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"Application Of Industrial Waste In The Manufacturing Of Self Compacting Concrete"

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Abstract— *To meet special architectural configurations Production of Workable concrete with the ability to fill up concrete in closely spaced reinforcement, to give good structural efficiency and adequate durability. Self-compacting concrete (SCC) is a advanced concrete that does not require vibrations for placing and compaction. It is capable of filling the formwork completely and under full weight, even in the presence congested reinforcements. The popularity of using self-compacting concrete (SCC) in concrete construction has increased in many countries, as the SCC effectively reduces the need for skilled workers on the construction site it is cost effective. Nowadays, the purpose of environmental orientation is to limit the use of natural raw materials in construction materials. But there is a growing interest in the use of alternative materials in various industrial waste (bi-products), which show significant financial, economic, and environmental benefits. One such industrial waste is fly ash that shows Pozzolanic properties. This paper explores the fresh and hardened properties of self-compacting concrete (SCC) containing fly ash. SCC was designed like a specific specification of the EFNARC, which was replaced cement by the fly ash in percentage like 0%, 10%, 20%, 30% for M40 grade of concrete.*

Keywords— *Self-compacting concrete, fly ash, super plasticizer, strength properties, Nan-su method for mix proportions.*

I. Introduction

Self-Compacting Concrete A new term "self compacting concrete" is just used for concrete mixing, which has high efficiency, high density and low permeability. High-Compacting Concrete is a mixture for low porosity and permeability because of low water cement ratio and mineral admixtures in it. The denser micro structure of concrete reduces permeability and hence increases the life of structure. Increasing population industrialization and urbanization increased the demand for basic infrastructure. In most studies it has been found that concrete performance can be increased significantly by using mineral mixture and by the use of certain industrial products. Fly ash is one of the most effective mineral products due to cementation or pozzolanic properties used in cement or concrete. Generally there is high cement content in the self-compacting concrete mix, which increases the heat of hydrations and can lead to increased contraction, which can lead to cracking and less durability. To overcome these problems, the cement space can be replaced by the pozzolnic material, which reduces the heat of the hydration; thus reduces the shrinkage. SCC mixture is always a powerful super-plasticizer that is necessary to produce high-liquid concrete mix, while the powder is essential for maintaining adequate mixing of the mixture so that bleeding, separation and settlement decreases. High strength self-compacting concrete can easily fill molds with visibility and efficiency, without the use of companies. High concentrations of mineral powder are essential for suitable self-compacting concrete design. In this study, the effects of the mineral mixture on the fresh and harsh properties of high strength self-compacting concrete have been checked. Nowadays, there has been an increase in the use of alternative materials (garbage) from various industrial activities that have produced industrial, energetic and environmentally significant benefits .In this investigation, self - compacting concrete was developed for the non - Mix the ratio.

A. ADVANTAGE OF SELF COMPACTING CONCRETE (SCC)

- Faster construction
- Reduction in site manpower
- Better surface finish
- Easy placing

- Reduces equipment wear
- Absence of vibration, reduced noise levels
- Thinner concrete section

B. FLY ASH

Fly-ash also known as 'Pulverized Fuel Ash' is one of the coal combustion products, compost of the fine particles that are driven out of the boiler with the flue gases. Ash that falls in the bottom ash In modern coal fired power plants, fly-ash is usually 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, the techniques have been developed to replace particles in high volume fly-ash.

II. Materials

A. Cement:-
Ordinary Portland cement 53 grade conforming to IS: 12269 having specific gravity 3.15
B. Fine Aggregate:-
All type of aggregate are suitable. Normal adopted size ranged 16 to 20mm. having specific gravity of 2.17 and fineness modulus of 4.4 has been used as fine aggregate for this study.
C. Coarse Aggregate:-
Coarse aggregate obtained from local quarry unit has been used for this study; maximum size of aggregate used is 20mm with specific gravity of 2.87
D. Admixture:-
High Range Water reducing Admixture called as super plasticizer are used for improving the workability for lower water- cement ratio with sacrifice in the compressive strength. PERMA PLAST PC-101 has been used as super plasticizer.
E. Water:-
Ordinary potable water available in the laboratory was used.

III. Methodology

Effect of fly ash on following properties of self compacting concrete

3.1 Fresh properties

1) Filling ability: the property of SCC to fill all corner of a formwork under its own weight is known as filling ability
2) Passing ability: The property of SCC to flow through reinforcing bars without segregation or blocking
3) Resistance to segregation: The property of SCC to flow without segregation of the aggregates.

Several methods are available to evaluate these main characteristic of SCC, the test have not been standardized by national or international organizations. The more common test used for evaluating the characteristics of fresh SCC are listed below.
a) The slump flow test
b) V-Funnel test
c) L-Box test

FIG. 1: SLUMP FLOW, V-FUNNEL, L-BOX TEST

Table I
QUANTITIES OF MATERIALS REQUIRED FOR 1M3 OF SCC USING FLY ASH

Cement (kg/m^3)	Fine Aggregate (kg/m^3)	Coarse Aggregate (kg/m^3)	Water (kg/m^3)
436.32	881.34	703.28	172.64
1	2.09	1.61	0.4

The mix proportion was based on the Nan-Su method. The mix design was carried out for M40 grade of SCC with Fly ash as partial replacement of cement with a fraction of 0%, 10%, 20% & 30%.

Table II
Mix Proportioning For $1m^3$ Of Scc With Fly Ash

Mix	Cement (kg/m3	Fly ash as replacement (kg/m3)	Fine aggregate(kg/m3	Coarse aggregate(kg/m3)	Water (kg/m3)	S.P (kg/m3)
mix-A	436.32	0	881.34	703.28	172.64	3.92
mix-B	392.68	43.632	881.34	703.28	172.64	3.92
mix-C	349.06	87.26	881.34	703.28	172.64	3.92
mix-D	305.42	130.89	881.34	703.28	172.64	3.92

Mix-A: - 0% Replacement of Cement with Fly ash.
Mix-B: - 10% Replacement of Cement with Fly ash.
Mix-C: - 20% Replacement of Cement with Fly ash.
Mix-D: - 30% Replacement of Cement with Fly ash.

RESULT AND DISCUSSION

4.1 Effects on Fresh property of self-compacted concrete using Fly Ash

Fly ash was used to replace the cement content by three various percentages (0, 10, 20 and 30%). The partial replacement with Fly ash was carried out for M40 grade of concrete. The tests were Slump flow, L-box, and V-funnel. The acceptance criteria for SCC and results of workability tests on SCC are shown in Table III and IV respectively.

TABLE III
Scc - Acceptance Criteria

Method	**Properties**	**Range of values**
Flow value	Filling ability	650-800mm
V-funnel	Viscosity	6-12 sec
L-box	Passing ability	0.8-1.0

Table Iv
Test Results For Self-Compatibility

Mixes	Mix-A	Mix-B	Mix-C	Mix-D
Slump flow test	680	670	655	650
V-funnel test	10	9.5	8	7.5
L- box test	0.98	0.90	0.89	0.88

4.2 Effects on hardened properties of self-compacted concrete using Fly Ash

Compressive Strength: In order to study the effect of compressive strength, when fly ash was added into high strength SCC as replacement of cement, the cube containing different proportion of fly ash (0%, 10%, 20% & 30%) were prepared and kept for curing for 7, 28 days. It was observed that for replacement up to 20%, strength was increased and after that strength decreased. The 20% replacement level has given maximum

strength but 30% replacement level has given optimum strength for M40 grade of concrete. Graph 4 shows variation of compressive strength with different mixes and age.

COMPRASSIVE STRENGTH

Table V

Results Of Compressive Strength Of Scc With Fly Ash For 7, 28 Days

COMPRESSIVE STRENGTH (MPa)		
Mixture no.	7 days	28 days
MIX-A	27.4	40.20
MIX-B	28.10	44.88
MIX-C	30	45.20
MIX-D	29.2	40.22

IV. Conclusions

1. The use of mineral admixtures improves the performance of SCC in fresh state and also avoids the use of VMAs.
2. SCC with fly ash has exhibits satisfactory results in workability, because of small particle size and more surface area.
3. At the water/ cement ratio of 0.4, slump flow test, V-funnel test, and L-Box test results were found satisfactory, i.e. passing ability, filling ability and segregation resistance are well within the limits as per the EFNARC.
4. The SCC mixes with the addition of 20% Fly ash gives an optimum strength for M40 grade
5. Compressive strength at 7 days and 28 days are found satisfactory.

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