An Experimental Study on Trinary Blended Self Compacted Concrete

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***Abstract*- Self compacting concrete is a flowable type of concrete mixture. It can be able to flow under its own weight and it is able to compact itself without any additional vibration or compaction. It completely fills formwork and makes it suitable for filling even in the presence of congested reinforcement. The mix design and testing methods are different compared with ordinary concrete. But wide spread applications of Self Compacting Concrete have been restricted due to lack of standard mix design procedure. In this paper the self compacting concrete mix design by IS 10262-2019 code book and EFNARC guidelines. In this an attempt has been made to study self compacting concrete with different sizes of coarse aggregates that is 16mm, 12.5mm by using Ordinary Portland cement, fine aggregate, water, fly ash and GGBS as a mineral admixture and super plasticizer is used to increase workability of concrete. Various trail mixes have been done to satisfy the workable properties of SSC. The fresh properties of self compacting concreter such as slum flow test, V-funnel and L-box tests were conducted and checked against EFNARC guidelines. On hard concrete compressive test, split tensile test and flexural strength at the age of 3,7,28 & 56days is determined for self compacting concrete.**

Index terms- Self-compacting concrete; Fly-ash; Silica fume; Fresh properties; Strength parameters.

INTRODUCTION

Self-compacting concrete (SCC) is a flowing concrete mixture that is able to consolidate under its own weight. The highly fluid nature of SCC makes it suitable for placing in difficult conditions and in section with congested reinforcement. Use of SCC can also help minimize hearing-related damages on the worksite that are induced by vibration of concrete. Another advantage of SCC is that the time required to place large sections is considerably reduced.

When the construction industry in Japan experienced a decline in the availability of skilled labor in the 1980s, a need was felt for a concrete that could overcome the problems of defective workmanship. This led to the development of self-compacting concrete, primarily through the work by Okamura. A committee was formed to study the properties of self-compacting concrete, including a fundamental investigation on workability of concrete, which was carried out by Ozawa et al. at the University of Tokyo. The first usable version of self- categories:

- Use of rheometers to obtain data about flow behavior of cement paste and concrete,
- Mixture proportioning methods for SCC,
- Characterization of SCC using laboratory test methods,
- Durability and hardened properties of SCC and their comparison with normal concrete, and
- Construction issues related to SCC.

These will be relevant to the immediate needs. In addition, the following questions also need particular attention, from a long-term perspective:

compacting concrete was completed in 1988 and was named “High Performance Concrete”, and later proposed as “Self-Compacting High Performance Concrete”. Current studies in SCC, which are being conducted in many countries, can be divided into the following

- Development of mixture design guideline tables similar to those for normal concrete,
- A shift to more ‘normal’ powder contents in SCC, from the existing high powder mixtures,
- Better understanding of the problems of autogenous and plastic shrinkage in SCC, and

- Development of site quality control parameters such as in 'all-in-one', acceptable tests.

MATERIALS AND METHODS

Cement

Cement is a binder, a substance used in construction that sets and hardens and can bind other materials together. The most important types of cement are used in the components in the production of mortar in masonry, and of concrete, which is a combination of cement and an aggregate to form strong building materials. Concrete produced from Portland cement is one of the most versatile construction materials available in the world.

Fly-ash

Fly-ash also known as 'Pulverized Fuel Ash' is one of the coal combustion produce, compost of the fine particles that are driven out of the boiler with the flue gases. Ash that falls in the bottom of the boiler is called bottom ash. In modern coal fired power plants, fly-ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys. Together with bottom ash removed from the bottom of the boiler. It is known as coal ash.

Fly-ash can significantly improve the workability of concrete. Recently, techniques have been developed to replace particles in it with high volume fly-ash.

MATERIAL PROPERTIES

3.3.1 Properties of cement

3.3.1Properties of cement S No	Test	Result
1	Specific gravity	3
2	Initial setting time (min)	90
3	Final setting time (min)	540
4	Standard consistency %	32

3.3.2 properties of fine aggregates

S No	Test	Result
1	Specific gravity	2.64
2	Fineness modulus	2.5
3	Bulk modulus(dry) (kg/m3)	1493.3
4	Bulk modulus (nodded) (kg/m3)	1602.6

3.3.3 properties of coarse aggregates

S No	Test	Result
1	Specific gravity	2.68
2	Fineness modulus	7.14
3	Bulk density (kg/m3)	1690
4	Water absorption	0.1
5	Flakiness index %	12.49
6	Aggregate impact value %	19.51
7	Aggregate crushing value %	18.19

MIXING OF CONCRETE

The blender should first be kept clean and in wet condition. The coarse and fine aggregates are put into the blender and mixed for 1 minute. Next the solid and fly powder, GGBS were incorporated with water and mixed for other 2 minutes. Finally, super plasticizer was incorporated. The total mixing should not outperform 15 minutes from the time coarse and fine aggregates added to the blender.

WORKABILITY TESTS

A self – compacting concrete is said to have awesome handiness when it has an ability to limited by its own weight, transported and put in the site. It is the property helpfulness is a property of recently mixed concrete. Disgraceful usefulness impacts quality and strength and besides appearance. Distinctive test strategies have been done to satisfy fresh properties of SCC.

Slump flow test

V-funnel test

L-box test

Slump Flow Test

Procedure

It is used to regulate the filling ability of concrete without causing any obstructions.

The apparatus required for this is mould, base plate, trowel, ruler and stopwatch. At first the base plate and the mould should be kept clean in a dry condition and the mould is placed at center of the base plate. Slump cone is filled with SCC up to its top. With the help of the trowel it is leveled and the left over residue on the base plate is cleaned immediately. The slump cone is raised upwards and allows the concrete flow freely. Simultaneously stop watch is started at the time of flow. The time taken by the concrete to reach the 50 cm circle is the T50cm slump test and the average measured diameter on both sides is slump

value. The T50cm value ranges from 2 to 6 sec and the slump value range from 600 to 800mm

Slump flow of self compacted concrete

RESULTS AND DISCUSSION

Workability tests like slump flow, V-funnel and L-box tests are conducted. Fly ash and GGBS is added as replacement for cement with different proportions were tested. All the mixes satisfied the workability limits.

Slump flow, V Funnel and L box values of Cubes

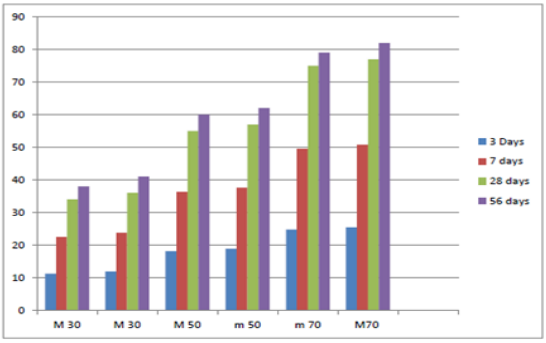
S No	Grade	Slump Flow(mm)	L Box	V Funnel(sec)
1	M30(10% Flyash,20%GGBS)	730	0.9	10
2	M30(20% Flyash,10%GGBS)	723	0.87	9
3	M50(10% Flyash,20%GGBS)	698	0.87	8
4	M50(20% Flyash,10%GGBS)	692	0.85	8
5	M70(10% Flyash,20%GGBS)	690	0.83	7
6	M70(20% Flyash,10%GGBS)	685	0.82	7

Slump flow, L Box and V funnel values of Beams and cylinders

S No	Grade	Slump Flow(mm)	L Box	V Funnel(sec)
1	M30(10% Flyash,20%GGBS)	740	0.9	10
2	M30(20% Flyash,10%GGBS)	723	0.88	9
3	M50(10% Flyash,20%GGBS)	700	0.87	8
4	M50(20% Flyash,10%GGBS)	692	0.85	8
5	M70(10% Flyash,20%GGBS)	690	0.84	8
6	M70(20% Flyash,10%GGBS)	685	0.83	7

Compressive strength values of Cubes

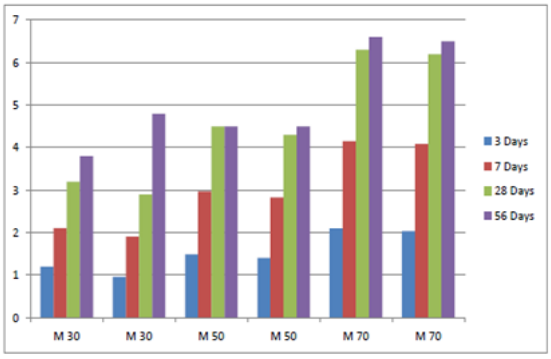
S No	Grade	Compressive Strength(N/mm²)			
		3Days	7Days	28 Days	56Days
1	M30(10% Flyash,20%GGBS)	11.22	22.44	34	38
2	M30(20% Flyash,10%GGBS)	11.88	23.76	36	41
3	M50(10% Flyash,20%GGBS)	18.15	36.3	55	60
4	M50(20% Flyash,10%GGBS)	18.81	37.62	57	62
5	M70(10% Flyash,20%GGBS)	24.75	49.5	75	79
6	M70(20% Flyash,10%GGBS)	25.41	50.82	77	82



Graph No 1:Grade of concrete Vs Compressive strength

Split tensile strength values of Cylinders

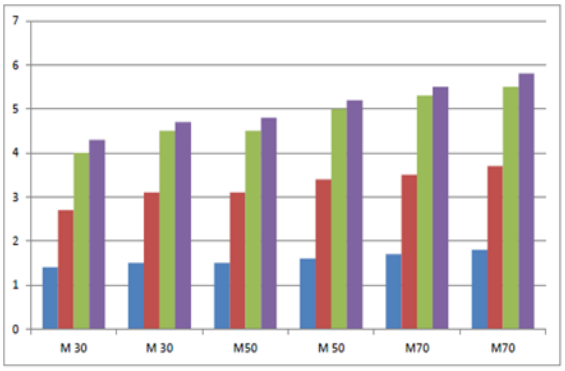
S No	Grade	Split tensile (Nmm²)			
		3Days	7 Days	28 Days	56 days
1	M30(10% Flyash,20%GGBS)	1.2	2.11	3.2	3.8
2	M30(20% Flyash,10%GGBS)	0.96	1.91	2.9	3.2
3	M50(10% Flyash,20%GGBS)	1.49	2.97	4.5	4.8
4	M50(20% Flyash,10%GGBS)	1.41	2.83	4.3	4.5
5	M70(10% Flyash,20%GGBS)	2.1	4.15	6.3	6.6
6	M70(20% Flyash,10%GGBS)	2.04	4.09	6.2	6.5



Graph No 2: Split Tensile strength Vs Grades of concrete

Flexural strength values of Beams

S No	Grade	Flexural strength (N/mm²)			
		3 Days	7 Days	28 Days	56 Days
1	M30(10% Flyash,20%GGBS)	1.4	2.7	4	4.3
2	M30(20% Flyash,10%GGBS)	1.5	3.1	4.5	4.7
3	M50(10% Flyash,20%GGBS)	1.5	3.1	4.5	4.8
4	M50(20% Flyash,10%GGBS)	1.6	3.4	5	5.2
5	M70(10% Flyash,20%GGBS)	1.7	3.5	5.3	5.5
6	M70(20% Flyash,10%GGBS)	1.8	3.7	5.5	5.8



Graph No 3: Flexural strength Vs Grades of concrete

CONCLUSION

a) From the investigation we can know the self compacting concrete can also be produced by using IS 10262-2019 and suitable adjustments are made by considering EFNARC guidelines which requires high powder content, lesser quantity of coarse aggregates, Super plasticizer which gives stability and fluidity to the concrete mix.

b) The workability of concrete increases by decreasing the size of coarse aggregates

c) The relation between grade of concrete and compressive strength, flexural strength and Split tensile test are Developed.

d) With minimum binder (cementious material) content, the fresh properties i.e., flowing ability, passing ability and segregation resistance were satisfied according to EFNARC specifications.

e) The design mix proportions were validated with experimental work. All the three mixes (M30,M50 and M70) have achieved fresh and hardened properties with minimum trails.

f) Sp dosage is varied for different mixes. based on trails we have change super p;asticizer dosage

g) By adding mineral admixtures workability of concrete increases and water content reduced.

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