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INFLUENCE OF SILICA FUME & STEEL FIBER ON MECHANICAL PROPERTIES OF HARDENED CONCRETE

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Abstract: The experimental work is carried out on concrete due to the effect of silica fume with and without steel fibers. In this research we used different concrete mixes with micro silica of 0%, 5%, 7.5%, 10%, 12.5%, 15% and 20% by the volume of concrete for M35 grade concrete. The optimum percentage of micro silica to give maximum compressive strength, flexural strength & tensile strength was found to be 12.5%. With the addition of straight steel fibers of diameter 0.5mm and length 12mm with aspect ratio 24, the various percentages as 0.2%, 0.4%, 0.6%, 0.8%, 1.0% and 2% to the optimized percentage of micro silica (i.e., 12.5) to determine the mechanical properties of concrete.

Keywords: *Silica Fume, Steel Fiber, Compressive Strength, Flexural Strength, Tensile Strength, SCC*

application. -- --

I INTRODUCTION

There are many kinds of fibers, both metallic and polymeric, which have been used in concrete to improve specific engineering properties of the material. Steel fibers are used in a wide range of structural applications, in general, when the control of concrete cracking is important such as industrial pavements precast structural elements and tunnel linings. Steel fibers have high elastic modulus and stiffness and pro-duce improvements in compressive strength and toughness of concrete. Improvements in flexural strength of the material are also obtained by the use of steel fibers in concrete. Increase in flexural strength is achieved with increasing fiber aspect ratio (length to diameter ratio) and fiber volume fraction; significant improvements are obtained at high volume fractions. In general, addition of steel fibers influences the compressive strain at ultimate load and ductility in flexure more significantly than the improvements in strength. Steel fibers, however, in-crease structure weight of concrete and exhibit balling effect during mixing, which lowers the workability of the mix. In addition, steel fibers easily basset and rust, and it also has the problem of conductive electric and magnetic fields. Self-compacting concrete has been depicted "the most progressive improvement in concrete development for a very long while". Initially created in Japan to balance a developing deficiency of talented work, it has proved to be beneficial from the following points. Speedier development, Reduction in site labor, Better surface, Easier putting, Improved durability, Greater flexibility in outline, Thinner concrete sections, reduced noise level, Safer working environment. Self-Compacting Concrete (SCC) can flow under its own weight and totally fill the casing, even within the sight of congested reinforcement, with no compaction, while keeping up homogeneity of the Concrete. Compaction is hard to be done in conditions where there are dense reinforcement and large placing area. Utilization of SCC will defeat the troublesome throwing conditions and diminish labor required. The addition fibres in concrete enhance the tensile strength, flexural strength, impact strength, toughness, drying shrinkage, and failure pattern of the concrete. Including fibres enhances the mechanical qualities and additionally the ductility of SCC as a similar way simply like vibrated concrete. As a result of the predominant execution of SCC in its new state, insertion of fibres will prompt a more uniform scattering of fibres which is exceptionally basic for the execution of any fibre reinforced. Synthetic fibres are less stiff than steel fibres and are most typically used in industrial pavements to reduce the cracking induced by shrinkage. Synthetic fibres are mainly effective in reducing crack formation, particularly at an early stage of the cast and in severe weather conditions (e.g. in dry climatic zones), when hygrometric shrinkage brings along some weak tensile stress which is yet too high for the fresh mixture to withstand. Synthetic fibers made using nylon Polypropylene and acrylic are available commercially. Polypropylene fibers are available in two different forms; Monofilaments and Fibrillated. Monofilament fibers are single strand of fibers having uniform cross-sectional. Fibrillated fibers are manufactured in the form of films or tapes that are slit in such a way that they have net like physical structure. Polypropylene fibers have good ductility, fineness, and dispersion so they can restrain the plastic cracks.

II. MATERIAL USED

2.1 Cement: Portland Pozzolana cement (PPC) is used in this research work.

2.2 Sand: Sand is available near Narmada River. This sand is used for the above research work.

Table 1: Chemical composition of micro silica

Properties	Observed value
Silica oxide	91%-97%
Aluminium tri oxide	0.7 -3.1%
Ferrous Oxide	0.4-0.9%
Magnesium Oxide	0.5-1.2%
Calcium oxide	0.2-0.7%
Potassium Oxide	0.4-0.8%
Calcium	0.6-1.5%
Loss on Ignition	Maximum 1.6%

2.3 Natural aggregate: 20 mm natural coarse aggregate is used having a specific gravity of 2.72.

2.4 Silica Fume (Micro Silica): Micro silica is a result se of high-purity quartz with coke in stimulating arc furnaces in the manufacture of silicon and ferrosilicon alloys: Chemical Composition of micro silica is as follows

2.5 Straight Steel Fiber: These Steel fibers are nothing but the pieces of steel wire from 0.3 to 1.1 mm in dia and these are having length 50 mm. These steel fiber are used in three-dimensional reinforcement of concrete and replaces steel mesh.

III. METHODOLOGY

3.1 Mix Design for M-.35 Grade: The proportion of M-35 grade concrete is calculated as per IS 10262-2009 & IS 456-2000 is 1:2.05:3.20. Water binder ratio is taken as 0.42.

3.2 Compressive Strength Test: The mould is prepared for cubes used in the compression test having a size of 0.15mX0.15mX0.15m. After preparing cubes rest on the compression testing machine and load is applied. After applying load the value noted from the dial gauge. Compressive strength determine at 7 & 28 days.

3.3 Flexural Strength Test: The mould is prepared for beams used in the bending test having a size of 0.10mX0.10mX0.50m. After preparing beams rest on the flexural testing machine and load is applied. After applying load the value noted from the dial gauge. Bending strength determine at 7 & 28 days

3.4 Split Tensile Strength: The mould is prepared for cylinder used in the tensile test having a size of 0.15m diameter and 0.30m height. After preparing cylinder rest on the compression testing machine and load is applied. After applying load the value noted from the dial gauge. Tensile strength determine at 7 & 28 days

IV. RESULTS & DISCUSSION

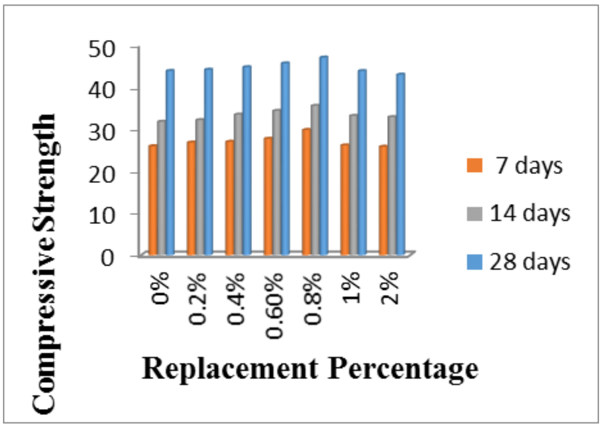
4.1 Compressive Strength; The below table shows the compressive strength for different percentage of Steel fiber which is vary from 0%-2.0%..

.Table 2: Compressive Strength Result

Mix Design	% Steel Fiber	7 days Compressive Strength	14 days Compressive Strength	28 days Compressive Strength
Mix-01	0	25.97	31.8	43.90
Mix-02	0.2	26.85	32.2	44.20
Mix-03	0.4	27.03	33.5	44.80
Mix-04	0.6	27.75	34.4	45.70
Mix-05	0.8	29.85	35.6	47.10
Mix-06	1.0	26.18	33.2	43.88
Mix-07	2.0	25.85	32.9	43.02

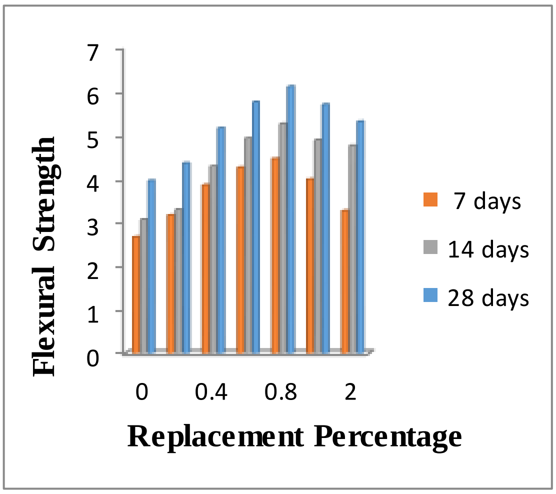
Table 3: Flexural Strength Result

Mix Design	% Steel Fiber	7 days Flexural Strength	14 days Flexural Strength	28 days Flexural Strength
Mix-01	0	2.65	3.05	3.95
Mix-02	0.2	3.15	3.28	4.35
Mix-03	0.4	3.85	4.28	5.15
Mix-04	0.6	4.25	4.92	5.75
Mix-05	0.8	4.45	5.25	6.10
Mix-06	1.0	3.98	4.88	5.69
Mix-07	2.0	3.25	4.75	5.30



Graph: 1. Compressive Strength in N/mm^2

4.3 Flexural Strength The below table shows the Bending strength for different percentage of Steel fiber which is vary from 0%-2.0%.

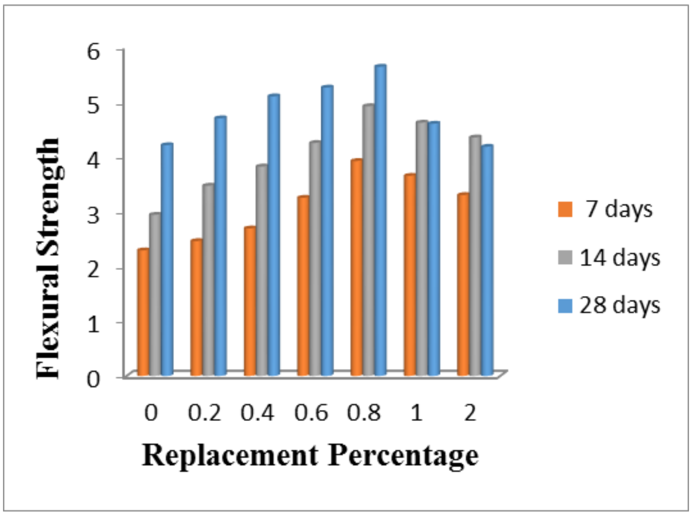


Graph:2 Flexural Strength in N/mm^2

4.4 Split Tensile Strength The below table shows the tensile strength for different percentage of Steel fiber which is vary from 0%-2.0%.

Table 4: Tensile Strength Result

Mix Design	% Steel Fiber	7 days Split Tensile Strength	14 days Split Tensile Strength	28 days Split Tensile Strength
Mix-01	0	2.29	2.94	4.21
Mix-02	0.2	2.46	3.47	4.70
Mix-03	0.4	2.69	3.82	5.10
Mix-04	0.6	3.25	4.25	5.26
Mix-05	0.8	3.92	4.92	5.64
Mix-06	1.0	3.65	4.62	4.60
Mix-07	2.0	3.30	4.35	4.18



Graph 3: Split Tensile Strength in N/mm^2

V. CONCLUSION

From the above research work the conclusion are as follows

1. The 7, 14 and 28 days compressive strength of self-compacting concrete with Straight Steel Fibers is maximum at 0.8%. The maximum increase in compressive strength was upto 9% at 28 days
2. The 7, 14 and 28 days flexural tensile strength of self-compacting concrete with Straight Steel Fibers is maximum at 0.8%. The maximum increase in flexural strength was upto 35% at 28 days
3. The 7, 14 and 28 days split strength of self-compacting concrete with Straight Steel Fibres is maximum at 0.8%. The maximum increase in tensile strength was upto 25.35% at 28 days
4. As the percentage of steel fibers increases, the percentage of tensile strength and flexural strength properties increases more than the compressive strength

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