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EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF CEMENT BY SILICA FUME IN ADDITION WITH FIBRE

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Abstract - This paper presents the study of silica fume and its influences on the properties of recent concrete additionally with steel fibre. The use of silicon oxide fume had major impact on industries, ability to habitually and commercially turn out silica fume changed concrete of flow in a position in nature however nonetheless stay cohesive, that successively produces high early and later age strength as well as immune to aggressive environments. We replaced silica fume to replace 9%, 10% & 11% of cement additionally of 0.5% of steel fibre.

Index Terms – Cement , Course Aggregate, Silica Fume, Fibre.

INTRODUCTION

The main aim of our study is the partial replacement of cement in concrete by Silica fume and in addition with fibre to study the compressive strength and the tensile strength of concrete which is one of the most important fundamental property of concrete. For determining the compressive strength of M20 grade concrete by partial replacement of cement by Silica fume from 9% ,10% &11% with addition with 0.5% steel fibre and the obtaining result is compared with the conventional concrete.

MATERIAL PROPERTIES:

1. **SILICA FUME**
2. **STEEL FIBRE**

SILICA FUME

Silica fume (SF) is a by-product of the smelting process (reduction of high-purity quartz with coal in electric furnaces) in the production of silicon and ferrosilicon alloys. It is also collected as a by-product in the production of other silicon alloys such as ferromanganese, ferromagnesium, ferrochromium, and calcium silicon (ACI 226-3R-87). It contains extremely fine amorphous particles of silicon dioxide (SiO_2) which usually make up more than 90% of SF constituents. SF is also known as micro silica, volatized silica, and condensed SF or silica dust. SF, because of its extreme fineness and high silica content, has been recognized as a pozzolanic material conforming to specifications of ASTM C1240 for use as supplementary cementitious material in cement mortar and concrete to enhance mechanical and durability properties. According to the Florida Department of Transportation, the quantity of SF should be between 7% and 9% by mass of cement replacement for mortar and concrete production (Panjehpour et al., 2011). The use of SF is well established in concrete industries throughout the world and, perhaps, represents the most deeply entrenched and accepted use of industrial by-products in the construction industry.

PHYSICAL PROPERTIES OF SILICA FUME

SL NO	PARTICULARS	VALUES
1	Fineness modulus	2000m^2/kg
2	Bulk modulus	240kg/m^3
3	Specific gravity	2.2

CHEMICAL PROPERTIES OF SILICA FUME

SL NO	PARTICULARS	OPC	VALUES
1	Silicon dioxide	20.25 %	85
2	Aluminium oxide	5.04 %	1.12
3	Iron oxide	3.16 %	0.2 - 0.8
4	Sodium oxide	0.08 %	0.5 – 1.2S

STEEL FIBRE

When steel fibre is mixed in concrete, less benefit is obtained for compressive conditions, but more benefit for tensile condition and the maximum benefit for flexural condition are obtained for the fibre concrete, and its advantages of confining crack and increasing toughness are more important than the increment of strength.

FINE AGGREGATE:

Sand was collected from nearby river Zone-III is used as a fine aggregate is passed through the sieve of 4.75mm. IS: 383(1970) is followed for fine aggregate.

COARSE AGGREGATE:

Coarse aggregates with nominal sizes of 12mm and 20mm maximum size obtained from the local crushing plants.

CEMENT:

Locally available Ordinary Portland Cement (OPC) of 53grade has been used .

WATER:

Water cement ratio (W/C) of 0.45 was used in the preparing of concrete and for this purpose portable water used for mixing and curing purpose.

METHODOLOGY:

The concrete mix design was done in accordance IS: 10262(1982). In this project we use M20 grade. By using this proportion value the volume of cement, fine aggregate and coarse aggregate are estimated. The Ordinary Portland Cement (OPC-53GRADE), Good stone aggregate and natural sand of Zone-III was used as coarse aggregate and fine aggregate. For this study cubes (150×150×150mm), cylinder (150mm dia&300mm height) were casted by replacement of cement by Silica fume and Steel fibre increasing the strength then further test are conducted such as workability then it will be casted.

CURING OF CONCRETE:

Casting of concrete after the completion of 24 hours mould will be removed then cured by using portable water. The specimen is fully immersed in portable water for specific age of 7, 14, 28 days. After the completion of curing it will be tested.

RESULTS AND TABLES:

TESTING ON HARDERNED CONCRETE

1.Compressive strength test

2.Split tensile strength test

3.Flexural Strength Test

COMPRESSIVE STRENGTH

S.NO	% of Silica Fume	% of Steel fibre	AVG. COMPRESSIVE STRENGTH (N/mm²)		
			7 days	14 days	28 days
1	0%	0%	13.05	18.00	19.80
2	9%	0.5%	14.10	19.10	20.15
3	10%	0.5%	14.40	19.70	20.80
4	11%	0.5%	14.05	19.25	20.30

SPLIT TENSILE STRENGTH

S.NO	% of Silica Fume	% of Steel fibre	AVG. SPLIT TENSILE STRENGTH (N/mm²)		
			7 days	14 days	28 days
1	0%	0%	1.01	1.55	2.10
2	9%	0.5%	1.15	1.70	2.35
3	10%	0.5%	1.20	1.73	2.42
4	11%	0.5%	1.10	1.62	2.31

CONCLUSION

(i) On the basis of present investigation, it can be concluded that, replacement of cement with silica fume upto 10% and steel fibre 0.5% of weight increases the compressive strength, splitting tensile strength

(ii) The Experimental work shows that properties of concrete M20 get improved due to incorporation of steel fibres with silica fume.

(iii) The Experimental work shows that workability of SFRC gets reduced as we increased the steel fibre percentage and silica content

(iv) The consistency of cement paste increases as the percentage of silica fume increases, maximum value we get is at 10 % of silica fume.

(v) The soundness of the paste decreases with increasing % of silica fume in cement paste.

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