvi and Dr. T.S. Thandavamoorthy. "Studies on The Properties of Steel and Polypropylene Fiber Reinforced Concrete without any Admixture", ISO 9001:2008 Certified, International Journal of Engineering and Innovative Techhnology(IJEIT), Volume 3, Issue 1, July 2013.
[7] KolliRamujee. "Strength Properties of Polypropylene Fiber Reinforced Concrete",International Journal of Innovative research in science, Engineering and technology, ISO 3297: 2007 certified organization, Vol.2, Issue 8, Aug 2013.
[8] AmitRana. "Studies on Steel Fiber Reinforced Concrete", International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, ISO 9001:2008 certified journal, Volume 3, Issue 1, January 2013, pp. 120 – 127.
[9] YaghoubMohammadi and S.K. Kaushik. "Investigation of Mechanical Properties of Steel Fiber Reinforced Concrete with Mixed Aspect Ratio of Fibers", Volume 33, No. 1, January 2003, pp. 1 – 14.
[10] D.V. Soulioti, N.M. Barkoula, A. Paipetis, T.E. Matikas. "Effects of Fiber Geometry and Volume Fraction on the Flexural Behavior of Steel Fiber Reinforced Concrete", Strain (2011) 47, pp. 535 – 541.
[11] Mohammad Adnan Farooq And Dr Mohammad Shafi Mir. International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, ISO 9001:2008 certified journal, Volume 3, Issue 2, February 2013, pp. 75 – 79.
[12] Saeed Ahmed, Imran A Bukhari, Javed Iqbal SIddiqui and Shahzad Ali Qureshi., 31stConference on OUR WORLD IN CONCRETE & STRUCTURES in Singapore, 16 – 17 August 2006. http://cipremier.com/100031008.
[13] A. Shivakumar and Manu Santhanam. "Mechanical Properties of High Strength Concrete Reinforced with Metallic and Non-MetallicFibers", Cement and concrete compesites, Volume 29, March 2007, pp. 603 – 508.
[14] Mustafa Sahmaranand I. OzgurYaman. "Hybrid Fiber Reinforced SelfCompacting Concrete with a High-Volume Coarse Fly Ash", Construction and Building Materials 21 (2007), pp. 150 - 156.
[15] Bureau of Indian Standards 12269:1987. "Ordinary Portland Cement, 53 Grade –Specification"
[16] Bureau of Indian Standards 383:1970. "Specification for Coarse and Fine Aggregates from Natural Sources for Concrete"
[17] Bureau of Indian Standards 10262:2009. "Concrete Mix Proportioning- Guidelines"

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