SCC REPLACED WITH METAKAOLIN AND FOUNDRY SAND IN CEMENT AND FINE AGGREGATE

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ABSTRCT:

An attempt to know Compressive and Tensile strengths of Self Compacted Concrete with replacement Metakaolin and Foundry Sand in Cement and Sand. We prepared some types mixes to know it is suitable for construction. The results are compared to EFNARC and IS 456:200. The result shows us the concrete is able to use in construction.

INTRODUCTION:

The method for achieving self-compatibility involves not only high deformability of paste or mortar, but also resistance to segregation between coarse aggregate and mortar when the concrete flows through the confined zone of reinforcing bars. Homogeneity of SCC is the ability to remain in unsegregated condition during transport and placing. High flowability and high segregation resistance of SCC.

Because of the addition of a high quantity of fine particles, the internal material structure of SCC shows some resemblance to high performance concrete having self-compatibility in fresh stage, no initial defects in early stage and protection against external factors after hardening. Self-compacting concrete can be produced using standard cements and additives.

Three basic characteristics that are required to obtain SCC are: high deformability, restrained flowability and a high resistance to segregation. High deformability is related to the capacity of the concrete to deform and spread freely in order to fill all the space in the formwork. It is usually a function of the form, size, quantity of the aggregates and the friction among the solid particles, which can be reduced by adding a High Range Water Reducing Admixture (HRWRA) to the mixture. Restrained flowability represents how easily the concrete can flow around obstacles, such as reinforcement, and is related to the member geometry and the shape of the formwork. Segregation is usually related to the cohesiveness of the fresh concrete, which can be enhanced by adding mineral admixtures and viscosity modifying admixture along with a HRWRA.

The main characteristics of SCC are the properties in the fresh state. The mix design is focused on the ability to flow under its own weight without vibration, the ability to flow through heavily congested reinforcement under its own weight, and the ability to retain homogeneity without segregation. The workability of SCC is higher than “very high” degree of workability mentioned in 15 456:2000.

A concrete mix can only be classified as self-complicating if it has the following characteristics.

- Filling ability
- Flow ability
- Passing ability
- Segregation resistance

The present work aims the suitability of SCC within the replacement of Metakalion and Foundry Sand in Cement and Sand in construction. In view of this, an attempt has been made to analyze the study of SCC is in exact parameters or not which are given in EFNARC and IS 456 : 2000

METHODOLOGY :

Mix proportions of M30 grade of self-compacting concrete are calculated based on the EFNARC specifications and guidelines. For M30 Grade of SCC as per IS 10262-2009 code target compressive strength is 38.25 MPa. In this present work, water powder ratio is 0.438 and 0.48% of super plasticizer by weight of binder.

Hence by considering the required adjustments the following proportions are considered for M30 grade of SCC.

Mix Proportions of SCC considered is 1:0.438:1.672:1.543:0.006 that is
cement: water: fine aggregates: coarse aggregates: super plasticizer

Sl. No	Mix Type	Description
1	SCC	0% replacement
2	MK5	5% Metakaolin replaced with cement
3	MK10	10% Metakaolin replaced with cement
4	MK15	15% Metakaolin replaced with cement
5	MK20	20% Metakaolin replaced with cement
6	FS100	100% Foundry sand is used as FA
7	FS10	10% Foundry sand replaced with FA
8	FS20	20% Foundry sand replaced with FA
9	FS30	30% Foundry sand replaced with FA
10	FS40	40% Foundry sand replaced with FA
11	MK5+FS10	5% Metakaolin replaced with cement + 10% Foundry sand replaced with FA
12	MK10+FS20	10% Metakaolin replaced with cement + 20% Foundry sand replaced with FA
13	MK15+FS30	15% Metakaolin replaced with cement + 30% Foundry sand replaced with FA
14	MK20+FS40	20% Metakaolin replaced with cement + 40% Foundry sand replaced with FA

Mix type	Cement kg/m^3	MK Kg/m^3	w/c ratio	Water l/m^3	FA Kg/m^3	FS Kg/m^3	CA Kg/m^3	SP l/m^3
SCC	500	0	0.438	219	902.88	0	756.16	2.4
MK5	475	25	0.438	220.5	902.88	0	756.16	2.4
MK10	450	50	0.438	222	902.88	0	756.16	2.4
MK15	425	75	0.438	223.5	902.88	0	756.16	2.4
MK20	400	100	0.438	225	902.88	0	756.16	2.4
FS100	500	0	0.438	234.34	0	902.88	756.16	2.4
FS10	500	0	0.438	220.53	812.652	90.228	756.16	2.4
FS20	500	0	0.438	222.06	722.304	180.57	756.16	2.4
FS30	500	0	0.438	223.06	632.016	270.864	756.16	2.4
FS40	500	0	0.438	225.13	541.728	361.152	756.16	2.4
MK5+FS10	475	25	0.438	222.03	812.652	90.228	756.16	2.4
MK10+FS20	450	50	0.438	225.13	722.304	180.57	756.16	2.4
MK15+FS30	425	75	0.438	228.23	632.016	270.864	756.16	2.4
MK20+FS40	400	100	0.438	231.33	541.728	361.152	756.16	2.4

Where FS is Foundry Sand

MK is Metakaolin

RESULTS AND DISCUSSION:

- **Compressive Strength**

The concrete cube specimens of size150mm x 150mm x 150mm were placed in the compression testing machine and loaded. Loading at constant rate was applied on the specimen. The failure load obtained is the strength of the specimen. The average strength of set of three samples was taken as cube strength.

Compressive strength = P/A (N/mm^2)

P = Applied load (N)

A= Surface area = (b x d) = 150mm x 150mm;

b = breadth of the cube = 150 mm;

d = depth of the cube = 150 mm.

- **Split Tensile Strength**

The concrete cylinder of 150mm diameter and depth 300mm was casted. The cylinder was placed and loaded in compression testing machine. The load was applied gradually till the cylinder got failed. The failure load obtained was taken as the strength of the specimen. The average strength of the two samples was taken as cylinder strength.

Split tensile strength (σ_t) = 2P / b d (N/mm^2)

where, P = Applied load (Newton);

b = Diameter of the cylinder;

d = Depth of the cylinder.

Percentage increase or decrease of 28 days compressive strength compared with respect to the SCC mix that is without replacement is mentioned in the given table

Mix Type	7 days (N/mm^2)	28 days (N/mm^2)	%Increase or Decrease
SCC	37.15	40.46	-
MK5	39.64	43.72	+8.05
MK10	30.38	43.43	+7.34
MK15	27.26	37.12	-8.25
MK20	26.54	37.53	-7.24
FS100	19.99	30.97	-23.45
FS10	31.39	40.92	+1.08
FS20	33.61	42.92	+6.08
FS30	26.77	34.44	-14.87
FS40	22.91	31.68	-21.70
MK5+FS10	29.12	41.8	+3.31
MK10+FS20	26.81	45.14	+11.56
MK15+FS30	20.17	38.18	-5.63
MK20+FS40	32.45	39.37	-2.69

Percentage increase or decrease of28 days split tensile strength compared with respect to the SCC mix that is without replacement is mentioned in the given table

Mix Type	7 days (N/mm^2)	28 days (N/mm^2)	%Increase or Decrease
SCC	3.02	3.50	-
MK5	3.06	3.62	+3.42
MK10	3.10	3.43	-2.00
MK15	3.40	3.49	-0.28
MK20	3.16	3.58	+2.28
FS100	2.89	3.01	-14.0
FS10	3.10	3.47	-0.85
FS20	2.99	3.59	+2.57
FS30	3.06	3.51	+0.28
FS40	3.27	3.46	-1.14
MK5+FS10	3.26	3.51	+0.28
MK10+FS20	3.22	3.69	+5.42
MK15+FS30	3.24	3.49	-0.28
MK20+FS40	3.16	3.43	-2.00

CONCLUSION:

The overall great compressive and tensile strengths compared to EFNARC and IS 456 : 2000 tells us the SCC which is prepared by our trail or study is able/suitable to use in Construction.

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