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A STUDY OF WORKABILITY OF DIFFERENT GRADE OF HIGH VOLUME FLY ASH CONCRETE WITH SLUMP TEST ANALYSIS

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Abstract:-*Global warming has emerged today as a life-threatening issue for the whole world. Since concrete is one of the most consumed material after water on the earth for infrastructure & construction industries, a commendable contribution can be made by optimizing the use of cement and natural resources in concrete manufacturing. High volume fly ash concrete is one of the major developments since last decade leading to utilization of fly ash in a bulk quantity and thereby reducing cement consumption and ultimately reducing CO2 in order of one ton per a ton of cement. The past research has been given due weight age for application of HVFA in different sectors like mass concrete, foundation, transportation etc. but the limitations of HVFA like ductility, poor performance towards expansion and contraction, flexural property, impact resistance have made its use limited. Introduction of structural/non structural with HVFA concrete application can overcome these problems and use of HVFA can be increased in developing nation like India for sustainability.*

Looking to the production of the Fly ash, worldwide in general and India in particular the utilization of Fly ash is almost negligible.

The HVFAC is typically characterized by Very low water content, with Low cement content. Also very high fly ash content, withVery low water to cementations ratio.it requires the use of super plasticizer to achieve the desired workability

Keyword: - Economic waste material, very low water and cement contain, high Volume fly ash

I. INTRODUCTION

Concrete is most widely used material all over the world. New development in the use of concrete is taking place constantly. With an enhanced rate of construction in further, cement concrete industry all over the world is likely to face a serious problem of cement shortage because of its limited resources. In such case Fly ash is a by-product of the combustion coal in the thermal power plants.

To study the effect of different percentage of fly ash on the properties of high volume fly ash concrete for compressive strength, flexural strength & impact strength.

Fly ash is finely divided residue resulting from the combustion of powdered coat and transported by the flue gases and collected by electrostatic precipitator. In U.K. it is referred as pulverized fuel ash (PFA). Fly ash is the most widely used pozzolanic material all over the world.

Concrete which has fly ash content more than 35% by mass of the cementitious materials content is termed as high volume fly ash concrete (HVFAC)

Scope of Present Work

The scope of study of **HVFAC** in various grades of concrete M25, M30, M35& M40.Workability

- Slump measurement

The mechanical properties studied are :

Compressive strength :	3, 7, 28, 56 days.
Flexural strength :	28, 56 days.
Impact strength :	28 days.
Fly ash content :	50 %, 55 % & 60 % by mass of cementing material.
Grade of Concrete :	M25, M 30, M35 & M40

II. FLY ASH IN CONCRETE

(1) High volume fly ash concrete (HVFAC)
(2) Self compacting concrete (SCC)
(3) Roller compacting concrete (RCC)
(4) High Performance Concrete (HPC)
(5) Under water Concrete (UWC)
(6) Reactive Powder Concrete (RPC)

III. HIGH VOLUME FLY ASH CONCRETE

This type of concrete often requires the use of a super plasticizer in order to achieve the desired workability. The fly ash quantity is optimized through judicious selection of materials, mixture proportioning and the use of chemical admixtures.

Fig:1- high volume fly ash concrete

IV. Properties and characteristic of HVFAC

- Minimum of 50% of fly ash by mass of the cementitious materials Must be maintained.
- Low water content, generally less than 130 kg/m^3 is mandatory.
- Cement content, generally no more than 200 kg/m^3 is disable.
- For concrete mixtures with specified 28days compressive strength of 30 MPa or higher, slumps >150 mm, and water-to cementitious materials ratio of the order of 0.30, the use of high-range water- reducing admixtures (super plasticizers) is mandatory.
- For concrete mixtures with slumps less than 150 mm and 28-day compressive strength less than 30 MPa, HVFA concrete mixtures with a water-to-cementitious materials ratio of the order of 0.40 may be used

without super plasticizers.

- Easier flow ability, pump ability, and compactability.
- Slower setting time
- Early-strength up to 7 days, which can be accelerated with suitable changes in the mix design.
- Much later strength again between 28 days and 90 days of more.
- Superior dimensional stability and resistance to cracking.
- After 3 to 6 months of curing, much higher electrical resistivity.
- Very high durability to the reinforcement corrosion.
- Better cost economy due to lower material cost and highly favorable lifecycle cost.
- Superior environmental friendliness due to ecological disposal of large quantities of fly ash.

V. Application of High volume fly ash concrete (HVFAC)

(1) Mass concrete.
(2) Pavement.
(3) Foundation.
(4) Gravity structure

Fig:2:- Application of High volume fly ash concrete (HVFAC)

VI. EXPERIMENTAL WORK

Workability

For a Concrete technologist, a comprehensive knowledge of workability is required to design a mix. Workability is a parameter, a mix designer is required to specify in the mix design process, with full understanding of the type of work, distance of transport, loss of slump, method of placing, and many other parameters involved. Assumption of right workability with proper understanding backed by experience will make the concreting operation economical and durable. The following test is commonly employed to measure workability.

Slump Test

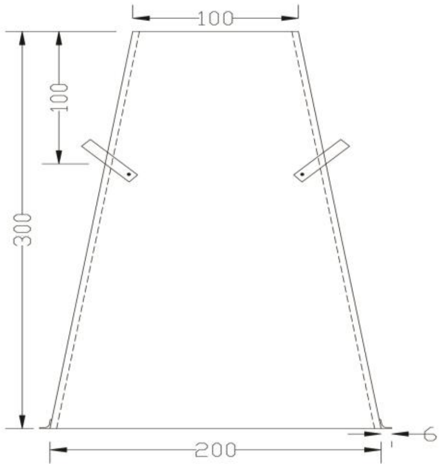

Fig. 3:-slump cone

Slump test is the most commonly used method of measuring consistency of concrete which can be employed either in laboratory or at site of work. The apparatus for conducting the slump test essentially consists of metallic mould in the form of a frustum of a cone

The thickness of the metallic sheet for the mould should not be thinner than 1.6 mm. Sometimes the mould is provided with suitable guides for lifting vertically up. For temping the concrete, it steel temping rod 16 mm dia, 0.6 m along with bullet end is used

The internal surface of the mould is thoroughly cleaned and freed from superfluous moisture and adherence of any old set concrete before commencing the test. The mould is placed on a smooth, horizontal, rigid and non-absorbent surface the mould is then filled in four layers, each approximately 1/4 of the height of the mould. Each layer is tamped 25 times by the temping rod taking care to distribute the strokes evenly over the cross-section. After the top layer has been rotted, the concrete is struck off level with a trowel and temping rod. The mould is removed from the concrete immediately by raising it slowly and carefully in a vertical direction. This allows the concrete to subside. The subsidence is referred as SLUMP of concrete. The difference in level between the height of the mould and that of the highest point of the subsided concrete is measured. This difference in height in mm. is taken as slump of concrete. ASTM measures the center of the slumped concrete as the difference in height. ASTM also specifies 3 layers.

MATERIALES:-

1. **CEMENT AND FLY ASH:-** 53 grade ordinary Portland cement to BIS 12269-1999 was used. Class F fly ash from Wanakbori thermal power station, Gujarat conforming to BIS 3812-2003 was used in the present study.
2. **ADMIXTURES:-**high range water reducing admixtures based on Naphthalene Sulfonate was used for preparation of trial mix and letter for plain HVFA concrete samples.
3. **AGGREGATES: -** Crushed stones of 20 mm down and 10 mm down were used as coarse aggregate.

10 mm aggregate from Sevalia – Timba
20 mm aggregate from Sevalia – Timba
Fly ash from Wanakbori (Gujarat)
Admixture from source SWC Mumbai

M 25 GRADE

SAMPLE	CEMENT KG/M3	FLYASH KG/M3	TOTAL CEMENTITIOUS MATERIAL KG/M3	WATER LTR/M3	SUPERPLASTICIZER KG/M3	W/C+FA	RIVER SAND KG/M3	COARSE AGGREGATE<20MM KG/M3	COARSE AGGREGATE<10MM	SUMP MM 60MM RETENTION	DENSITY KG/M3
A10	195	195	390	120	2.40	0.31	642	761	441	90	2394.4
A20	202	248	450	125	3.6	0.28	600	853	379	75	2410.6
A30	180	270	450	140	3.6	0.31	591	839	373	110	2396.6

M 30 GRADE

SAMPLE	CEMENT KG/M3	FLYASH KG/M3	TOTAL CEMENTITIOUS MATERIAL KG/M3	WATER LTR/M3	SUPERPLASTICIZER KG/M3	W/C+FA	RIVER SAND KG/M3	COARSE AGGREGATE<20MM KG/M3	COARSE AGGREGATE<10MM	SUMP MM 60MM RETENTION	DENSITY KG/M3
B10	225	225	450	130	3.4	0.29	554	757	432	95	2326.4
B20	225	275	500	130	4.00	0.26	585	850	351	90	2417.0
B30	200	300	500	145	4.00	0.30	568	825	341	110	2383.0

M 35 GRADE

SAMPLE	CEMENT KG/M3	FLYASH KG/M3	TOTAL CEMENTITIOUS MATERIAL KG/M3	WATER LTR/M3	SUPERPLASTICIZER KG/M3	W/C+FA	RIVER SAND KG/M3	COARSE AGGREGATE<20MM KG/M3	COARSE AGGREGATE<10MM	SUMP MM 60MM RETENTION	DENSITY KG/M3
C10	250	250	500	140	4.0	0.28	554	757	432	100	2387.0
C20	247	303	550	138	3.80	0.28	525	848	336	95	2400.9
C30	220	330	550	137.5	3.80	0.25	514	826	327	90	2358.3

M 40 GRADE

SAMPLE	CEMENT KG/M3	FLYASH KG/M3	TOTAL CEMENTITIOUS MATERIAL KG/M3	WATER LTR/M3	SUPERPLASTICIZER KG/M3	W/C+FA	RIVER SAND KG/M3	COARSE AGGREGATE<20MM KG/M3	COARSE AGGREGATE<10MM	SUMP MM 60MM RETENTION	DENSITY KG/M3
D10	280	280	560	150	5.6	0.27	501	761	415	110	2392.6
D20	270	330	600	150	4.2	0.25	485	820	318	110	2377.6
D30	240	360	600	144.0	4.2	0.35	471	8.39	319	100	2377.2

VII. CONCLUSION

- The mix found to be homogeneous and workable.
- Water to cementitious material ratio varies from 0.25 to 0.40 and slump at 60 min retention period varies between 85 to 100mm for different mix. Values observed satisfy the provision of BIS: 4562000.
- For higher proportion of cementing material in higher concrete grade the dosage of user plasticizer was increased to 1.00% to achieve desired slump and workability.

GRADE	*50% FLY ASH*		*55% FLY ASH*		*60% FLY ASH*	
	SLUMP	*W/C*	*SLUMP*	*W/C*	*SLUMP*	*W/C*
M25	*90*	*0.30*	*90*	*0.28*	*90*	*0.31*
M30	*95*	*0.29*	*100*	*0.28*	*100*	*0.30*
M35	*100*	*0.28*	*100*	*0.26*	*110*	*0.25*
M40	*110*	*0.27*	*110*	*0.26*	*110*	*0.35*

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