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Characterization of High Strength Concrete Pavement with steel fibre & silica fume

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Abstract— Steel Fibre reinforced concrete (SFRC) are maximizes the ductility of Concrete after adding in Concrete and Silica fume increases the density of Concrete[2]. In this investigation we have to determine the combined effect of Steel fibre and silica fume, the main focus of this studies is that to improve the mechanical properties here we use 80 aspect ratio of steel fibre [1] Expansion diverse level of steel fibre and distinctive rate silica smoulder by weight of concrete substance. The droop cone strategy is utilized to decide usefulness [2].By Conducting the experimental test we can determine the flexural strength of steel fibre which is harden concret test[3]. Plain solid asphalts have low flexural quality and strain limit; By utilizing fibre basic qualities are improved and likewise permits decrease of the thickness of the asphalt layer. These better properties are impressive and constrained by qualities of fiber and rate by reducing the thickness of pavement we can minimize the thickness of pavement and gives solidness. Fragility of cement diminished by expansion of steel fiber and density of concrete improves by addition of silica fume. Else it will be brittle in nature. Improvement in such mechanical properties like flexural strength gives better performance in their life span. It will be beneficial for long term operation on Concrete roads[10].

Keywords— Steel fibre, Silica fume, cement, Composite, physical properties, concrete properties

I. INTRODUCTION

Steel strands utilized in concrete from 1990s.As per IRC:SP:46-1997 steel filaments have identical distances across dependent on cross-sectional territory which is lies between 0.015 cm to 0.2 cm and lengths from 0.7 cm to 7.5 cm. Normally aspect ratio is kept between 20 to 100. The aspect ratio is defined as the ratio between length of fibre to the equivalent diameter of the fibre, [4].

Unbending asphalts are so named in light of the fact that the asphalt structure avoids next to no under stacking because of the high modulus of versatility of their surface course

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High strength concrete having more load carrying capacity than ordinary concrete. Performances of concrete specimens reinforced with either steel or macro-synthetic fibres under three-point bending. Steel fibres are often used to improve the flexural toughness of concrete and are used in various structural applications while synthetic fibres are more often used to reduce crack opening due to shrinkage. Macro-synthetic fibres have been proposed more recently with the aim of creating an alternative to steel fibres in structural applications but their use is still limited. In general steel fibres were more efficient in increasing the toughness of concrete than macro-synthetic fibres, even though their results were significantly more scattered.[5]. Concretes containing steel fibre have been shown to have substantially improved resistance to impact and greater ductility of failure in compression, flexure and torsion. It has been extensively used for overlay roads, airfield pavements and bridge decks. Extensive research work has been carried out in the field of concrete by using every type of fibres. Steel fibre is one of the most commonly used fibre [6].

As of late the utilization of Steel fiber and Silica rage in concrete in development has been expanded. The assurance of properties of steel fibre and silica seethe The performance of High strength depends on the ingredients of the concrete and mix design, admixtures, mixing methods, placement of steel fibre curing efficiency.Bleeding phenomenon is reduced by addition of stel fibre and silica fume [1].

II. OBJECTIVES

A. Submission of the paper

The proposed work has the objective of started below.

1. To find optimum Steel fibre Percentage for maximum strength of concrete.
2. To determine the flexural strength of Concrete at 1/2 position from top
3. To determine the flexural strength of Concrete at 2/3 position from top
4. To determine Correlation regression relation equation.

In this area dialog about exploratory work are completed. The materials and their properties, blend extents have been depicted.

III. MATERIALS

A) Steel fibre:

Steel fibre used for steel fibre reinforced concrete having aspect ratio 80 is used. It is circular in shape in cross section. It is hooked end type steel fibre. Using steel fibre enhances the static flexural strength, fatigue resistance and shear strength. It also improves torsional strength and toughness. By applying SFRC, it is possible to minimize the crack width highly corrosive environment. The concrete becomes more ductile and its resistance to crack formation increases tremendously. The uniform distribution of steel fibres in the concrete ensures three dimensional reinforcement. The complete elimination of wire mesh in shotcrete leads to easy handling cost saving and term reliability.

FIG - STEEL FIBRE

Table: Physical and mechanical properties of steel fibre.

Sr. No.	Properties	Result
1	Diameter	0.6 mm
2	Specific Gravity	7.9
3	Length	48 mm
4	Aspect ratio	80
5	Tensile strength	370 MPa
6	Modulus of Elasticity	2 X 10^5MPa
7	Modulus of Rigidity	0.769 X 10^5Mpa
8.	Coefficient of thermal expansion	12 X 10-6 / 0C

B) Silica fume

Silica fume has been recognized as a pozzolanic admixture that is effective in greatly enhancing mechanical properties. The addition of silica fume in concrete improves the latter's durability by reducing permeability and refining pore structure, leading to a reduction in diffusion of harmful ions and calcium hydroxide content , resulting in greater resistant to sulphate attack. [7].

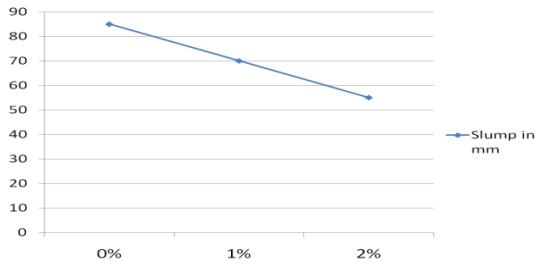
FIG - SILICA FUME

IV. CONCRETE TESTING

Table: Test results of slump cone test

% of steel fibre	0 %	1 %	2 %
Slump in mm	85	70	55

Graph: Graph showing test results of slump cone test



Graph represents that as percentage of steel fibre increases Workability will be decreases

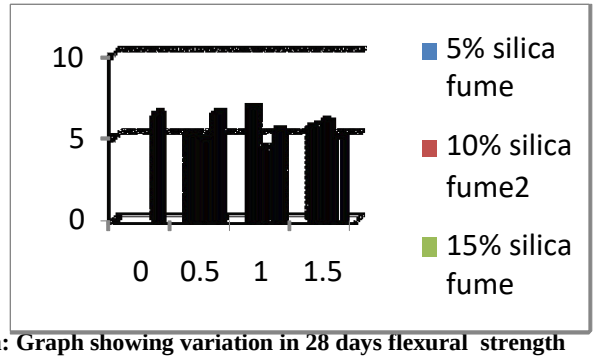
Flexural strength test of concrete can be conducted by using centre point loading method as per following formula.

$$\textbf{Flexural Strength (N/mm}^2\textbf{)} = \frac{P\,l}{b \times d^2}$$

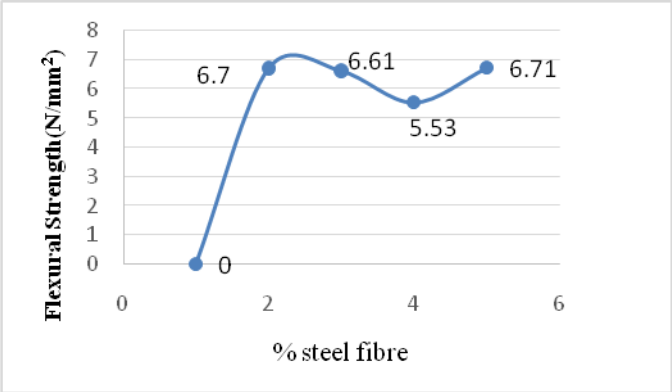
Here, p = load at failure (N)
l = length of beam specimen (mm)
b = breadth of beam specimen (mm)
d = depth of beam specimen (mm)

Table: Result showing variation in 28 days Flexural strength for 1/3rd position of steel fibre :

% steel fibre	% of Silica fume	Aspect ratio	Position of fibres	Load (KN)	Displacement at failure (mm)	Flexural strength (N/mm^2)	Average flexural strength (N/mm^2)
0.0		80	1/3 rd position	29.4	1.0	6.09	6.45
				33.1	1.3	6.86	
				30.9	1.1	6.40	
0.5	5			18.8	1.9	3.89	5.17
				30.78	1.4	6.38	
				25.3	1.5	5.24	
	10			16.24	1.6	3.36	4.92
				25.78	2.0	5.34	
				29.27	1.4	6.07	
	15			23.03	0.7	4.77	6.58
				39.00	1.3	8.08	
				33.49	0.9	6.9	
1	5			22.59	2.7	4.68	5.84
				33.37	3.3	6.92	
				28.57	3.1	5.92	
	10			18.14	1.6	3.76	4.38
				23.85	2.2	4.94	
				21.48	1.9	4.45	
	15			28.12	2.9	5.83	5.49
				25.12	3.2	5.12	
				26.64	3.0	5.52	
1.5	5			28.46	2.0	5.90	5.71
				26.38	2.6	5.47	
				27.78	1.7	5.76	
	10			28.26	3.2	5.86	6.04
				30.16	4.1	6.25	
				28.98	3.5	6.01	
	15			21.49	3.6	4.45	5.04
				28.44	2.7	5.89	
				23.12	3.1	4.79	



Graph: Graph showing variation in 28 days flexural strength for randomly mixed steel fibre and silica fume

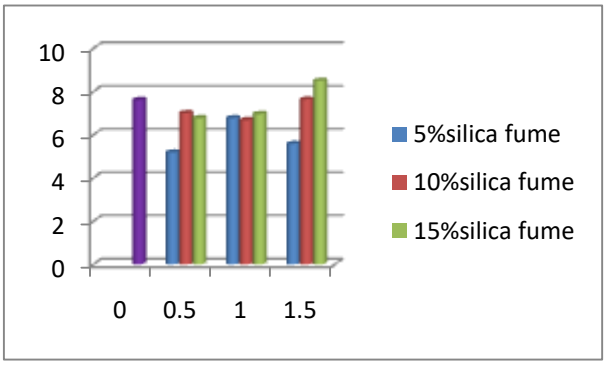


On the basis of above result we get following regression equation,

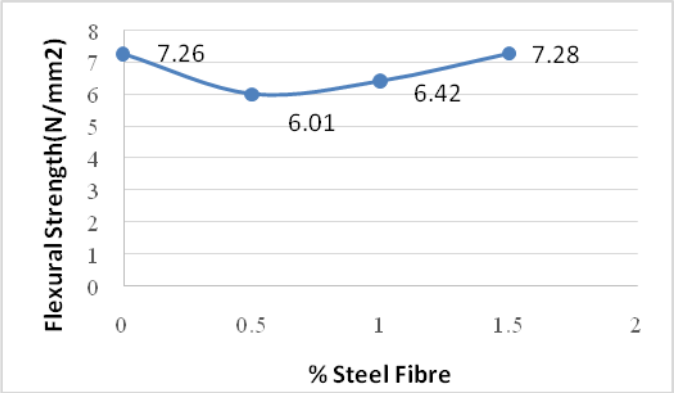
$$y = -0.8593x^2 + 6.3807x - 4.58$$

Table: Result showing variation in 28 days Flexural strength for 2/3rd position of steel fibre :

% steel fibre	% of Silica fume	Aspect ratio	Position of fibres	Load (KN)	Displacement at failure (mm)	Flexural strength (N/mm^2)	Average flexural strength (N/mm^2)
0.0		80	2/3rd position	38.71	0.8	6.88	7.61
				43.02	1.1	7.64	
				40.12	0.9	8.32	
0.5	5			21.67	2.6	3.85	5.18
				33.43	3.2	5.94	
				27.84	3.0	5.77	
	10			33.49	3.7	5.95	7.00
				41.10	3.4	7.3	
				37.48	3.6	7.77	
	15			37.48	3.2	6.66	6.77
				36.12	3.9	6.42	
				34.87	4.0	7.23	
1	5			36.84	3.8	6.54	6.68
				35.25	4.7	6.26	
				34.98	4.8	7.25	
	10			37.19	4.3	6.61	6.96
				37.32	3.6	6.63	
				36.96	4.4	7.66	
	15			34.62	2.9	6.15	6.58
				35.72	3.2	6.35	
				34.94	3.0	7.24	
1.5	5			34.33	2.4	6.10	6.84
				38.91	3.3	6.91	
				36.24	2.8	7.51	
	10			42.12	4.1	7.48	7.63
				39.12	4.3	6.95	
				40.86	4.2	8.47	
	15			45.02	4.9	8.00	8.5
				46.88	6.2	8.33	
				45.49	5.0	9.43	



Graph: Graph showing variation in 28 days Flexural strength for 2/3rd position of steel fibre and silica fume.



On the basis of above result we get following regression equation,

$$y = 2.11x^2 - 3.071x + 7.1995$$

V. CONCLUSION

a) 1.5 % of steel fibre in concrete gives higher strength than other percentage combination which improves the ductility of concrete.
b) Silica fume at 15% gives more strength to concrete by increasing density of concrete.
c) Concrete of 2/3rd Position steel fibre gives less strength than 1/3rd placed steel fibres as more tensile load acts on that position.
d) Displacement in 1/3rd position steel fibre concrete behaves more brittle which gives more displacement during loading than 2/3rd position steel fibre concrete
e) Micro silica is work as admixture like super plasticizer which enhances the workability of concrete and provides good finishing to concrete.
Regression equation gives analytic representation of strength of harden concrete which is helpful to determine outcome of the experimental work.

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REFERENCES

1. S.Gopalkrishanan “Mix proportion and properties of steel fibre reinforced roller-compacted concrete for pavement”.
2. M. Gulfam Pathan. “Experimental Study on Steel Fibre Reinforced Concrete”
3. Ravindra V. Solanki “Structural strength enhancement of rigid pavement using scrap steel fibre reinforcement”
4. Abdul Ghaffar, Amit S. Chavhan, DrR.S.Tatwawadi," Steel Fibre Reinforced Concrete", International Journal of Engineering Trends and Technology (IJETT) .
5. Eva Latifa et al “Performance of Steel Fiber Concrete as Rigid Pavement”.
6. Kota Sai Krishna. “Strength Characteristics of Concrete Using Eco-Friendly Materials”.
7. Shetty M.S. “Concrete technology”, Fibre reinforced concrete
8. Amit Rana," Some Studies on Steel Fiber Reinforced Concrete"
9. Yu-Chen, Ou, Tsai, Mu-Sen and Chang, Kuang-Yen Liu and Kuo-Chun.“Compressive Behaviour of steel –Fiber- Reinforced Concrete With a High Reinforcing Index”. Journal of Materials in Civil Engineering; Vol. 24, No. 2, pp.207-215, 2012.S. Gopalkrishanan Research paper on “Mix proportion and properties of steel fibre reinforced roller-compacted concrete for pavement”.
10. Majid Jaral Research paper on “Structural strength enhancement of rigid pavement using scrap steel fibre reinforcement
11. S Johnston, C. D.“Fibre-Reinforced Cement and Concrete”. Advance in concrete technology, Vol. 03, pp.185-187, 2006.
12. Roger M. Larson and Kurt D. Smith, (2009) Research paper on “Minimum concrete cover, and with the bottom of the reinforcement being at or above the mid-depth of the slab”
13. Nihal Arıoglu, Z., Girgin, Canan and Arıoglu, and Ergin.“Evaluation of Ratio between Splitting Tensile Strength and Compressive Strength for Concretes up to 120 MPa and its Application in Strength Criterion”. ACI Materials Journal, V. 103, No. 1, 2006.
14. IS:10262-2009 Concrete Mix Proportioning –Guidelines (First revision)
15. R.S. Olivio and F.A. Zuccarello (2010) Lying both mix design and fibre length”.
16. Niranjana, G., Mathew, S. and Jayabalan, P., (2000), “Structural Strength Enhancement of Rigid Pavement Using Scrap Steel Fiber Reinforcement”.
17. ACI method code for mix design used is ACI 211.4R-93

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