Utilization of Fly ash and Pond ash in Self Compacting Concrete

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Abstract:- **Self Compacting Concrete (SCC) is a flowing concrete mixture that is able toconsolidate under its own weight, without the need for vibration. The highly fluid nature of SCC makes it ideal for placing in difficult conditions and in sections withcongested reinforcement. Mixture proportions for SCC differ from those of ordinary concrete, in that the former has more powder content and less coarse aggregate. Supplementary cementitious materials such as fly ash, silica fume and blast furnaceslag, pond ash are normally used as powders to enhance the technology of SCC. In addition, SCC also incorporates chemical admixtures, such as HRWR (High RangeWater Reducer), and VMA (Viscosity Modifying Agent). Large amount of fly ash andpond ash is being generated in India annually and hence there is a strong need to usethis byproduct from thermal power stations, in large proportions in concrete which isalso makes the concrete as cost effective. A SCC mix was arrived based on availableEFNAARC guide lines and using various mix combinations. An experimental study ismade on the properties of SCC incorporating fly ash and pond ash. Slump flow test,V-funnel test, L-box test were carried out to confirm the self-compact ability ofconcrete. Compressive strength test, split tensile test, flexural strength test, youngs modulus test were carried out on SCC. Experimental studies confirm that the mixessatisfy the requirement for SCC.**

Keywords- Self compacting concrete, fly ash, pond ash, compressive strength

I. INTRODUCTION

SCC concept can be stated as the concrete that meets special performance and uniformity requirements that cannot always be obtained by using conventional ingredients, normal mixing procedure and curing practices. The SCC is an engineered material consisting ofcement, aggregate, water and mineral admixtures like fly ash, pond ash etc and chemicaladmixtures to take care of specific requirements, such as, high-flowability, high workability, compressive strength, enhanced resistances to chemical or mechanical stresses, lower permeability, durability, resistance against segregation, and possibilityunder dense reinforcement conditions. The main characteristic of SCC is the highercement matrix aggregate ratio with respect to an ordinary concrete. In other words, thevolume of cement matrix responsible for the mobility of the concrete mixture must be increased in order to push the aggregate under the gravity action or under the pressure ofa pumping system. On the other hand, the volume of the aggregate in particular thecoarse aggregate must be reduced in terms of both volume and maximum size, toimprove the mobility and the segregation-resistance of the fresh mixture.

Materials Used

The raw materials used in this experimental studies for manufacturing Self-CompactingConcrete are cement, fly ash, pond ash, fine aggregate, coarse aggregate, Glenium. Ordinary portland cement (Grade 53) was used for the experimental work. Specific gravity of cement is 3.15.Pond ash is collected from Thermal Power Plant, Mettur (TamilNadu). The specific gravity of pond ash is 2.31 and the particle size of pond ash rangesbetween (10-50)µm. Fly ash is obtained from Mettur Thermal Power plant (Tamil Nadu).The specific gravity and particle size of fly ash are 2.72 and (10-50)µm respectively. From chemical composition of Fly ash, CaO content is less than 5%, so thefly ash is classified as class F according to the ASTM C 618. Locally available naturalriver sand is used as fine aggregate. Crushed stone with 10mm maximum size is used ascoarse aggregate . Both fine aggregate and coarse aggregate confirmed to IndianStandard Specification IS: 383-1970.The specific gravity of sand is 2.65 and the finenessmodulus of fine aggregate is 2.67.The specific gravity and fineness modulus of coarse aggregate is 2.71 and 7.09. GLENIUM B233 is an admixture of a new generation based on modified Polycarboxylic ether. GLENIUM B233 is free of chloride & low alkali. It iscompatible with all types of cements.

II. MIX PROPORTION

There is no standard method for the mix design of SCC. However, the Europeanguidelines for SCC are useful in the mix design. These guidelines are not intended to provide specific advice on mix design, but indicate the typical range of constituents inSCC by weight and by volume. Table 1 shows the various mix combinations for SCC.

Mix designation	Cement (kg/m³)	Fly ash (kg/m³)	Pond ash (kg/m³)	Water (kg/m³)	Fine Aggregate (kg/m³)	Coarse Aggregate (kg/m³)	Super Plasticizer (% total powder content)
M1	450	100	50	200	550	600	1.1%
M2	400	100	100	200	500	600	1.1%
M3	380	100	120	200	500	500	1.1%
M4	380	60	40	255	900	300	1.1%
M5	375	61	44	255	831	225	1.1%

Table 1: Mix Combinations for SCC

Fresh Concrete Properties Of SCC

The fresh properties of SCC consist of workability, flowability, filling ability which canbe tested by slump flow test, V-funnel test, L-Box test were carried out as per theEFNAARC guide lines. Table 2 shows the fresh concrete properties of SCC. Slump value varies between 620 to 710 mm for the mix M5 to M1 .In V-funnel test the concrete passes from 10 to 25 secs for the mix M5 to M1.In L-box test value varies from 0.9 to 2.6. Based on EFNAARC guide lines, M4 and M5 satisfy the acceptable limit forSCC concrete. Hardened concrete tests proceed for the mix combination M5.

Slump flow test

V-funnel test

L-Box test

Figure2: Fresh concrete properties of SCC

Mix proportion / Tests	M1	M2	M3	M4	M5	Acceptable limit
Slump flow (mm)	710	667	656	670	620	600 to 800mm
L - box(H2/H1)	2.6	1.9	1.2	1.0	0.9	0.8 to 1.0
V- funnel(sec)	25	21	17	12	10	6 to 12sec

Table 2: Test Results on Fresh Concrete Properties of SCC

III. PROPERTIES OF MATERIAL USED

To investigate concrete compressive strength a n d split tensile strength o f S C C w i t h t h e combination of fly ash and different proportioning of poly carboxylic ether with the adding of fly ash and m sand. Self-compacting concrete was made of cement, sand, water, fly ash and admixture.

1) Cement: Ordinary Portland cement, 53 Grade Conforming to IS: 12269 – 1987.

2) Fine aggregate: Locally available river sand and M sand The M-sand is first sieved through 4.75mm sieve to remove any particles larger than 4.75mm.

3) Coarse aggregate: Locally available crushed blue granite stones conforming to Graded aggregate of nominal size 12.5 mm as per IS: 383 – 1970.

4) Mineral admixture: Dry Class F-Fly ash confined as per IS 3812-2000.

5) Chemical admixture : Super p l a s t i c i ze r G l e n i u m-B233 a s p e r E N 934 -2 T3.1/3.2.and Viscosity modifying agent Glenium stream -2 as per ENC180VMA.

6) Water: Water used was fresh, colorless, odorless and tasteless potable water free A. Initial Testing Of Constituents Fine Aggregates for river sand (R-sand) Fine aggregate is natural sand which has been washed and sieved to remove particles larger than 4.75 mm. That the particles which are between 2mm to 4.75 mm is termed as fine aggregates.

Table I Physical properties of Fine aggregate

Properties	Values
Specific gravity	2.62
Bulk density	1736 kg/m^3
Water absorption	1.3%

Table II Sieve Analysis of Fine Aggregate (R-sand)

Passing through IS sieve (mm)	Weight retained (gm)	Cumulative % retained	% passing
4.75	39	3.9	96.1
2.36	94	13.3	86.7
1.18	357	49	51
0.6	261	75.2	24.8
0.3	166	91.8	8.2
0.15	62	98	2
pan	20	100	0

Fine Aggregates for Manufactured Sand (M-sand) Fine aggregate is manufactured sand which has been washed and sieved to remove particles larger than 50 micron. That the particles which are between 2mm to 4.75 mm are termed as fine aggregates.

Table III Physical properties of Fine aggregate

Properties	Values
Specific gravity	2.62
Bulk density	1960 kg/m^3
Water absorption	2.13%

Coarse Aggregates Coarse aggregate is gravel which has been crushed, washed and sieved so that the particles vary from 4.75 up to 50 mm in size. That particle which size varies from 4.75mm to 50mm is known as coarse aggregates.

Table V Physical properties of coarse aggregate

Properties	Values
Impact value	10.35% (hence strong)
Specific gravity	2.86
Bulk density	1629 kg/m^3
Water absorption	0.53%

Table VI Sieve Analysis of Coarse Aggregate

Passing through IS sieve (mm)	Weight retained (gm)	Cumulative % retained	% passing
40	12	0.4	99.6
20	655	0.4	77.8
10	2211	22.2	4.1
4.75	108	95.5	0.5
pan	14	99.96	0

Cement A building material made by grinding calcite limestone and clay to a fine powder, which can be mixed with water and poured to set as a solid mass or used as an ingredient in making mortar or concrete. Ordinary Port land Cement (53 grade) ultra tech cement conforming to IS 8112 was used the cement The different laboratory tests were conducted on cement to determine standard consistency, initial and final setting time as per IS 4031 and IS 269-1967. The results conforms to the IS recommendations

Passing through IS sieve (mm)	Weight retained (gm)	Cumulative % retained	% passing
4.75	7	7	99.3
2.36	55	6.2	93.8
1.18	307	36.9	63.1
0.6	153	52.2	47.8
0.3	139	66.1	33.9
0.15	157	81.8	18.2
pan	182	100	0

Table VII Physical properties of cement

Properties	Values
Specific gravity	2.62
Standard consistency	32%
Initial setting time	60 min
Final setting time	150 min

Fly ash A building material made from the combustion of powdered coal and transported by the flue gases and collected by electrostatic precipitator. Fly ash is the most widely used pozzalonic Material all over the world. The quality of fly ash is governed by IS 3812 – Part 1 – 2003 .class F fly ash normally produced by burning anthracite or bituminous coal, usually has less than 15% Cao. Class F fly ash has pozzolanic properties only.The specific gravity of Fly Ash is 2.14.

IV. SUMMARY AND FUTURE WORKS

This chapter presents detailed summary and important conclusions that were drawn from the project. After arriving the conclusions of the project, some economic benefits of using self compaction concrete for masonry works involving cubes are being furnished. In the present study, self-compacting concrete mix has been developed by using fly ash and manufactured sand. Characterization studies of all the ingredients of SCC have been carried out. SCC containing different proportion of fly ash have been tested for Slump flow, V-funnel, U-Box, L-box and Jring and found that the values are within the limits prescribed by EFNARC. Various durability aspects such as Sorptivity and Rapid chloride penetration resistance have been studied for all the SCC mixes. It is observed that water absorption increases because of the inert behaviour of fly ash and the more pore percentage as compared to control mix at the initial ages, after that when fly ash reaction mechanism takes place there is no significant rise in percentage of water absorbed. In the first phase complete literature review, material collection and some basic test.

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